



## *Dysphania schraderiana* (Schult.) Mosyakin & Clemants – An overlooked medicinal and ritual plant used in Poland

Łukasz Łuczaj<sup>a,\*</sup>, Mateusz Wolanin<sup>a</sup>, Jacek Drobnik<sup>b</sup>, Monika Kujawska<sup>c</sup>,  
Jarosław Dumanowski<sup>d</sup>, Kim Walker<sup>e,f</sup>, Michał Tomczyk<sup>g</sup>

<sup>a</sup> Institute of Biology and Biotechnology, Rzeszów University, Ul. Pigonia 1, 35-310, Rzeszów, Poland

<sup>b</sup> Department of Pharmaceutical Botany and Herbal Medicine, Faculty of Pharmaceutical Sciences in Sosnowiec, Medical University of Silesia in Katowice, Ul. Ostrogórska 30, 41-210, Sosnowiec, Poland

<sup>c</sup> University of Łódź, Institute of Ethnology and Cultural Anthropology, Ul. Lindleya 3/5, 90-131, Łódź, Poland

<sup>d</sup> Faculty of History, Nicolaus Copernicus University in Toruń, Ul. Bojarskiego 1, 87-100, Toruń, Poland

<sup>e</sup> Royal Holloway University, Egham Hill, Egham, TW20 OEX, United Kingdom

<sup>f</sup> Royal Botanic Gardens Kew, The Herbarium, Richmond, TW9 3AE, United Kingdom

<sup>g</sup> Department of Pharmacognosy, Faculty of Pharmacy, Medical University of Białystok, Ul. Mickiewicza 2a, 15-230, Białystok, Poland

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### ABSTRACT

**Ethnopharmacological relevance:** The paper discusses the traditional ritual, medicinal and insect repellent use of *Dysphania schraderiana* in Poland, a plant with little ethnobotanical and phytochemical data. Our research suggests that its properties should be further studied comparing it with the related *D. botrys* and *D. ambrosioides*. **Aim of the work:** *D. schraderiana* is an aromatic and medicinal annual herb related to *D. ambrosioides* and *D. botrys* and practically absent from historical accounts of plant uses in Europe. The aim of this work is to characterise the current use of *D. schraderiana* in south east Poland on the background of historical *Dysphania* species use in Europe.

**Materials and methods:** The data on *D. schraderiana* was collected in 2020, based on interviews with 42 people in rural areas of south-eastern Poland where the species is used today. A range of textual sources were searched including old medicinal herbals, pharmaceutical handbooks, ethnobotanical publications and culinary databases regarding all the uses of *Dysphania* species in Europe.

**Results:** In the study area *D. schraderiana* occurs in the whole spectrum of cultivation stages – from being intentionally cultivated to completely wild. The plant is used mainly as an apotropaic and insect repellent, blessed during Catholic church holidays (mainly Assumption Day), and sometimes used as incense in churches (and blessed on Epiphany Day). *D. schraderiana* rarely occurs in European historical sources, except sometimes classed as a false, inferior form of *D. botrys*, which has been known for centuries as a moth repellent and treatment for respiratory illness. We hypothesise that the plant was not easily distinguished from *D. botrys* and their uses strongly overlapped. For some unknown reason the use of *D. botrys* died out, whereas a relatively large semi-feral population of *D. schraderiana* exists in south-eastern Poland where it has remained a culturally important plant.

**Conclusions:** *D. schraderiana* is a rare case of a non-native plant traditionally used within an area of Europe but previously nearly overlooked in European ethnobotanical literature. Historical uses of *Dysphania* spp. in other areas of Poland and former Poland (now western Ukraine) suggest that the genus was used more widely in regions beyond the one studied. However, a very compact distribution of use suggests that *D. schraderiana* may have been brought to SE Poland from a single source outside the study area. Its common name, and use as a holy incense plant, is associated it with the well-known biblical tree resin obtained from *Commiphora myrrha* (Nees) Engl.

\* Corresponding author.

E-mail address: [lukasz.luczaj@interia.pl](mailto:lukasz.luczaj@interia.pl) (Ł. Łuczaj).

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## 1. Introduction

### 1.1. General background

European herbal folklore is well documented and medicinal uses of native or early established European plants have been strongly influenced by written sources since antiquity through early modernity up to the 20th century (Rostafiński, 1895; Leonti, 2011; Köhler, 2015). It is therefore important that ethnobotanists in Europe focus on the taxa or uses not documented, or little documented, in herbals. For example, a native *Epilobium angustifolium* L. was little used in Europe in the past but recently it has gained a lot of popularity as a medicinal plant (Sökand et al., 2020). There are also possibly closely related, hard to distinguish, rarer species within a more widely used genus which are not mentioned in the texts and no longer have much traditional use. The examples here include some endemic taxa which, due to their rarity, do not appear in old herbals. One example includes *Satureja visiani* Šilić, endemic to a small section of coastal Croatia (Łuczaj et al., 2021). This paper outlines another such overlooked plant species rarely found in European herbals and ethnographic material - *Dysphania schraderiana* (Schult.) Mosyakin & Clemants, (Amaranthaceae), which was found to be traditionally used in an area of south-eastern Poland.

In 2010, the first author (ŁŁ) received a communication from a former inhabitant of Siedliska near Rzeszów, SE Poland. It contained a specimen of *D. schraderiana*, known there as *mirra* (Polish for myrrh) and used in this village as a ritual plant blessed in the local church on Assumption Day (15 August). After this, more information came on its cultivation and use in other parts of SE Poland, which encouraged the researchers to start searching for more places it may be in use. In 2014, one of the authors visited churches around Rzeszów on Assumption Day to look for *D. schraderiana* brought for church blessings. This study confirmed that the blessing tradition was relatively alive and that 45 out of 96 bouquets seen contained the species, although none of the people who brought the plant specified any other uses apart from it being an important blessed plant (Oklejewicz and Łuczaj, 2015). It was then decided to further explore the issue of its use in Poland as the plant rarely occurs in pharmaceutical and ethnobotanical literature.

*Chenopodium* L. (Amaranthaceae) is a large genus of plants used for food and medicine, including culturally and economically important species such as quinoa (*Chenopodium quinoa* Willd.) and common goosefoot (*Chenopodium album* L.). In the past, another group of aromatic species, used as medicinal vermifuges, were included in the genus *Chenopodium*. These have now been moved to a separate genus, *Dysphania* R.Br. (Mosyakin and Clemants, 2002; Clemants and Mosyakin, 2003). Currently, the genus *Dysphania* comprises 43 globally-distributed, accepted species (Plants of the World Online, 2021a). Of these, a single species, *Dysphania botrys*, is native to Europe, and its range extends from western and southern Europe to Mongolia and the Western Himalayas (Kew Science, 2021). Apart from native *D. botrys*, at least 8 other species have been introduced to Europe (Kew Science, 2021), including *D. schraderiana*.

In the three subchapters below we present the information found on the uses of three *Dysphania* spp. in Europe, as a background for our fieldwork. We attempt to cover the whole of Europe through its main textual sources, and all the known sources from the present territory of Poland and areas which were formerly a part of the Kingdom of Poland. We give the main examples from other countries and regions, particularly Germany, due to its many historical and geographical connections with Poland.

Out of the three most common *Dysphania* species in Europe, *D. ambrosioides* is the most distinct morphologically, with less divided leaves, whereas *D. botrys* and *D. schraderiana* are harder to distinguish. According to Uotila (2013: 67), *D. botrys* has “Perianth divided into narrowly ovate segments, back of segments hardly keeled; glandular hairs distinctly stalked with small globular pale yellow heads.” Whereas *D. schraderiana* has a “perianth divided into ovate to broadly ovate

segments or lobes, back of segments and lobes apically swollen or variously keeled; glandular hairs subsessile, heads yellow to orange. Leaf blade pinnatifid, lobes broadly entire to dentate; perianth divided into segments, back of segments cristate, with several lobes.”

### 1.2. *Dysphania ambrosioides* in Europe

The most well-known species from this genus is *Dysphania ambrosioides* (L.) Mosyakin & Clemants (the most well-known synonyms are *Chenopodium ambrosioides* L. and *Ch. anthelminticum* L., but see Plants of the World Online (2021b) for the full list of synonyms). It was first described under the name *botrys ambrosioides Mexiocana* by Bauhin (1623: 138, 516) with the following Latin comment: “cujus semen Parote Mexiocanae nomine missum, in horto D. D. Plateri, foeliciter Anno 1619, et sequentibus, crevit”. Translation: “whose seed, sent under a Mexican name Parote, is successfully grown in the year 1619 and the next years in Doctor Plater’s garden”. Bauhin thus seems to have witnessed the introduction of this plant in European gardens. Parkinson (1640: 89) proposed another name, *botrys fruticosa Americana* and its English name *shrubby Oke of Jerusalem*. Ray (1686: 196) added that the powdered herb mixed with honey was a superior remedy in *pulmonum vomicae* (i.e. lung tumors), as well as uterus pains. He also states that *botrys ambrosioides Mexiocana* seemed to be identical with the *epazotl* mentioned by Hernández (1651: 159), and he repeats that it was used in pulmonary conditions: the fresh or cooked plant was used to strengthen the ‘condiments’ recommended in asthma and other pectoral obstructions (condiments were a kind of medicated nourishment). In addition, broth boiled from the roots was a remedy in dysentery, inflammations, and against venoms of snake bites. If Ray’s identification was correct, then the text by Hernández would be the earliest ethnopharmacological account about *D. ambrosioides* (as Hernández’s manuscript was written in the years 1570–1577).

The species became relatively well-known in pharmacy after the 17th century (after its occurrence in Parkinson’s herbal from 1640), and took a variety of pharmaceutical names which, in part, originated from its polynomials (i.e. pre-Linnaean) nomenclature, and included: *anserina anthelminthica*, *atriplex Americana*, *atriplex odorata Americana*, *botrys Americana*, *botrys Mexicana*, as well as *thea Hispanica*, *Americana*, *Mexicana*, *Silesiaca* or *Romana*. The names reveal both the medicinal use (anthelmintic), origin (America, Mexico), suppliers (Spanish merchants), areas of cultivation in Europe (Mediterranean region, Silesia), and the drug form (decoction, a tea). The *Pharmacopoeia of Wirtenberg* (Anonymous, 1760: 46) recommended it in “pectoral affections, especially in heavy cough, to provoke menstruation, and in stillbirth.” There were two other remarks: that the freshly dried herb was narcotic (or rather stupefying), and the fresh leaves were an effective clothing moth-repellent. In the 19th century, an essential oil of the herb was imported from America to Europe. This drug could have substituted the juice pressed from the fresh herb or eventually the dried and powdered plant or its seeds (Sawiczewski, 1839: 35).

Although the medicinal use of *D. ambrosioides* seems to decline in Europe after this period, it is still one of the most used medicinal plants in the world, according to WHO (Baleixo da Silva et al., 2021). This annual or short-lived perennial plant, native to South America and Mesoamerica, today has a world-wide range and is considered as a cosmopolitan plant (Baleixo da Silva et al., 2021; Heiser, 1990). But in the centre of its dispersion, in Mesoamerica, *epazote* (from Nahuatl: ‘fetid sweet herb’) has been utilized since Pre-Colonial times as an aromatic herb in cuisine and in medicine (Lozoya and Lozoya, 1982; Picó and Nuez, 2000; Gómez-Castellanos, 2008). During colonial times in America, the species, known as *paico* by the indigenous Guaraní and *yerba de Santa María* by Jesuit monks, was reported to have been used as an anthelmintic drug in Jesuit missions in Paraguay (Martín and Valverde, 1995: 23–24). It was reported in use in Brazil by Martius (1843: 101) under the Portuguese name *erva de Santa Maria*. It is absent in his dictionary of the languages Tupi and Galibi [Carib] and their

dialects (Martius, 1863). The principal folk medicinal use in Latin America coincides with this plant's principal bioactivity - as a remedy against internal parasites, mainly nematodes (Gómez-Castellanos, 2008; MacDonald et al., 2004). Polish migrants, who arrived in subtropics of Argentina in the early 20<sup>th</sup> century, found *ka'a rê* (from Guaraní) so efficient in the treatment of intestinal worms, that they abandoned traditional European remedies, such as garlic, black pepper and pumpkin seeds and switched to *D. ambrosioides* (Kujawska and Hilgert, 2014). Earlier, the vermifugal properties were mentioned in a book *Formulário e Guia Médico* issued in 1864 by another Polish emigrant, Piotr Czerniewicz/Chernoviz (Ricardo et al., 2017). Other folk medicinal uses were recorded in different local pharmacopoeias worldwide, including for treating indigestion and dyspepsia across America (Quinlan et al., 2002; Campos-Navarro and Scarpa, 2013), headaches in the Andes (Paniagua-Zambrana et al., 2020), cough in Mexico (Andrade-Cetto, 2009), skin infections among the indigenous populations in Paraguay, in Mexico, Vietnam and South Africa (Pin and Céspedes, 2009; Andrade-Cetto, 2009; Lee et al., 2019; Afolayan et al., 2014), and against malaria in Congo (Many et al., 2020). This species has also been considered an effective mosquito repellent and used in fumigation in the Yunnan province of China (Gou et al., 2020).

*D. ambrosioides* occurs relatively sparsely in European current ethnobotanical and ethnopharmacological sources, and its range is limited to the south of the continent. In Poland, it is extremely rare, both in cultivation and as a garden escape (Fig. 1; Szafer, 1921; Szafer et al., 1924; Urbisz, 2011). The first appearance in Polish botanical literature occurred under the name *mączyniec wonny* *Orthosporum ambrosioides* Brown (Czerwiakowski, 1859: 1180). *D. ambrosioides* appears under the French names *Ambroise du thé du Mexique* and *anserine de Mexique* in a

historical Catalan herbarium of Francesc Bolòs (1773–1844) (Gras et al., 2017). According to Muntané (1994), this species was already known in Spain and Portugal in the 18<sup>th</sup> century, used in infusions for digestive disorders, treatment of eczema, fever, intestinal worms and cough (Baleixo da Silva et al., 2021). Pardo de Santayana et al., (2005) have recorded several names for the species in Spanish botanical and pharmacological sources, many evoking place names, such as *té de borde* ('tea of the roadside'), *té de Argentina*, *té de Méjico*, *té de Nueva España*, etc. This species has been a popular herbal-medicinal tea in Spain. *D. ambrosioides* is known as *té* 'tea' in Galicia, Spain, and has been employed by the local population as a digestive, stomachic and laxative agent (Blanco et al., 1999).

Infusions made from *D. ambrosioides*, *Mexikanishes Traubenkraut* and *Chenopodium ambrosioides* L., were mentioned in a Prussian handbook for replacing exotic products with local plants (Schmidt, 1830: 5). Published in Mohrungen (then East Prussia, now Morąg in NE Poland), it stated: "This annual plant comes from southern Europe and Mexico, but grows well in our garden and bears fertile seeds. (...) The leaves after removing the stalks, when the weather is dry and quickly dried, with boiling water, yield a beautiful bitter-spicy infusion, which will be a good tea but also recommended for those with chest pains."

### 1.3. *Dysphania botrys* in Europe

*Dysphania botrys* (Schult.) Mosyakin & Clemants (formerly known mainly as *Chenopodium botrys* L., see [Plants of the World Online \(2021c\)](#) for the full list of synonyms), is native to southern Europe, starting around Spain, all the way to western Himalaya and Mongolia; it is regarded as native in Hungary and Ukraine, but not Poland or Germany

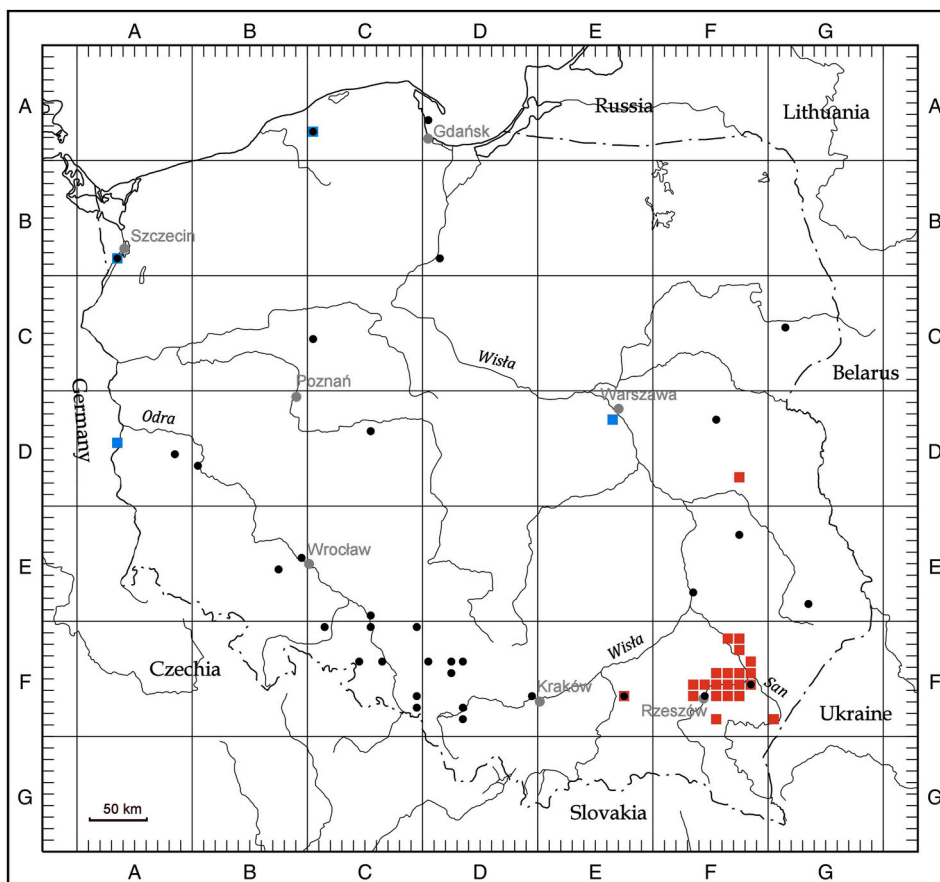


Fig. 1. Records on the occurrence of *Dysphania botrys*, *D. schraderiana* and *D. ambrosioides* in the wild in Poland (Urbisz, 2011; Zajac and Zajac 2001, 2019). Black circles – *D. botrys*, red squares - *D. schraderiana*, blue squares – *D. ambrosioides*. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

(Plants of the World Online, 2021c). It is however, reported from Poland as a garden escape (Fig. 1). It is an aromatic annual or biennial herb which had some use in Antiquity and occurs in the works of Dioscorides as βότρυς (Dioscorides, no date; Tschirch, 1933: 1301; Staub et al., 2016), Aegineta (Adams, 1847: 73) and Pliny (Bostock and Riley, 1855). It was not noticed by Galen, Aetius, Oribasius, Celsus, nor probably any of the Arab herbals with the exception of Ibn al-Baitar (Bostock and Riley, 1855).

*D. botrys* also occurs in 16<sup>th</sup>–18<sup>th</sup> century European herbals. The species was mentioned in the work of Matthioli (as *botrys Dioscoridi* in the *Index*) and Tabernaemontanus (Matthioli, 1563: 479; Tabernaemontanus 1588: 46). Dodoneus (1583: 34) recommended it against dyspnoea, and described a medicated wine and a preparation of the herb with sugar. It was later mentioned by Bauhin (1623: 138), as well as Gerard (1597: 950) and Parkinson (1640: 89) who called it *oke of Jerusalem*, or *Jerusalem oak* (Morteza-Semnani, 2015). In Britain, it was also mentioned in a 17<sup>th</sup> century poem by Robert Chester (Grosart, 1878: 95):

Oke of Jerusalem being thoroughly fired,  
And laid in presses where your clothes do lie  
No Mothes or venome mongst them shall abide,  
It makes them smell odoriferously,  
That it doth kill them all immediately:  
It helps the breast that's stopped with corruption,  
And gives mans breath fit operation.

*D. botrys* appears first in the Polish *Antibolomenum* dictionary from 1472 published by Rostafiński (1900: 156). It appears under the names *herba tinee* (Latin name no. 1066), *molnik* (no. 1590) and *kwcicień* (no. 1591). It is also present in the herbal of Sirennius (1613: 730–732), the most complete of Polish herbals, where it occurs under the name *stozjarn*, *molownik*, *milek* along with Latin (*Botrys herba*, *Herba Botry*, *Quercula peregrina*, *Millegrania*) and German names (*Traubenkraut*, *Schwalekraut*, *Rottenkraut*, *Turkischen Beyfusz*, *Welsch cychen laub*). Sirennius gave a very long list of uses for *D. botrys*, such as against wheezing, blocked liver, stomach pains, urinary and menstrual issues, as well as to protect clothes against moths. Sirennius quotes uses from Dioscorides, Pliny, Aegineta and Tabernaemontanus, and recommends it to be macerated in wine or beer and sweetened with honey. He also described vodka, salt, confits and oil extracts. Another 17<sup>th</sup> century Polish source (Knapski et al., 1621: 432), lists it under the names *molownik ziele*, *banagdyk*, *stozjarn*, *milek*, *botrys*. *D. botrys* was also recorded as being under cultivation in the Warsaw botanic garden in 1651 (Rostafiński, 1928).

In strictly pharmaceutical monographs, *D. botrys* is featured in a Silesian (an area now within Poland) materia medica book by Schweckenfeld (1600: 242), who called it *uva botrys*, *Traubenkraut*, *Lungenkraut* and *Mottenkraut*. He advocated using the plant to treat phlegm in the chest and trachea, asthma, heart and lung diseases, after-birth pains and as an insect repellent – specifically against bugs and cockroaches. Cartheuser (1769: 150) regarded the pharmacological uses of *D. botrys* and *D. ambrosioides* as comparable.

The herb and its diaspores (treated as seeds) are listed in *Pharmacopoea Genevensis* (de la Roche et al., 1780: 12) and *Ricetario fiorentino* (Anonymous, 1789: 22). The herb of *D. botrys* was a commodity in the 18<sup>th</sup> century trade of materia medica. It was listed in the pharmaceutical price-book for Zerbst (Anonymous, 1726: 60) as *herba Atriplicis odoratae* and German *Wohlriechende Garten-Welde*. *D. botrys* is also mentioned in Zedler's 64<sup>th</sup> volume dictionary of science and arts from Leipzig (Zedler, 1733: 436), as *Botrys Kraut*, *Traubenkraut*, and *Turckischer Beyfuß*. Zedler states that the plant is planted in Germany, grows wild in France and Italy, and is used to repel clothes moths, treat lung diseases and chest

pain. He proposes tincture, a thick syrup or mixing the seeds with cereals or fruits.

In the 19<sup>th</sup> century, scientific mentions of the plant were of a wider ethnobotanical character: Endlicher (1841: 183) wrote that due to its odour it was now simply used against moths eating woolen clothes, and Presl (1846: 1279) regarded it as *formerly* medicinal. Sawiczewski (1839) considered it a valuable odoriferous plant worth cultivation. He stressed that *D. botrys* should not be substituted with *D. schraderiana*.

A review of the ethnographic uses, chemical composition and biological activities of *D. botrys* was published by Morteza-Semnani (2015). Today, the species remains in traditional use in Pakistan and northern India, but other records of its use according to Morteza-Semnani (2015) encompass areas of Iran, France, Serbia, Germany and the USA. However, a closer look reveals that the above-mentioned study does not cite original ethnographic or historical papers, focusing instead on ethnopharmacological articles which in turn cite other sources (Yadav et al., 2007; Maksimović et al., 2005; Gostuški, 1979). The study shows that the predominant application of *D. botrys* is for respiratory and gastric problems, headaches and as vermifuge. It is also used as food spice in soups in Labul, India (Koelz, 1979) and as spice in Serbia (Morteza-Semnani, 2015). As far as its traditional use in Central Europe is concerned, *D. botrys* (as *macicula oliwna* (*Chenopodium Botrys*)) had been used against cough in the village of Wisła near Cieszyn (southern Poland) (Wyslouchowa, 1896: 136). Fischer (Kujawska et al., 2016) reported that *D. botrys* (as *Ch. botrys*) was used by Hutsul Highlanders (now SW Ukraine) under the name *myrziele*. It was dried and added to water for bathing children and applied as a hair wash for treating headaches in villages around Kosów (Kociv) and Worochna (Bopoxra).

#### 1.4. *Dysphania schraderiana* in herbals and ethnobotanical studies

*Dysphania schraderiana* (Schult.) Mosyakin & Clemants (formerly known mainly as *Chenopodium foetidum* Schrad., *Ch. schraderianum* Schult., see Plants of the World Online (2021d) for the full list of names) is a species closely related to *D. botrys*, but originating from Africa and Arab Peninsula (Plants of the World Online, 2021d-this website gives the list of African floras where it is cited). In Poland, it is reported mainly from the south-east (Fig. 1). *D. schraderiana* does not seem to occur in pre-19<sup>th</sup> century European literature. The species was established by Schrad in 1808 (as *Chenopodium foetidum* Schrad.). European botanical texts issued prior to 1808, however, may mention a plant named *Chenopodium foetidum* or *Ch. foetidum* Lam.. This is a different species, now known by the accepted name of *Chenopodium vulvaria* L.

*D. schraderiana*, though little known to European botanists and pharmacists, is, however, traditionally used in its native range. In Yemen, the seeds and leaves are used locally against intestinal worms and the seeds are used to treat tumors (Hussein and Dhabe, 2018). In Ethiopia, it is called *yocho* and the seeds are used to treat dysentery, headache and eye diseases (Awas and Demissew, 2009). In Traditional Chinese Medicine (TCM), *D. schraderiana* was applied against wheezing, inflammation, spasms and migraines (Xie, 1996). It further spread to other parts of Asia (Uotila, 2013), and to Europe, being occasionally recorded in the wild in the central and south-eastern part of the continent (Plants of the World Online, 2021d). According to Polish materia medica writer Sawiczewski (1839), the species was only found in botanical gardens. *D. schraderiana* does not officially occur in European herbals, but it may have been used when confused with *D. botrys*. If its difference was noted, it was probably seen as a 'false' *D. botrys* with an inferior, more pungent scent. This is confirmed in Czerwiakowski's (1859: 1178–1180) *Opisanie roślin*, the only pharmaceutical document in Poland, who compares the two species. Czerwiakowski wrote that it was "a stimulating, anticonvulsive herb, which had been a previously important medicinal, but was still locally used as a vermifuge. Further, he mentions *D. schraderiana* under its old name *Ch. foetidum* Schrad. stating: "It has [an] exceptionally bad smell and is confused with the former, it is much taller, less glandular-sticky, the leaves are deeper

lobed, and the upper three-lobed. The tepals in the fruit are sharply toothed at the apex, it is regarded only as the variety of the former. Used in a similar way.” According to (Hager, 1876: 822), *D. schraderiana* was also considered a substitute of *Ch. ambrosioides* in European pharmacy.

In Polish literature, the generic name “komosa” for *Chenopodium* L. was introduced by Waga (1847: 443). Originally, *komosa*, was a folk name of *Ch. album* L. and a few closely related species (see e.g. Łuczaj, 2010; Łuczaj and Szymański, 2007) but in the scientific nomenclature came to mean all the species from the genus *Chenopodium*. *D. schraderiana* was named “komosa cuchnąca” (i.e. “stinking goosefoot”) by Czerwiakowski (1859: 1178). *D. botrys* was named “komosa wonna” (i.e. “fragrant goosefoot”) by Waga (1847: 449). Adjectives in Polish names help distinguish these two similar species by the most prevailing character of fresh plants, through their respective disagreeable or agreeable odour. As far as Polish ethnographic sources are concerned, *D. schraderiana* (as *Ch. schraderianum*) is only mentioned by Gustawicz (1882: 43), who reported that it was called *mirzil* and grown in gardens in Żabno, (there are two locations with this name, near Tarnów and Radomyśl nad Sanem) and in Bilcze near Drohobycz (Drohobych, now western Ukraine). He also thought that it was the unidentified *myr-zilje* which was used against headache in Ukraine (Marcinkowski, 1857: 168).

The only recent literature concerning the use of the species within Europe is the publication of Oklejewicz and Łuczaj (2015) who reported its frequent presence (under the name *mirra* which in Polish signifies myrrh *Commiphora myrrha* (Nees) Engl. tree resin) in the bouquets blessed on Assumption Day around the city of Rzeszów (see also Fig. 3).

### 1.5. Aim of study

The above-mentioned body of historical and ethnographic sources suggests that *D. schraderiana* may be one of few medicinal species occurring wild in Europe for at least two centuries and used traditionally, but rarely featured in old herbals or pharmacy handbooks. As our observations from 2010 to 2014 showed, *D. schraderiana* is still a widely known plant in south-eastern Poland, used in church rituals and probably also medicinally. Therefore, we started searching for any possible information of the use of this plant in the study area.

Specifically, we wanted to determine:

- the range of use,
- the names of the plant,
- local uses and stories associated with it,
- its status, i.e. if it is mainly collected from the wild or cultivated,
- compare its uses with the closely related *D. botrys* and also with *D. ambrosioides*, the best studied species from this group.

## 2. Materials and methods

In our field studies, we followed general guidelines for ethnopharmacological research outlined by Heinrich et al. (2018) and Weckerle et al. (2018), which included standard methods used in ethnobotany, such as historical source analysis and semi-structured interviews with local interlocutors, who use, or remember the use, of this plant.

The study area encompassed south-eastern Poland (within the Podkarpackie voivodeship). The southern part of this region is flat, being a part of the Sandomierz Basin, a lowland area at the fork of the rivers Wisła and San, with the Carpathians at the foot. The Carpathian Mountains constitute the southern part of the region, and are composed of the Beskid Niski Mountains, Bieszczady Mountains and the Carpathian Foothills (Szafer and Zarzycki, 1972; Rogala and Marcela, 2000). The highest elevation in the region is Tarnica (1346 m a.s.l.). The Podkarpackie voivodeship is, like most Poland, predominantly inhabited by Poles (97.8% of the population). The majority of the population (92.5%) declare themselves Roman Catholic (Cierpiał-Wolan, 2013).

Roman Catholic churches are located in most villages, and at least one in every town of the region. All of the Roman Catholic churches perform plant blessing rituals on Assumption Day and Corpus Christi Octave.

Both the vascular flora and ethnobotanical traditions in the region are well studied.

The first two authors of the paper carried out numerous floristic research studies in this area for years and have never encountered *Dysphania* species outside the area marked by Rzeszów and Przemyśl. In 2020, all the squares in the 10 km grid of *Atlas of the Distribution of Vascular Plants* where *D. schraderiana* was recorded were visited (Zajac and Zajac, 2019), (Fig. 2). If the plant was noticed in the garden or a roadside, we asked the owners of land or the neighbours if they knew the plant and if it was used. We used a structured questionnaire.

Thirty-seven people were interviewed in the field study during the season the plant was flowering or fruiting. In the field work, discussion was initiated, and information gained by showing the participants photographs as well as a voucher and/or a live plant specimens. If the participant recognised the plant, they were further interviewed on its identification and uses. Additionally, an appeal was published in a botanical blog of the corresponding author (Łuczaj, 2020) for people who know or use the plant to contact us. The blog included a photograph of the plant, and a link to a YouTube film with an interview with one of the ladies growing *D. schraderiana* (Łuczaj, 2018). The blog post was read by 4625 people all over Poland and five people responded: three with information from the Rzeszów area (our area of study), one from the Lublin area and one, with obviously mistaken information about a different plant, from Silesia (not included in the results). Altogether, our database included 42 interviews, 37 from females and 5 males. The mean age of respondents was 67 years, minimum 40, maximum 91.

The plant identification of *D. schraderiana* was confirmed with three voucher/herbarium specimens (see Data Availability section), and documented in photographs taken in all the localities where the species

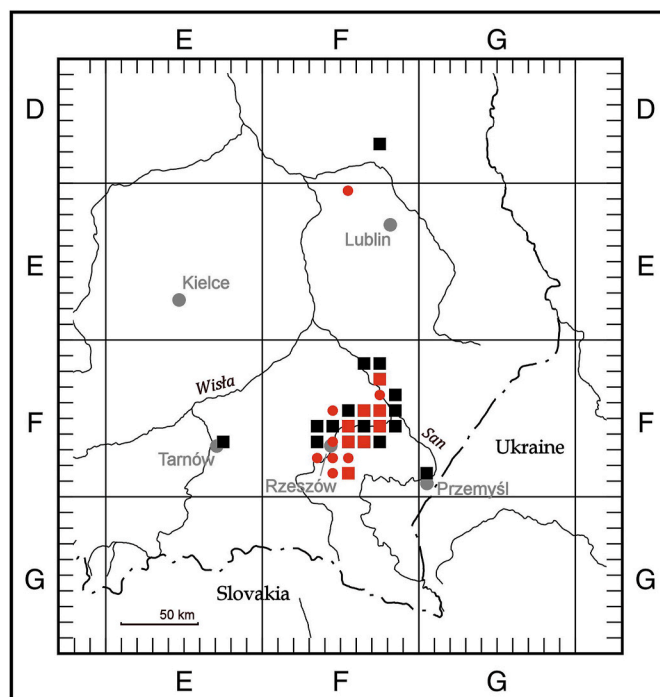


Fig. 2. The distribution of wild populations of *Dysphania schraderiana* in southeastern Poland, and the distribution where the use was recorded. Red circles – the plant is or was only cultivated and used, red squares – the plant is or was both cultivated and wild and used, black squares – the plant is found wild but there is no data on its use. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)



Fig. 3. A bouquet with *Dysphania schraderiana* blessed on Assumption Day in Siedliska (suburbs of Rzeszów) in 2015. Photo by Ł.Ł.

was encountered in the field. We put special attention to verification of whether an individual was *D. schraderiana* or *D. botrys*. *D. botrys* was not found in the area during the intense field search in 2020.

### 3. Results

During the fieldwork, only *D. schraderiana* was found and only this species is used there. No other *Dysphania* species were recorded in the study area, either in cultivation or in the wild. All the interlocutors consistently named this plant *mirra*. The plant is used within the city of Rzeszów and in several villages and small towns east, north and south from it (Fig. 2; Table 1).

The species is collected by users from their own gardens or their direct vicinity (Figs. 4 and 5). Only seven out of forty-two respondents remembered sowing it on purpose. In most conversations *D. schraderiana* is self-sown but it is taken care of. The owners of the gardens make sure it is not mown or destroyed by other garden activities. In Sokołów Małopolski and Przeworsk, the plants of this species are sold in the local open market.

The most important use of *D. schraderiana* (Table 1) is blessing in church rituals, which still has numerous apotropaic meanings for some people in the countryside (Fig. 3). The plant is still commonly blessed on the Assumption Day (15th of August), as stated by nearly all the

**Table 1**  
Summary of uses of *D. schraderiana* recorded during the study.

Type of use	Number of respondents (N = 42)	Remarks
Blessed in mixed herbal bouquets on Assumption Day (usually as the most important ingredient of the bouquet)	38	Throughout
Moth repellent	8	Albigowa (ŁA); Zwiężczyca, Łąka, Siedliska, Kielnarowa, Sokotów Małopolski (all RZ)
Used on Epiphany Day to fumigate the house	5	Budy Łańcuckie (ŁA); Brzózka Królewska (LE); Siedliska, Straszylde (RZ); Dębiny (LU); Kurów (PU)
Blessed in herbal wreaths on Corpus Christi	4	Kuryłówka (LE); Markowa (ŁA); Dębów (PRZ); Dębiny (LU)
Applied in the form of an infusion given as a drink to strengthen postpartum cows	3	Albigowa, Żołyńia (ŁA); Łąka (RZ)
Placed in the kitchen together with mint as a perfume to mask cooking cabbage	2	Grodzisko Dolne (LE); Markowa (ŁA)
Used in funerary rituals	2	Markowa (ŁA); Dębów (PRZ)
Used as a protective plant when building a new house	2	Markowa (ŁA), Straszylde (RZ)
Blessed on Corpus Christi Octave and then hung on houses to protect them from strong winds or storms	1	Kuryłówka (LE)
Corpus Christi wreaths were used for fumigating the house during storms	1	Dębów (PRZ)
Assumption Day bouquets with <i>mirra</i> tucked behind the picture of Virgin Mary	1	Studzian (PRZ)
Dried flowering of fruiting shoots of <i>mirra</i> are used medicinally against sore throat (fumigation),	1	Lipiny Dolne (BI)
Dried flowering or fruiting shoots of <i>mirra</i> are used medicinally to treat crying 'possessed' children (fumigation)	1	Brzózka Królewska (LE)
Infusion against fever to treat farm animals	1	Albigowa (ŁA)

Abbreviations of counties: BI – Bitgoraj, LE – Leżajsk, LU – Lubartów, ŁA – Łańcut, PRZ – Przeworsk, PU- Puławy, RZ – Rzeszów.

respondents (38 out of 42) but also included in the wreaths blessed on Corpus Christi (4 respondents). Moreover it used on Epiphany Day (6<sup>th</sup> of January), as incense to fumigate the house (5 people). The dried crushed plants were used as an additional ingredient of the church incense. One respondent stated that rosin (*pix Graeca*), called in Polish *kalafonia*, was mixed with the crushed herb to be thrown on the hot stove on that day.

In Kuryłówka, wreaths containing *mirra* are blessed on Corpus Christi Octave and then hung on houses to protect them from strong winds or storms. In Dębów, these wreaths were used for fumigating the house during storms. In Studzian, such protective effect was performed by placing Assumption Day bouquets with *mirra* tucked behind the picture of Virgin Mary.

Dried flowering of fruiting shoots of *mirra* is also used medicinally against sore throat (fumigated with Assumption Day bouquet, Lipiny Dolne), for lowering fever, against cancer (Albigowa), and to treat crying 'possessed' children (Brzózka Królewska). The species also had an ethnoveterinary application in the form of a tonic infusion given as a drink to strengthen postpartum cows (Łąka, Żołyńia, Albigowa) as well



Fig. 4. *Dysphania schraderiana* semi-cultivated in home gardens. Top left – Brzózka Królewska, top right – Albigowa, bottom left and right – Dębów. August 2020, photos by MW.



Fig. 5. *Dysphania schraderiana* semi-cultivated in home gardens. Top row – Grodzisko Dolne, bottom row – Zielonka. August 2020, photos by MW.

as against fever in farm animals (Albigowa).

Another important use is as a moth repellent (8 respondents), mainly used in wardrobes, but also in places where groats or flour are kept (Rzeszów, Zwiężczyca, Łąka, Siedliska, Albigowa, Kielnarowa, Sokołów Małopolski).

There is an interesting use of *mirra* in funerary rituals. Up until the turn of the 20th and 21st centuries, the bodies of the dead were kept for a

couple of days at home before the funeral. In Markowa, the body of the deceased was fumigated with the Corpus Christi mirra Octave wreaths. In Dębów, the twigs of the species, or Assumption Day bouquets containing *mirra*, were placed under the head of the deceased, partly as a deodorant, and also “so that Mary takes them to Heaven.”

*Mirra* was also used as a protective plant when building a new house. In Straszyle, the twigs of the species were placed in each four corners

on the foundations. And in Markowa, the Corpus Christi Octave wreaths, which had to include *D. schraderiana*, were used instead.

In Grodzisko Dolne and Markowa it was also placed in the kitchen together with mint as a perfume to mask cooking cabbage.

One respondent to our internet questionnaire reported that her grandmother from the Lublin area used a plant called *mirra*, which grew semi-wild in her garden. She dried the plants, fumigated her house with wreaths made with *mirra*. She also supplied it to two local priests so that they could use it for blessing of myrrh on Epiphany (in the two places where she lived in Dębiny near Michów, and in Kurów, both in the Lublin area). However, due to the fact that this is a historical account, we could not confirm the identification of the plant used.

Within *D. schraderiana*'s known continuous range in south-eastern Poland the species is no longer used, remembered nor cultivated in 11 ATPOL squares. In 8 squares, the plant is cultivated, used and reported from wild locations. In 5 squares, the plant is only cultivated and used, but no specimens outside gardens were reported (Fig. 2).

#### 4. Discussion

Our field study shows that *D. schraderiana* used to have a wide spectrum of functions. It is probably the religious and at the same time apotropaic function which helped to maintain the local interest in the plant. The name *mirra* is Polish for myrrh, which is also used as a highly aromatic church incense, though the scents are not similar. This name association may be why the plant is included in Epiphany (January the 6th) blessing rituals when the church also blesses myrrh and frankincense. It is difficult to guess when and where someone started adding this plant to the church incense in the area. Its wide use as insect repellent was another important function which may have helped to maintain its presence in the local ethnobotany in spite of the plant's strange musky scent, perceived by some people as unpleasant (which would confirm its old botanical specific name *foetidum*).

What is interesting in this study is that there is a very compact geographical range of the species in Poland, both in terms of its occurrence in the wild and in its use. In contrast, *D. botrys* has several isolated locations scattered around Poland (Fig. 1). Whereas most *D. schraderiana* locations make a well-defined compact range. It is probably the local garden cultivation that has helped to maintain the 'wild' population which is probably recorded as an occasional escapee from cultivation. A form of incipient cultivation takes place in the area, which may lead to incipient domestication. The plant, once sown, maintains itself in the garden, being spared during weeding, a fact mentioned by a number of informants. Incipiently domesticated plants are those at an early stage of domestication with relatively low phenotypic and genetic differentiation compared to their wild relatives (Lins Neto et al., 2014). Population studies of the related *D. ambrosioides* in Oaxaca, Mexico showed that although epazote is usually considered a wild weed, the results from as many as four lines of evidence (cultural differentiation patterns, gigantism, reduction in chemical defenses and toxic compounds, and inheritance of adaptive traits) make a strong evidence for the existence of an incipient domestication process in the study zone (Blanckaert et al., 2012).

There are differences between the use and cultural position of *D. schraderiana* in Poland and *D. ambrosioides* in the Americas (Table 2). The former is used mainly as an apotropaic plant and a moth repellent, with some extra medicinal uses mainly concerning the upper part of the body (headaches, sore throat), whereas the latter is mainly used as a vermifuge, usually with no ritual use. This can be explained by phytochemical differences, though the differences between the species are difficult to quantify due to few studies concerning this genus. Phytochemical studies of *Dysphania* species have shown several phytoconstituents covering various type of compounds. Secondary metabolites such as essential oils, flavonoid compounds, saponins, terpenes (triterpenes), carotenoids, sterols (phytosterols, ecdysteroids) and alkaloids were found. The presence of carbohydrates, amino acids, proteins, and

**Table 2**  
Comparison of *Dysphania* species occurring in Poland.

	<i>D. schraderiana</i>	<i>D. botrys</i>	<i>D. ambrosioides</i>
Native range	NE Africa and SW Asia	From Mediterranean Europe to W Asia	Central and South America
First occurrence in Europe	Medieval to early 19 <sup>th</sup> century?	Native	17 <sup>th</sup> century
Main use in general in Poland	Apotropaic and moth repellent	Medicinal and moth repellent (formerly)	Practically not used
Main use throughout the world	Medicinal	Medicinal	Medicinal and in food
Main medicinal uses	Dysentery, headache and in eye diseases (Africa), vermifuge and against hot tumors (Arab Peninsula); Against sore throat, for lowering fever and against cancer, against crying 'possessed' children, for cows after giving birth in order to strengthen them (Poland)	Used against headache (Poland); dried and added to water for bathing children and washing hair for people suffering from headaches there (Ukraine)	Anthelmintic, gastric problems, headache, cough (Latin America), malaria (Congo), mosquito repellent (China); Herbal-medicinal tea, anthelmintic, cough, fever, eczema (south-western Europe)
Distribution in Poland	Quite frequent in one region of south-eastern Poland	Very rare, scattered	Very rare, scattered, probably only an ephemerophyte
Traditional use in Poland	Still used	Extinct	Not used
Presence in pre-medieval written sources in Europe	No	Yes	No
Presence in Renaissance European herbals	No	Yes	No
Presence in later periods European herbals and pharmacopoeias	Yes	Yes	Yes

organic acids, vitamins, and minerals are also mentioned (Kokanova-Nedialkova et al., 2009). All the three species, *D. ambrosioides*, *D. botrys* and *D. schraderiana*, are rich in essential oils, depending on the origin of the plant material. The essential oil obtained from *D. ambrosioides* has been the most investigated (Singh and Pandey, 2021). Studies revealed that the oil is a complex of monoterpenes, sesquiterpenes, and various aldehydes, acids, alcohols, and ketones. However, the main ingredients of the oil obtained from *D. ambrosioides* are ascaridole (*cis* and *trans*),  $\alpha$ -terpinene, *p*-cymene, and caryophyllene oxide. According to several studies, the main components of essential oil of *D. botrys* from different origin were  $\alpha$ - and  $\beta$ -eudesmol,  $\alpha$ - and  $\beta$ -chenopodiol, eudesma-3, 11-dien-6 $\alpha$ -ol, botrydiol, elemol, elemol acetate,  $\gamma$ -eudesmol, and guaia-3,9-dien-11-ol, new sesquiterpene alcohol, accounted for 7.4% of the oil. Ascaridole (from 7.5% to 40%) was also reported in the essential oil of *D. botrys* collected from a different origin (Morteza-Semnani, 2015). In the essential oil of *D. schraderiana*, 52 phytochemical compounds were identified, and the most abundant constituents of the oil were aliphatic compounds (54.2%) and terpenoids with their



oxygenated derivatives (31.9%). Among terpenoids, monoterpenes made up 5.1% of the total, and sesquiterpenoids made up 26.8%. It is also notable that the essential oil consists of other compounds such as perilla alcohol,  $\beta$ -ionol, or citral. In contrast, the presence of ascaridole was not observed (Shi et al., 2016; Fu et al., 2019). Other more polar components that have been well-characterized in these species are polyphenols and terpenes. From the phytochemical point of view, *D. ambrosioides* contains saponins, terpenoids, and flavonoids such as kaempferol and quercetin derivatives (aerial parts and fruits). From aerial parts of *D. botrys*, derivatives of flavones (salvigenin, sinensetin, hispidulin) have been isolated. Other studies also revealed the presence of glycosides of isorhamnetin. It is worth noting that polyphenolic compounds in *D. schraderiana* have not been described so far. Further, phytochemical analysis of the leaves and stems of *D. ambrosioides* showed the presence of avenasterol and spinasterol. Also,  $\alpha$ - and  $\beta$ -carotene as main carotenoids in *D. ambrosioides* have also been described (Kokanova-Nedialkova et al., 2009). These ingredients are currently considered to be responsible for the multidirectional pharmacological activity of *Dysphania* plant materials.

It must be noted that the traditional uses of *D. schraderiana* in Africa (dysentery, headache and in eye diseases – Awas and Demissew, 2009) and the Arab Peninsula (vermifuge and against hot tumors – Hussein Dhabe, 2018) are different than the uses in Poland. Moreover, in these areas the seeds are predominantly used whereas in Poland the whole herb is preferred. In TCM, the uses of the species (Xie, 1996), i.e., against wheeze, inflammation, spasms and migraines, are more closely aligned with Polish use.

Plants blessed in churches in Poland for Assumption Day and Corpus Christi Octave are reservoirs of once important medicinal plants as already discussed by Luczaj (2011a, 2011b, 2012; Fig. 3). The case of *D. schraderiana* adds evidence to this argument (Oklejewicz and Luczaj, 2015). Further research in areas where the related *D. botrys* was previously used is needed to discover if the species is remembered, blessed or used medicinally. The lack of response from these areas to the internet questionnaire about *mirra* issued by Luczaj (2020) enables us to suspect that it is only in our study area (the area between Rzeszów and Przemyśl) that the use of *Dysphania* spp. survived. However, it may be potentially useful to look at sites in western Ukraine from which *D. schraderiana* and *D. botrys* were also reported (Szafer, 1921; Szafer et al., 1924).

Although the general apotropaic use dominates over directly medicinal uses, this type of plants' influence on people's health should not be dismissed. We can imagine that just the "presence" of blessed herbal bouquets and wreaths in people's dwelling may have a measurable health effect corresponding to the placebo effect, well known in medicine but also extensively discussed in ethnopharmacological and ethnobotanical aspect by Moerman (1979, 2002).

We propose to use the term *ecclesiophilous* (from Latin *ecclesia* - church) for plants whose use in a community is maintained due to its presence in church rituals and then is transferred to other uses. In the case of *D. schraderiana*, it may have been initially used as an aromatic plant in church practices, specifically as myrrh substitute. Such an important position probably enhanced other apotropaic uses also influencing ethnomedicinal and ethnoveterinary practices. This assumption points to a complex and vivid connection between church blessed plants and medicinal plants in Polish folk phytotherapy. The use of such a minor medicinal plant would probably not survive without being conserved within church blessing rituals, as already pointed out by Luczaj (2011a, 2011b, 2012). It is worth noting that some similar herb blessing rituals were observed in Ukraine in both Orthodox and Greek-Catholic communities, although the holidays on which these plants are blessed may differ (Stryamets et al., 2021).

One should also pay attention to the name of the related *D. botrys* in some European languages associating it with oak and the city of Jerusalem, such as *oke of Jerusalem* (Gerard (1597: 950), Parkinson (1640: 89) and *Eiche von Jerusalem* (Schkuhr, 1791: 172), both being of

importance in European culture. Such names are not recorded in Polish but may signify positive associations with the plant in general which may have facilitated its spread to nearby regions and countries.

So how did *D. schraderiana* enter the Polish (and Ukrainian) folk pharmacopoeia? We can imagine a few stages of the expansion of the use of *D. schraderiana* in Central Europe, mainly due to being difficult to distinguish from *D. botrys* or being a replacement for it.

First, only *D. botrys* has been used throughout Europe both from wild and cultivated sources since antiquity. *D. schraderiana* appeared later, migrating from Africa or Arab Peninsula, probably spread by people using it in a similar fashion to *D. botrys*, not distinguishing the two species. *D. schraderiana* may have been treated as an inferior form of *D. botrys*. For example, difficulties in determining Himalayan plants as either *D. botrys* or *D. schraderiana* (also as *Ch. foetidum*) have been noted on some labels and determination slips of herbarium sheets by Uotila (2013). We do not know when this migration happened, but sometime between the Medieval times and the 19<sup>th</sup> century. Simultaneously, the use of *D. ambrosioides* was spreading in Europe, but it became mainly restricted to the south and is distinct from the other two *Dysphania* species. Eventually, someone popularised the use of *D. schraderiana* in the Rzeszów area – this was probably an introduction from one source as all the people use the same folk name, *mirra*, which is different to the folk names used for *D. botrys* in Poland and Ukraine. For unexplained reasons the use likely spread through people exchanging seeds during the Assumption Day bouquet blessing. It is not unlikely that the plant spread through the present area of Ukraine as it was reported in the pre-1939 Polish flora from this part of Europe. The city of Lviv (Lwów, Lemberg) had a large Armenian diaspora (Smirnów, 2002) and maybe via family contacts, the plant was brought into cultivation from the area of Turkey or Caucasus to Central Europe. The look at the pre-World War II Polish floras supports the first hypothesis, as both *D. botrys* and *D. schraderiana* were much commoner east of the post-war borders of Poland (Szafer, 1921; Szafer et al., 1924). The most exact distribution of the two species in what is now Ukraine and Belarus was given by Szafer (1921) who wrote that the former species occurred wild only in Podole (Podolia) and occasionally feral throughout [pre-war Poland], especially in southern Wołyń (Volhynia), and the latter species is occasionally feral in Polesie (Polesia), e.g. in Pińsk and Łojów (now Pinsk and Loyow, both in Belarus) and in Volhynia (Żytomierz and Humań, now Zhytomyr and Uman' in Ukraine). Unfortunately, we do not have modern distribution maps of the species in those two countries. Further ethnobotanical investigations of the use of *Dysphania* species should focus on in Polesia, Podolya and Volhynia, as the areas where *Dysphania* species were most common.

## 5. Conclusions

*Dysphania schraderiana* is an African-Arabian species used in a similar way as *D. botrys*. The latter was used in Poland, though probably not very frequently, and the use has likely become extinct, whereas the use of the former became common to one region. The local use of *D. schraderiana* in the Rzeszów area encompasses a variety of applications: ritual, apotropaic, medicinal and as moth repellent. Its use is enhanced by its pungent scent and a vivid tradition of blessing it in churches. Nowadays the ritual use in churches survives while other uses have been nearly forgotten. Historical uses of *D. schraderiana* (known in Europe at least since the 19<sup>th</sup> century) were described only as similar to those of *D. botrys*. The knowledge of its repelling properties survived up to the present times. *D. schraderiana* is being cultivated in home gardens of the Rzeszów area, but *D. botrys* was not observed.

## Data availability

The plant identification of *D. schraderiana* was confirmed with three voucher/herbarium specimens deposited in the herbarium of Warsaw University, Poland (WA10000102183, 184, -185). The original data

matrix was deposited in the Repository of Rzeszów University (<http://repozytorium.ur.edu.pl/handle/item/6302>).

### Authors' contributions

Concept of study – ŁŁ. Interviews and field work – MW and ŁŁ. Elaboration of historical sources – JDr, ŁŁ, JDu, MK, KW. Phytochemical aspects – MT. All authors took part in writing the first draft of the paper.

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### CRediT authorship contribution statement

**Łukasz Łuczaj:** Conceptualization, Methodology, Investigation, Writing – original draft, Writing – review & editing, Data curation, Visualization. **Mateusz Wolanin:** Conceptualization, Methodology, Investigation, Writing – original draft, Writing – review & editing, Data curation, Visualization. **Jacek Drobnik:** Investigation, Writing – original draft, Writing – review & editing. **Monika Kujawska:** Investigation, Writing – original draft, Writing – review & editing. **Jarosław Dumanowski:** Investigation. **Kim Walker:** Investigation, Writing – original draft, Writing – review & editing. **Michał Tomczyk:** Investigation, Writing – original draft.

### Declaration of competing interest

The authors declare no competing interests.

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