Annales Universitatis Paedagogicae Cracoviensis
Studia Naturae, 1: 85–94, 2016, ISSN 2543-8832

Larysa M. Makhynia

Department of Pharmacognosy and Botany, Bogomolets National Medical University, Pushkinska 22 St., 01601 Kyiv, Ukraine,
Larisa_2015@ukr.net

Bidens frondosa L. resource evaluation in the Dnipro River bottomland (in range of the forest steppes of Ukraine)

Introduction

Modern globalization threats and the current trends of the climatic changes over particular areas contribute to the acceleration of spreading of invasive species and create conditions for their quicker rooting under new conditions (Protopopova, 1991; Bondar et al., 2011). In the study area two indigenous species (*Bidens tripartita* L., *B. cernua* L.) and two adventive ones (*B. frondosa* L., *B. connata* Muehl.) are met. During the last 10–15 years a sharp resource decrease of a pharmacopoeic species of *B. tripartita* is viewed due to the fast spreading of an invasive one – *B. frondosa*. Consequently, in the near future it will cause serious losses of biological variety and economic significance of ecosystems in which this species has been spreading (Protopopova, 1973, 1991; Bortnyak, 1976; Horbyk, Husak, 1983; Mosyakin, 1988a; Chorna, 2001, 2006).

B. frondosa was first found on the Ukrainian territory in the town of Kaniv in 1970 by a famous Polish researcher J. Kornaś (1971). Also *B. frondosa* spreading was pointed out in the research of Protopopova (1973, 1991), Bortnyak (1976), Kotov (1979), Horbyk and Husak (1983). Mosyakin (1988b) noticed that this species is much more frequently met in Kyiv than *B. tripartita*, often creating dense undergrowth. Minarchenko and Timchenko (2002) indicated the fast spreading of *B. frondosa* throughout Ukraine. Danylyk and Danylyk (2009) showed the habitat of two new species (*B. frondosa*, *B. connata*) as a part of Shatsky National Park flora though they haven't been met there before. The authors explain this fast spreading of invasive species throughout Ukraine as the increase of the vegetation anthropogenic transformation. Some of Makhynia's publications (2005, 2009, 2012, 2015), as well as Makhynya and Strumens'ka's ones (2010), are devoted to the issues of spreading and fast exploration of new, especially transformed areas, and extruding other indigenous species – *B. tripartita*.

The conditions prevailing on the study area, i.e. the intensive development of the riverside territories for the management (creating private areas, fish farms, treatment plants etc.) contribute to more and more successful occupation of transformed territories by the invasive species. The next 10–15 years will have a significant impact on *B. tripartita* spreading and resources. Due to this, topical is the search of objects with the analogous or similar chemical composition, sufficient and accessible resource base. It is obvious that a successful candidate for such research is *B. frondosa*, industrial storing of which may negatively influence the species further expansion.

B. frondosa is not used in Ukraine, but due to the research of foreign authors it may be rather a promising species. In the USA it refers to the pharmacopeia is used in gynecology and otolaryngology (Morton, 1962; Mitich, 1994). In Northern America infusions from its roots and leaves are used in arrhythmias, bronchitis and laryngitis, and its fruits – in metrorrhagia (Kolla, 1985). The researches of Japanese scientists show the antioxidant activity of tetrahydroxyaurone of *B. frondosa*. It supports the issue on the prospects of the use of the raw material of this species and the topicality of its resource (Venkateswarlu et al., 2004).

The aim of the study was to investigate the *B. frondosa* resources in the Dnipro river bottomland as a promising substitute of *B. tripartita*.

Study area

The bottomland of the medium forest steppe of the Dnipro is located between Kyiv and Kremenchuk (Fig. 1) and differs significantly from those parts of the Dnipro which are in the north in forest zone and in the south in the steppe zone by the nature of its bottomland, stream flow and floodplains with its plant and ground coating (Afanas'yev, 1950). The Dnipro bottomland which occupies accumulative terrace is 120 km wide near Kyiv and consists of floodplains, upland, and loess terraces up to 35–40 m height above the river level (Marynych, Shyshchenko, 2006).

Due to its layering relief the bottomland belongs to the Bug–Dnipro level, the heights of which reach 200–300 m. It is located within the Ukrainian shield. Its surface looks like a slightly wavy plain dissected by valleys and gullies. There are not many lowland interfluves. Bedrock exfoliates on the slopes of river valleys and gullies (Marynych, Shyshchenko, 2006). In accordance with agro-ground zoning of Ukraine, the Dnipro bottomland is in the northern sub-province of the right bank central high province of forest steppe zone of typical black earth and gray ashed soils (Vernander, 1986). Floodplain soils and sandy terraces lie on eluvium, the rest are formed on loess.

Riverine floodplain is characterized as consisting of little turf, turf sand, rarely – sandy soils. Soils of central floodplain are wet meadow, sandy, and loamy soils. Among soils of pre-terrace floodplain there prevail meadow marsh and swamp loam ones. On

Fig. 1. Map scheme of resource areas placement of the Dnipro bottomland (within the forest steppe of the Ukraine).

Resource areas: I – Kyiv, II – Protsivsko–Kozynsriy, III – Pereyaslav–Khmelnitsky, IV – Kaniv, V – Zolotonosha, VI – Cherkasy, VII – Chygyryn, VIII – Protsenky, IX – Kremenchuk

the major part of pre-terrace floodplain, alluvial deposits of organic–mineral character are concentrated (Afanas'yev, 1950).

Upland terraces of the Psel and Sula bottomlands, as well as the one of the Dnipro, are covered with sod low-podzolic sandy soils. The duration of spring flood varies widely from the beginning of April till July. The long spring flood determines considerable dynamics of flood plains, the development of which is fully linked with the Dnipro floodwaters. The Dnipro significant solid flow is of great importance for floodplain formation (Poryvkyna, 1986).

The vegetation of the study area is formed under the influence of the artificial reservoirs (Kaniv and Kremenchuk), created in 60s–70s as a result of the Dnipro channel regulation and the construction of hydroelectric power plants. Total water area constitutes 292 ha. Reservoirs are characterized by a variable hydro regime due to which huge areas

with periodic flooding water are formed. They became biotopes of mass distribution of *B. frondosa*. Vegetation is represented by floodplain forest, meadow, psamophytic, marsh, higher aquatic, and ruderal types (Afanas'yev, 1950; Voytyuk, 1999). Floodplain forests are spread fragmentary and occupy in average 10–15%, their distribution is determined by the floodplain regime. Meadow vegetation in respect of the floristic is the richest and most widely spread, having an average of 70–75% of the total area. It includes steppe, real and marshy meadows. Marshy meadows account for 12–15%. They occur sporadically, mainly in central and pre-terrace floodplains. Psammothytic vegetation occupies small areas and is represented by few communities (about 3–5%).

The vegetation of new ecotypes, among which the most frequently spread are, as it is already been mentioned, *B. frondosa* and *B. tripartita*, occupies rather significant territories (about 20–35%) and is differentiated in relation to humidity on aquatic, riverside and ruderal communities with *Lemna minor* L., *Salvinia natans* All., *Trapa natans* L. s. str., *Nuphar lutea* (L.) Sibth. et Sm., which belong to higher aquatic vegetation which occurs fragmentarily (about 25–30%). The vegetation of riverside ecotypes (5–15%) consists of *Typha angustifolia* L., *Scirpus lacustris* L., *Glyceria maxima* (Hartm.) Holmb., *Phragmites australis* (Cav.) Trin. ex Steud., *Sagittaria sagittifolia* L., *Bidens tripartita*, *B. cernua*, *B. connata* and *B. frondosa*. Ruderal vegetation is formed from violations, azotized areas and occupies 7–15%. In relation to the increased anthropogenic influence (recreational in particular) the communities of ruderal vegetation rather quickly supersede the natural ones and its areas increase. The dominant communities were formed by *Xanthium albinum* H. Scholz., *Chenopodium album* L., *Tussilago farfara* L., *Polygonum hydropiper* L. and *Bidens frondosa*.

Material and methods

Resource research was carried out on the basis of the method of registration plots (Borisova, Shreter, 1966; Borisova et al., 1982; Kryilova, Shreter, 1971; Kryilova, 1973, 1981; Shreter, 1986; Kryilova et al., 1989; Kryilova, Kaporova, 1992). The size of registration plots depends on the location of masses on the study area.

Registration plots were diagonally located on the area occupied by the community of species (if its size was not more than 0.5 ha) or were placed as parallel or separated transects on the extended areas (riverside territories). The number of registration plots depended on the sample size (Kryilova, Shreter, 1971; Kryilova, 1973, 1981; Kryilova, Kaporova, 1992). In all, 347 plots were laid. Raw material collected on every sample plot was weighed. Weighed data was entered into the associations description form. Freshly gathered raw material was put in separate paper-bags with weight, place and date of collection being fixed on them. Raw material drying was performed in accordance with conventional methods as required (*Gosudarstvennaya farmakopeya SSSR*,

1989). After drying the re-weighting was carried out. Data on dry weight was entered into the form. Main calculations were performed under camera conditions. Recalculating, we received data about raw material weight averages of every investigated species in g/m^2. Drying coefficient was determined by the formula C = 100×(A–B)/A, where A – freshly gathered raw material weight, B – dry weight (Salo, 1972). Biological reserve of raw material was determined as the sum of the area and phytomass from g/m^2. Operational reserve of raw material was determined as the rate of 50% to the biological reserve since *Bidens frondosa* is a herbaceous annual, the raw material of which is the aboveground organs. This very amount of single use provides the minimal population ability to recover after raw material collection (Kovalev, Zhuravlev, 1989; Yakovleva, Blinovoy, 2004; Minarchenko, Minarchenko, 2004; Minarchenko, 2012). The rotation of the possible volume of collection for these species must be carried out every two years (Kovalev, Zhuravlev, 1989; Yakovleva, Blinovoy, 2004).

Statistical data processing was performed by the applied computer program Excel for Windows Office 2007 and Windows XP, as well as the methods of variation statistics. a true average (M) and the error of the average (m) with an acceptable accuracy coefficient (P) to 15% were calculated (Lakin, 1990; Tsarenko et al., 2000).

Results and discussion

The main reserve of *Bidens frondosa* is located on low riverside areas of floodplain and riverine parts of rivers, lakes, ponds, oxbow lakes, marshy forests, islands, riverside areas of water reservoirs mainly of the left bank bottomland and less of the right bank. They create continuous tracks of undergrowth, occur sporadically, but also can be found in small groups. As to spreading *B. frondosa* occupies about 70% of growing areas of all representatives of the genus (Tab. 1). The largest areas are concentrated in Cherkasy region (IV, V, VII resource areas), Kyiv region (II resource area) and on islands in Poltava region (IX resource area). The fewest ones are in Kyiv region (I, III resource areas) and on the outskirts of villages of Poltava region (VIII, IX resource areas) (Fig. 1).

Much rarer spreading and significantly smaller reserve are characteristic of *B. tripartita* (Tab. 2). Firstly, it is caused by its lower ecologic amplitude (Vinogradova, 2003; Vinogradova et al., 2009; Vasileva, Papchenkov, 2011; Makhynya, 2009, 2011); secondly, by the conditions which have developed on the study area, that is, active conquering of riverside territories for management needs (the creation of private areas, fish farms, treatment plants etc.) and excessive fluctuations in water levels of artificial reservoirs. Another aspect which influences the intensity of *B. tripartita* extrusion is the speed of seed germination of *B. frondosa* in comparison with the aboriginal type and the tempos of development under the juvenile condition (Vinogradova et al., 2009; Makhynya, 2011). In the region *B. tripartita* occupies about 20% of growing

area. Its largest areas are concentrated in Cherkasy region (V, VI resource areas) and in Kyiv region (II resource area). The smallest are in Kyiv region (I, III resource areas) and Poltava region (VIII resource area) (Fig. 1).

The peculiarities of territorial and ecological reserve differentiation of *B. frondosa* and *B. tripartita* are established. The main reasons for the reduction of this species are its narrow ecological amplitude. They are intensified by the condition changes prevailing on the study area and being negative for this species.

It is found that the largest raw material reserves are peculiar of *B. frondosa* in Cherkasy region (IV, V, VII resource areas), Kyiv region (II resource area) and on the islands in Poltava region (IX resource area). According to the features of annual use and the reserve accessibility of the areas *B. frondosa* are concentrated in Cherkasy region (V resource area). Total area constitutes 32 648 ha; biological reserve is correspondingly between 1130–1190 t, operational – between 565–595 t of dry raw material (Tab. 1). *B. tripartita* occupies only 25 573 ha; biological reserve is 108–124 t, operational – 54–62 t of dry raw material (Tab. 2).

The relevance of further resource research in other parts of the bottomland and monitoring by the resources dynamics of *B. frondosa* under the conditions of artificial reservoirs is obvious. This species harvesting will assist its negative influence reduction on natural reproduction of *B. tripartita*. For more successful conservation of resources *B. tripartita* needs some passive protection measures of its reserves creating natural reserves objects of both state and regional levels. Main objects of protection have to be herb resources, the reserves of which are sharply decreasing in Ukraine.

Tab. 1. *Bidens frondosa* raw material reserves

Resource area	Total spreading area [ha]	Total thickets area [ha]	Raw material phytomass [g/m^2]; ±SD	Biological reserves of dry raw material [t]	Operational reserves of dry raw material [t]	Amount of possible annual use of dry raw material [t]
Kyiv	448	2.48	868.90 ±59.80	6.02–6.91	3.01–3.45	1.50–1.73
Protsivsko–Kozynsriy	5200	56.22	882.96 ±22.05	145.30–151.74	72.65–75.87	36.32–37.94
Pereyaslav–Khmelnitsky	1300	20.45	856.50 ±13.70	51.70–53.39	25.85–26.69	12.93–13.35
Kaniv	4150	78.13	862.70 ±22.80	198.55–208.32	99.27–104.16	49.64–52.08
Zolotonosha	4500	117.09	837.24 ±26.12	289.91–308.41	144.95–154.21	72.48–77.10
Cherkasy	3900	42.89	779.70 ±30.03	103.44–109.83	51.72–54.92	25.86–27.46
Chygyryn	8000	57.95	879.20 ±20.08	149.03–155.93	74.52–77.97	37.26–38.98
Protsenkiv	1550	29.23	892.50 ±14.70	76.97–79.55	38.49–39.78	19.24–19.89
Kremenchuk	3600	48.44	829.54 ±28.43	109.50–116.29	54.75–58.14	27.37–29.07
Total	32648	452.88	854.36 ±26.41	1130.43–1190.39	565.21–595.19	282.61–297.60

Tab. 2. *Bidens tripartita* raw material reserves

Resource area	Total spreading area [ha]	Total thickets area [ha]	Raw material phytomass [g/m^2]; ±SD	Biological reserves of dry raw material [t]	Operational reserves of dry raw material [t]	Amount of possible annual use of dry raw material [t]
Kyiv	248	1.05	428.80 ±48.50	0.59–0.75	0.30–0.38	0.15–0.19
Protsivsko–Kozynsriy	4825	42.24	266.60 ±21.30	15.28–18.05	7.64–9.03	3.82–4.51
Pereyaslav–Khmelnitsky	1300	14.85	243.20 ±12.60	5.14–5.70	2.57–2.85	1.28–1.42
Kaniv	3750	45.25	230.00 ±14.60	14.15–15.93	7.08–7.96	3.54–3.98
Zolotonosha	3920	53.50	327.23 ±25.50	23.16–27.09	11.58–13.55	5.79–6.77
Cherkasy	3440	40.07	307.40 ±18.80	17.09–19.37	8.54–9.69	4.27–4.84
Chygyryn	4200	28.62	311.70 ±12.70	12.93–14.04	6.47–7.02	3.23–3.51
Protsenkiv	1550	7.14	282.20 ±22.50	2.78–3.26	1.39–1.63	0.69–0.81
Kremenchuk	2340	31.17	396.40 ±34.20	16.95–20.18	8.47–10.09	4.24–5.04
Total	25573	263.89	310.40 ±23.40	108.08–124.38	54.04–62.19	27.02–31.09

References

Afanas'yev, D.Y. (1950). *Zaplavni luky Serednoho Dnipra ta zakhody yikh polipshennya.* Kyiv: AN URSR. [In Ukrainian]

Bondar, O.I., Bilyavs'kyy, H., Horlitsi B., Marushevsky G.B., Ovchinnikov B.N., Romanov N., Tymochko T.V., Jakowlew E. (2011). *Natsional'na dopovid' pro stan navkolyshn'oho pryrodnoho seredovyshcha v Ukrayini u 2009 rotsi*. Kyiv: Tsentr Ekolohichnoyi Osvity ta Informatsiyi. [In Ukrainian]

Borisova, N.A., Tokarieva, V., Kuznetsova, M.A. (1982). *Izuchenie resursov lekarstvennogo rastitelnogo syirya dlya ih ratsionalnogo ispolzovaniya i ohranyi.* Kursk: Izdatelstvo Kurskaya pravda. [In Russian]

Borisova, N., Shreter, A. (1966). K metodike ucheta i kartirovaniya resursov lekarstvennyih rasteniy. *Rastitelnye resursyi, 2(2)*, 271–277. [In Russian]

Bortnyak, M. (1976). Notatky pro adventyvnu floru Kyyivs'koyi oblasti. *Ukrayins'kyy botanichnyy zhurnal, 33(6)*, 619–621. [In Ukrainian]

Chorna, H.A. (2001). *Roslyny nashykh vodoym: atlas-dovidnyk*. Kyiv: Fitosotsiotsentr. [In Ukrainian]

Chorna, H.A. (2006). *Flora vodoym i bolit Lisostepu Ukrayiny. Sudynni roslyny*. Kyiv: Fitosotsiotsentr. [In Ukrainian]

Danylyk, R., Danylyk I. (2009). *Rid Bidens* L. (Asteraceae) u flori Shats'koho natsional'noho pryrodnoho parku. *Naukovyy visnyk Volyns'koho Natsional'noho universytetu imeni Lesi Ukrayinky. Biolohichni nauky, 2*, 22–26. [In Ukrainian]

Gosudarstvennaya farmakopeya SSSR/MZ SSSR. (1989). 11-e izd., dop.Vyip. 2. Obschie metodyi analiza. Lekarstvennoe rastitelnoe syire. Moscow: Izdatelstvo Meditsina. [In Russian]

Horbyk, V., Husak, S. (1983). Flora verkhn'oyi chastyny Kyyivs'koho vodoskhovyshcha. *Ukrayins'kyy botanichnyy zhurnal, 40(5)*, 25–27. [In Ukrainian]

Kolla, V.E. (1985). Lekarstvennyie rasteniya semeystva Aystrovyih (slozhnotsvetnyih): Rasteniya roda chereda, ih biologicheski aktivnyie veschestva i farmakologicheskoe deystvie. Izyiskanie, izuchenie deystviya i analiz sinteticheskih i prirodnyih veschestv. *Perm. Med. In-t*, 62–70. [In Ukrainian]

Kornaś, J. (1971). Suchasni antropohenni zminy u flori Pol'shchi. *Ukrayins'kyy botanichnyy zhurnal, 28(2),* 167–173. [In Ukrainian]

Kotov, M. (1979). Izmeneniya vo flore g. Kieva i ego okrestnostey za poslednie 200 let. *Botanichnyy zhurnal, 64(1),* 53–57. [In Ukrainian]

Kovalev, V.N., Zhuravlev, N.S. (1989). *Metodicheskie ukazaniya po farmakognozii (Resursovedenie lekarstvennyih rasteniy).* Kharkiv: KhGFI. [In Russian]

Kryilova, I.L., Shreter, A.I. (1971). *Metodicheskie ukazaniya po izucheniyu zapasov dikorastuschih lekarstvennyih rasteniy.* Moscow: Izdatelstvo VILR. [In Russian]

Kryilova, I.L. (1973). O chisle uchetnyih ploschadok i modelnyih ekzemplyarov pri opredelenii urozhaynosti lekarstvennyih rasteniy. *Rastitelnyie resursyi, 9(3),* 375–370. [In Russian]

Kryilova, I.L. (1981). Sposobyi opredeleniya srokov vosstanovleniya zapasov syirya lekarstvennyih rasteniy. *Rastitelnyie resursyi, 17(3),* 446–450. [In Russian]

Kryilova, I.L., Kaporova, V.I., Soboleva L.S., Kiseleva T.M. (1989). Metodika orientirovochnoj ocenki velichiny zapasov lekarstvennogo rastitel'nogo syr'ya. *Rastitelnyie resursyi, 25(3),* 426–432. [In Russian]

Kryilova, I.L., Kaporova, V.I. (1992). Sostavlenie raschetnyih tablits dlya otsenki urozhaynosti lekarstvennyih rasteniy po proektivnomu pokryitiyu. *Rastitelnyie resursyi, 28(3),* 141–157. [In Russian]

Lakin, G.F. (1990). *Biometriya: uchebnoe posobie.* Moscow: Izdatelstvo Vyissh. shk. [In Russian]

Makhynya, L. (2005). Ekoloho-tsenotychni osoblyvosti vydiv rodu *Bidens* L. v dolyni Serednoho Dnipra. *Zbirnyk naukovykh prats': Aktual'ni problemy botaniky ta ekolohiyi, 1,* 57–62. [In Ukrainian]

Makhynya, L. (2009). Nasinnyeva produktyvnist' vydiv rodu *Bidens* L. dolyny Serednoho Dnipra (v mezhakh Lisostepu Ukrayiny). *Introduktsiya roslyn, 3,* 53–56. [In Ukrainian]

Makhynya, L. (2011). Ontohenez vydiv rodu *Bidens* L. Serednoho Dnipra. *Introduktsiya roslyn, 3,* 35–42. [In Ukrainian]

Makhynya, L. (2012). Ekoloho-fitotsenotychna stratehiya vydiv rodu *Bidens* L. Lisostepu Ukrayiny. *Zbirnyk tez dopovidey: IV Vidkrytyy zyizd fitobiolohiv Prychornomorya prysvyachenyy yuvileyu profesora Mykhayla Fedosiyovycha Boyka, 19 sichnya 2012.* Kherson, 62. [In Ukrainian]

Makhynya, L. (2015). Syntaksonomiya klasu *Bidentetea tripartitae* dolyny Dnipra (v mezhakh Lisostepu Ukrayiny). *Ukrayins'kyy botanichnyy zhurnal, 5(72),* 310–324. [In Ukrainian]

Makhynya, L., Strumens'ka O. (2010). Vydy rodu *Bidens* L. yak skladovi elementy pryberezhno-vodnykh uhrupovan'. Perspektyvy yikh vykorystannya u medytsyni ta farmatsiyi. *Materialy mizhnarodnoyi konferentsiyi molodykh uchenykh: aktual'ni problemy botaniky ta ekolohiyi, 21–25 veresnya 2010.* Yalta–Simferopol', 125–126. [In Ukrainian]

Marynych, O.M., Shychchenko, P.G. (2006). *Fizychna geohrafiya Ukrayiny: Pidruchnyk.* Kyiv: Znannya. [In Ukrainian]

Minarchenko, V.M. (2012). Resursy likars'kykh roslyn Ukrayiny: dyferentsiatsiya, dynamika, stratehiya optymizatsiyi vykorystannya ta zberezhennya. Kyiv: In-t botaniky im. M.H. Kholodnoho. [In Ukrainian]

Minarchenko, V.M., Timchenko, I.A. (2002). *Atlas likars'kykh roslyn Ukrayiny (khorolohiya, resursy ta okhorona).* Kyiv: Fitosotsiotsentr. [In Ukrainian]

Minarchenko, V.M., Minarchenko, O.M. (2004). *Metodyka obliku roslynnykh resursiv.* Kyiv: Virlen. [In Ukrainian]

Mitich, L.W. (1994). Beggarticks. *Weed technology, 8(1),* 172–175.

Morton, J. (1962). Spanish needles (*Bidens pilosa* L.) as a wild food resource. *Economic Botany, 16(3),* 173–179.

Mosyakin, S. (1988a). *Rid Bidens* L. (Asteraceae) u flori URSR. *Ukrayins'kyy botanichnyy zhurnal, 45(6),* 63–64. [In Ukrainian]

Mosyakin, S. (1988b). Znakhidka novoho dlya flory SRSR vydu *Bidens connata* Muehl. ex Willd. na Kyyivs'komu Polissi. *Ukrayins'kyy botanichnyy zhurnal, 45(2)*, 72–74. [In Ukrainian]

Poryvkyna, O.V. (1986). Severnaya lesostepnaya oblast' Dneprovskoy terrasovoy ravnynyi. *Fyzyko-heohrafycheskoe rayonyrovanye Ukraynskoy SSSR*. Kyiv: Kyev. Un-ta. [In Russian]

Protopopova, V.V. (1973). *Adventyvni roslyn lisostepu i stepu Ukrayiny*. Kyiv: Naukova dumka. [In Ukrainian]

Protopopova, V.V. (1991). *Synantropnaya flora Ukrayiny y puty ee razvytyya*. Kyiv: Naukova dumka. [In Ukrainian]

Salo, L.P. (1972). Itogi raboty VILR po izucheniyu norm vyhoda suhogo lekarstvennogo syr'ya iz svezhesobrannogo. *Resursy dikorastushchih lekarstvennyh rastenij SSSR., 2*, 31–36. [In Russian]

Shreter, A.I. (1986). *Metodika opredeleniya zapasov lekarstvennyh rastenij*. Moscow: Izdatelstvo CBNTIleskhoza. [In Russian]

Tsarenko, O.M., Zlobin, Y.A., Sklar, V.G., Panchenko, S.M. (2000). *Komp'yuterni metody v sil's'komu hospodarstvi ta biolohiyi: navch. posibnyk*. Sumi: Universytetska knyga. [In Ukrainian]

Vasileva, N., Papchenkov, N.V. (2011). Mehanizmyi vozdeystviya invazionnoy *Bidens frondosa* L. na aborigennyie vidyi cheredyi. *Rossiyskiy Zhurnal Biologicheskih Invaziy, 1*, 15–22. [In Russian]

Venkateswarlu, S., Panchagnula, G.K., Subbaraju G.V. (2004). Synthesis and antioxidative activity of 3',4',6,7-tetrahydroxyaurone, a metabolite of *Bidens frondosa*. *Bioscience Biotechnology Biochemistry, 68(10)*, 2183–2185. DOI: 10.1271/bbb.68.2183

Vernander, N. (1986). Pochvyi lesostepnoy zonyi. *Priroda Ukrainskoy SSSR. Pochvyi*. Kyiv: Naukova dumka. [In Ukrainian]

Vinogradova, Y.K. (2003). Rol effekta osnovatelya pri formirovanii vtorichnogo areala *Bidens frondosa* L. *Tez. dokl. 11 Mezhdunar. sovesch. po filogenii rasteniy*. Moscow: Izdatelstvo Tsentra ohranyi dikoy prirodyi. [In Russian]

Vinogradova, Y.K., Mayorov, S.R., Horun, L. (2009). *Chernaya kniga floryi Sredney Rossii: chuzherodnyie vidyi rasteniy v ekosistemah sredney Rossii*. Moscow: Izdatelstvo GEOS. [In Russian]

Voytyuk, Y. (1999). Suchasnyy stan ta struktura psamofil'nykh florotsenotychnykh kompleksiv Serednoho Prydniprov'ya. *Ukrayins'kyy fitotsenolohichnyy zbirnyk. Ser. A, 1/2*, 9–19. [In Ukrainian]

Yakovleva, G.P., Blinovoy, K.F. (2004). *Lekarstvennoe rastitelnoe syire. Farmakognoziya: ucheb. posobie*. St. Petersburg: Izdatelstvo SpetsLit. [In Russian]

Abstract

The article concentrates on the investigation of *Bidens frondosa* L. resources in the Dnipro River bottomland as a promising substitute of *B. tripartita* L. due to its phyto-resources deterioration on the territory of Ukraine. The features of their distribution, ecological and cenotic components, and these species reserve at the most perspective raw material significant territories are identified. Threat factors for *B. tripartita* resources are clarified. The research was performed on the basis of the method of registration plots with the subsequent calculation of the biological and operational reserves and the possible volume of the annual collection of dry raw material. Registration plots were diagonally located on the area occupied by the community of species. In the extended areas they are placed as parallel or separated transects. *B. frondosa* plant raw material reserve is established and the decrease for *B. tripartita* is proved. In connection with the increase of *B. frondosa* resource base, the prospects of using its raw material as a successful substitute of *B. tripartita* are justified. Corresponding proposals are submitted to the Ministry of Ecology and Natural Resources of Ukraine.

Key words: *Bidens frondosa*, *B. tripartita*, bottomland, Dnipro River, raw material

Received: [2016.05.29]

Accepted: [2016.09.04]

Uczep amerykański *Bidens frondosa* L. ocena zasobów w terasie rzecznej Dniepru (w zasięgu lasostepu Ukrainy)

Streszczenie

Artykuł dotyczy badań zasobów uczepu amerykańskiego *Bidens frondosa* L. w terasie rzecznej Dniepru jako ekspansywnego następcy uczepu trójlistkowego *B. tripartita* L., w połączeniu z pogorszeniem fito-zasobów drugiego z wymienionych gatunków na terenie Ukrainy. Określono cechy ich rozmieszczenia, ekologiczne i cenotyczne składniki oraz ich rezerwuar gatunkowy na znacznej części badanego terenu. Sprecyzowano również czynniki zagrożenia zasobów dla *B. tripartita*. Badania przeprowadzono w oparciu o metodykę poletek z późniejszym wyznaczeniem biologicznych, operatywnych zasobów oraz wielkości pozyskania rocznego surowca suchej masy. Stałe poletka były rozmieszczone diagonalnie na obszarze zajmowanym przez zbiorowiska z tymi gatunkami. Na rozległych powierzchniach były one umiejscowione w równoległych lub odrębnych transektach. Zasoby surowca roślinnego *B. frondosa* okazały się być stabilne, a ich obniżanie udowodniono u *B. tripartita*. W połączeniu ze wzrostem bazy surowcowej *B. frondosa*, perspektywy wykorzystania jego surowca jako substytutu *B. tripartita* są uzasadnione. Stosowne wnioski złożono do Ministerstwa Ekologii i Zasobów Naturalnych Ukrainy.

Słowa kluczowe: *Bidens frondosa*, *B. tripartita*, terasa rzeczna, Dniepr, surowiec zielarski

Information on the author

Larysa M. Makhynia

Currently she is researching the species of the genus *Bidens* L. resource evaluation in the Dnipro River bottomland (in range of the forest steppes of Ukraine). Also, she investigated the distribution, ecological and cenological features of new association communities of *Bidenti frondosae – Bidentetum connatae*. She has previously examined distribution, ontogeny, ecology, cenology, ecolo-cenotic strategy of the genus *Bidens* (*B. tripartita* L., *B. cernua* L., *B. frondosa* L., *B. connata* Muehl.).