Thaiszia, Košice, 3:31 - 52, 1993

Synanthropic occurrence of *Taraxacum bessarabicum* in Košice, Eastern Slovakia *

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MIKOLÁŠ V. et MIHOKOVÁ L. (1993): Synanthropic occurrence of *Taraxacum bessarabicum* (HORNEM.) HAND.-MAZZ. in Košice, Eastern Slovakia. - Thaiszia, Košice, 3:31 - 52. - ISSN 1210-0420.

ABSTRACT: *Taraxacum bessarabicum* is a species with wide area, limited to subhalophyte and halophyte plant communities from France to NW. China and NE. Mongolia. On the territory of Slovakia, its occurrence is concentrated to the southern part, which forms northern extension of its distribution in the Pannonian Basin. A new finding comes from the Košice Basin, were it grows as a synanthropic species. Its variability is briefly analysed and the karyology of the species studied as well. On its new habitat studied it behaves as an epekophyte growing always within the reach of magnesite pollution on antropogenous soils usually without vegetation or with loosen plant cover, which is represented by degradation stages of various synanthrope communities convergating under the influence of decisive factor - magnesite pollution. Its behaviour is compared with that of *Puccinellia distans*, very aggressive species, which belongs to the most expansive species on certain synanthropic habitats and with which *T. bessarabicum* often grows together.

KEYWORDS: *Taraxacum bessarabicum*, *Asteraceae*, synanthropic occurrence, variability, karyology, Eastern Slovakia.

Introduction

Taraxacum bessarabicum (HORNEM.) HAND. - MAZZ. belongs together with *T. anatolicum* VAN SOEST, *T. pachypodum* LINDB. and *T. gaditanum* TALAVERA to the sect. *Leptocephala* VAN SOEST. (Distribution map of the sect. cf. DOLL, 1982, p. 555, Fig. 3. and JÄGER in MEUSEL et JÄGER 1992). The species of the section are characterized by slender appearance, significant glabrescence, little capitula, yellow flowers, exterior ligules striped red-brown on their outer side and achenes with rostrum and reddish pappus. The taxonomy of the species of the

* paper is dedicated to the memory of RNDr. Peter ČERNAJ, CSc (1953-1993).

section is not solved completely. According to DOLL (op. cit., p. 560) *T. bessarabicum* subsp. *gumusanicum* VAN SOEST, described from NE. Anatolia, can be of a hybrid origin, regarding red-brown colouring of achenes. *T. pachypodum* from W. Morocco and SW. Algeria is, according to the same author, close to *T. bessarabicum*, but differs by more divided leaves, lighter pappus and small achenes. The same author does not exclude its hybrid origin either. This species was separated from the area of *T. bessarabicum* in Pleistocene and it could have arisen as a result of hybridization of *T. fulvipile* HARV. in HARV. et SONDER and *T. bessarabicum*.

The section, regarding its specific ecology (halophytes), evolved probably in northern part of Asia Minor, where three of its taxa occur and from where the section members spread as far as W. Europe and NW. Africa. Later change of climate separated parts of the distribution range in NW. Africa (*T. pachypodum*), SW. Spain (*T. gaditanum*) and France (sometimes separated as an independent species *T. salsugineum* LAMOTTE), sometimes probably connected with hybridization, as discussed above. Autogamy, which has developed at *T. bessarabicum* may be connected with the accommodation of plants to expansive spreading in loosen (or uncovered, respectively) halophyte habitats.

General distribution of the species

The species is distributed from France, northwestern and central Bohemia (cf. distribution maps in TOMAN 1976, KUBÁT 1986), greater part of Pannonian Basin in Hungary (here the European distribution of the species is concentrated), reaching Lower Austria (FÜRNKRANZ 1960, with map of the distribution), southern Moravia (GRULICH 1987, distrib. map), southern and southwestern Slovakia, SE. Poland (adventive occurrence) over southern and central parts of Ukraine, Romania, Moldavia, Bulgaria (KOTSCHEV 1984, distrib. map) and Serbia (Voyvodina), Crimea, Asia Minor, southern and southeastern part of European Russia (it reaches Southern Ural), to northwestern, southwestern and northern Iran, northern Ciscaucasia, Transcaucasia, northern and northeastern Afghanistan, the adjacent part of Pakistan, northwesternmost part of India (Karakoram), in Siberia as far as Baycal, and northwards to about 57° of northern latitude, further it is scattered in the territories of former Soviet Central Asia (Turkmenistan, Uzbekistan, Kirghizstan, Tadjikistan, Kazakhstan; ORAZOVA 1975, map of distrib.), northwestern China (Xinjiang province) and northeastern Mongolia (as far as about 108° E. longitude). The occurrence in South Africa (since 1820) is secondary. [The distribution in this paragraph was set on the basis of following works: FÜRNKRANZ 1960, GAJIĆ 1975, GEYDEMAN 1986, GRUBOV 1982, HUGHES et RICHARDS 1989, KIRSCHNER et ŠTĚPÁNEK 1983, KOTOV 1965, 1987, KOTSCHEV 1984, MEUSEL et JÄGER 1992, NYARADY 1965, ORAZOVA 1975, PESHKOVA 1979, RICHARDS et SELL 1976, SHISHKIN 1964, SHUROVA 1989, SOÓ 1970, TACIK 1980, TAKHTADZAN, FEDOROV et al. 1972 and TZVELEV 1989].

Occurrence of the species in Slovakia

The distribution of the species in Slovakia is bound to the Podunajská nížina lowlands (the distribution is summarized in the work of KRIST{1940, map no. 8}), it is given altogether from 32 localities that are spread in the belt NW. of Nové Zámky (the northernmost reach Galanta), in eastern part of Žitný Ostrov (W.of Komárno) and W. and NW. of Štúrovo, one new locality is given in the work of SVOBODOVÁ (1972) - Poľný Kešov S. of Nitra. DOSTÁL (1989) mentions its occurrence in Záhorská nížina lowlands, but GRULICH (pers. comm.) has not confirmed it recently. The species is absent in halophyte localities of Spišská kotlina basin, too.

In E. Slovakia (cf. Fig. 1) the species occurs (or, in many cases, occurred, to be exact) predominantly on East-Slovakian Lowlands. The following survey has been compiled on the basis of papers of VICHEREK (1964, 1973), DOSTÁL (1989) and supplemented with one record from the paper of MAŤAŠ et MOCHNACKÝ (1983).

1) Košice, 2) Sol, 3) Kuzmice, 4) S. of Novosad, 5) W. of Šamudovce, 6) 2 km E. of Malčice, 7) 1km NW. of Veľké Raškovce, 8) W. of Malé Raškovce, 9) NW. part of Slavkovce (Slavkov), 9a) NW. of Zemplínske Kopčany (absent on the map, very close to loc.9), 10) S. of Veľký Kamenec, 11) 3 km W. of Strážne, on the beach of a dead branch of Karč, 12) E. of Somotor.

The species is included among the critically endangered species of Slovak flora (category C I) (MAGLOCKÝ 1983).

Phytocoenology and ecology of the species in natural vegetation

According to SOÓ (1980) and JURKO (1990) it belongs among the species tolerant to the soils with high salt content, it is nitrophobic, xero- to mesophile, basoclinal and subtermophile. The nitrophoby given is doubtful, because the species is recorded from village green, often probably with nitrified soils and it is perhaps plastic enough in its relation to nitrogen content.

In Slovakia the species occurs in various halophyte and subhalophyte vegetation of the classes *Festuco - Puccinellietea*, *Isoëto-Nanojuncetea*, *Molinio-Arrhenathеretea*, and *Phragmiti-Magnocaricetea*. The richest occurrence is in *Festuco - Puccinellietea*, of which it is the characteristic species and where it can be found in communities of three orders: *Artemisio-Festucetalia pseudoovinae*, *Festuco-Puccinellietalia* and *Scorzonero-Juncetalia gerardii* in corresponding three alliances *Festucion pseudovinae*, *Puccinellion limosae* and *Scorzonero-Juncion* and it grows in four associations here: *Statico gmelinii - Artemisietum monogynae*, *Plantagini tenuifoliae - Pholioretum pannonici*, *Puccinelietum limosae* and *Scorzonero parviflorae - Juncetum gerardii*. In the classes *Phragmiti - Magnocaricetea* and *Isoëto - Nanojuncetea* it occurs in both in one

association: *Astero panonici - Bolboschoenetum compacti*, or *Cyperetum pannonici*, resp. In *Molinio - Arrhenatheretea (Agrostietalia stoloniferae, Loto - Trifolion*) it is present in three associations: *Loto - Potentilletum anserinae, Agrostio - Caricetum distantis and Trifolio - Caricetum divisae.*

In Hungary it is given from the same communities. In addition, it occurs in *Thero - Suedetalia, Nanocyperetalia, Molinietalia, Beckmannion eruciformis* and *Puccinellion peisonis*.

In Eastern Slovakia, its occurrence is limited to East-Slovakian Lowlands and four associations: *Puccinellietum limosae, Plantagini tenuifoliae - Pholioretum pannonici, Statico gmelinii - Artemisietum monogynae and Agrostio - Caricetum distantis (Festuco - Puccinellietalia and Molinio - Arrhenatheretea*). The occurrence of the species in smaller number of associations in E. Slovakia is connected with geographical position of East-Slovakian Lowlands, which represents the northernmost extremity of Great Hungarian Lowlands (Alföld), therefore the halophyte vegetation is, when compared with Hungarian (but also with west-Slovakian) rather impoverished and even this impoverished fragment of halophyte vegetation was mostly destroyed by large and ill-judged meliorations. The survey is according to SOÓ (1970, 1973), VICHEREK (1973), nomenclature according to BALÁTOVÁ-TULÁČKOVÁ (1986), MUCINA (1986 B), MUCINA et MAGLOCKÝ (1986a,b), SOÓ (1964) and ŠPANIKOVÁ et al. (1986).

Synanthropic distribution of the species in Košice

Exclusively synanthropic occurrence of the species is not recorded in literature. TOMAN (1976), ŠTĚPÁNEK et KUBÁT (1990), GRULICH (1987) give it, in some cases, directly from villages, or railway stations, respectively. KUBÁT (1987, p. 14) points out that *Taraxacum bessarabicum* can survive in NW. Bohemia only on trampled and grazed areas in villages, and thus he confirmes certain apofytization of the species. It is, however, the occurrence very close to natural localities of the species. The same case can be found in KOSTYLEV (1992), who gives the species from two ruderal associations: *Achilleo millefoliae - Grindelietum squarrosae* (invalidly published name) and *Hordetum murini* LIBBERT 1932 (syn. *Bromo - Hordeetum murini* (Allorge) Lohm. 1950). The occurrence is probably accidental, even if synanthropic here.

The presence in Košice is characteristic by the absence of the species in natural communities of the Košice Basin and thus by exclusively anthropic, abundant occurrence .

The species was collected for the first time by the first author in 1987. Neither KRIPPELOVÁ (1974, 1981), nor HAJDÚK (e.g. 1961) nor HOLUB (1956) give it from the territory, probably it was omitted and mistaken for *Taraxacum "officinale"* (*Taraxacum* sect. *Ruderalia*). Because the species is widespread in Košice at the present time, it can be supposed to grow here for quite a long period. The occurrence of the species in Košice is represented on the Fig. 2. The

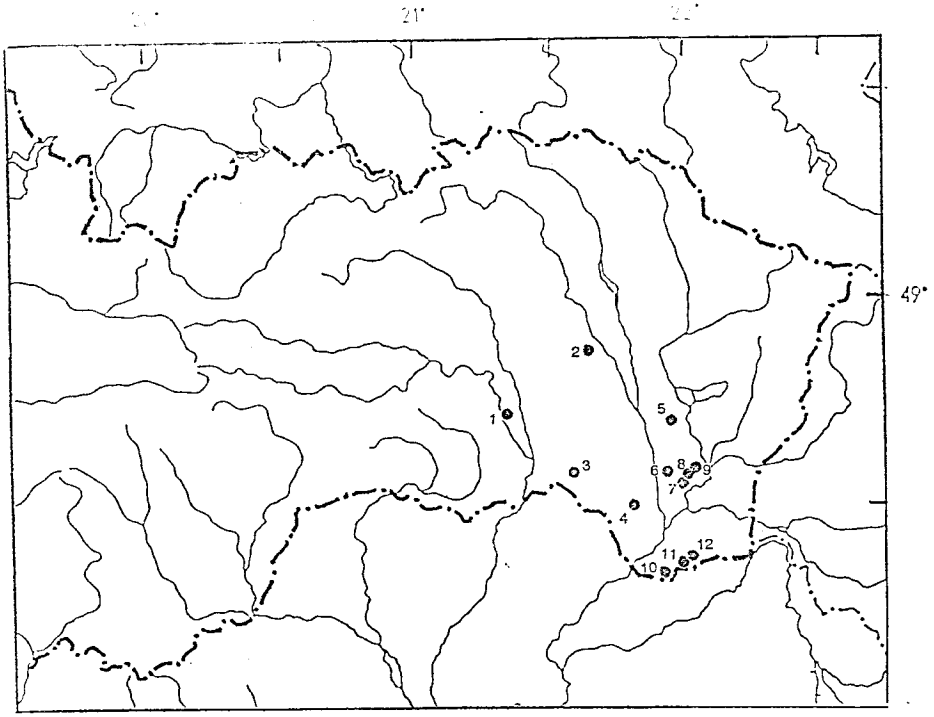

Fig. 1. Distribution of *Taraxacum bessarabicum* (HORNEM.) HAND. - MAZZ. in Eastern Slovakia.

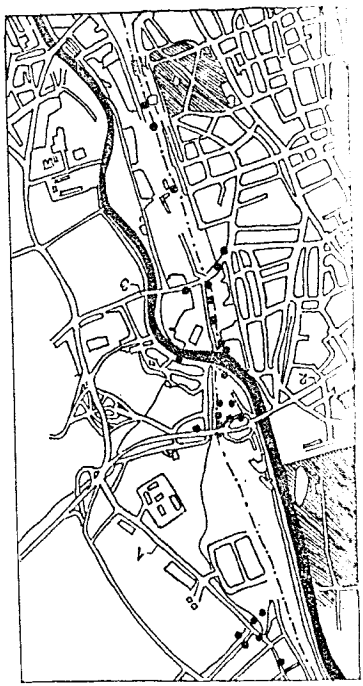

Fig. 2. Synanthropic distribution of *Taraxacum bessarabicum* (HORNEM.) HAND. - MAZZ. in Košice (1. Magnezitárska Street; 2. Hlinkova Street; 3. Rampová Street).

map shows that the occurrence of the species is concentrated to the belt between the post-office building (northwards from the main railway station in Košice) and Ťahanovce village (now part of Košice on its northeastern border), with the local centres of the occurrence between railway crossing about 1 km northwards from the main railway station and the Duklianskych hrdinov (Hlinkova) street and between magnesite plant in Ťahanovce and Ťahanovce village. The occurrence of the species in this belt is connected partly with the influence of prevailing northern winds bringing magnesite pollution from magnesite plant situated in northern direction, partly with the presence of greater number of suitable habitats near railway track and on river embankments of Hornád. The research of the species distribution has not been detailed, so the occurrence can be supposed probably between Hlinkova street and magnesite plant, too.

The list of localities:

On account of better arrangement the occurrence of the species was divided in four parts:

1) between the post-office north of the main railway station in Košice and the crossing of Košíková (Alwinczyho) - Rampová streets: Košice, the post-office, near the railway line, 17. 9. 1989 (KO) (all leg. V. Mikoláš); along the railway track, about 100 m north of the above locality, dtto.

2) between the crossing Košíková (Alwinczyho) - Rampová streets and the river Hornád (railway crossing): near railway line behind railway crossing, by the right side of Hornád, plentiful, 3. 10 .1987 (KO); crossing Rampová - Košíková streets and above it, sandy gravel, 23. 10. 1988 (KO), 17. 9. 1989 (obs.), 10. 9. 1992 (KO); between Hornád and the previous locality, 17. 9. 1989 (obs.), 10. 9. 92 (obs.); the right side of the river Hornád, gravel embankment near railway crossing (Medzi mostami street), 17. 9. 1989, (KO), 20. 10. 1990 (obs.);Košíková Street, near the crossing, 10-15 blooming plants, 17. 9. 1989 (obs.); Košíkova Street, in front of the gate to the "Drobný tovar" enterprise stock, 17. 9. 1989 (KO), 20. 10. 1990 (obs.); Rampová street, near coal stock, 4 blooming plants, 17. 9. 1989 (obs.).

3) behind the railway crossing of the river Hornád (left side) to Hlinkova ulica street: left side of Hornád (Northern Embankment), outer bank of Hornád, 17. 9. 1989 (obs.); mouth of the spring Moňok to Hornád (Northern Embankment), 20. 10. 1990 (obs.); near the railway line of northern railway bridge over Hornád, 20. 10. 1990 (obs.); near the road to Prešov - opposite Magnesite Plant, 4 plants, 20. 10. 1990 (obs.), under the road bridge close to previous locality, dtto, (KO); near the brooklet under the road crossing (in the direction of Prešov) near the railway line, 20. 10. 1990 (obs.), not far from previous locality by the railway line, 1 plant, dtto; by the town bus stop behind railway viaduct (opposite previous locality in the direction of Prešov), 26. 10. 1991 (KO); in front of Poľnostav (southwards from Hlinkova street, between Hornád and railway crossing), 20. 10. 1990 (obs.); near petrol station (Hlinkova street, between Hornád and railway viaduct) - up to road viaduct over railway, 17. 9. 1989 (obs.), 20. 10. 1990 (obs.), 26. 10. 1991.

4) Ťahanovce area - village and in the surroundings of Magnesite Plant: in front of the Magnesite Plant gate, 17. 9. 1992 (obs.); along the road to Ťahanovce village, north of previous locality, dtto; railway crossing north of previous locality, plentifully on both sides of road, dtto, (KO); along the railway track to Magnesite Plant northwards, 14. 10. 1989 (KO), 17. 9. 1992, plentifully (obs.); between south border of Ťahanovce and railway track to Magnesite Plant, 14.

10. 1989 (obs.); Ťahanovce, SSE. part of the village, Pri Hrušove street, ruderalised lawns, 21. 9. 1989 (KO); dry brooklet near Pri Hrušove street in Ťahanovce, 14. 10. 1989, 30. 9. 1990 (KO); Ťahanovce, Zberné suroviny salvage, Magnezitárska street, 14. 10. 1989 (obs.); in the village along the street Magnezitárska, 21. 9. 1989 (obs.); Ťahanovce, Magnezitárska street near the crossing with the street Pri Hrušove, plentifully, 17. 9. 1992 (KO); Ťahanovce, 36, Želiarska Street, 13. 10. 1992 (KO), dtto along all the street.

Variability of the species

Literature data

The literature mentioned was used as the source of the data on distribution also to excerpt and summarize the data on variability of the species. They show significant variability of the species, especially as far as the fruit size and spinule density, transition of fruit body to the cone and the transition size, rostrum and the pappus colouring are concerned. In some cases it cannot be excluded that variability given in literature includes also other species.

Leaves: from almost entire to acutely dentate.

Inner bracts: more or less black-green, with narrow white margin, or, with wider margin as well; longitudinally linear, twice longer than outer bracts.

Outer bracts: narrower, lanceolate to linear-lanceolate; semi-patent to patent, with broad white margin; reddish coloured.

Exterior ligules: orange coloured.

Fruit colour: (light)grey-brown, brown - light grey, light grey, grey, grey - bronze.

Pappus colour: brownish to rosy, brownish-reddish-whitish, with reddish tinge, beige, grey-white, brownish, greyish tinge.

Fruit length (including pyramid): (4)5 - 5.5 mm

The transition of the body to cone: gradual; abrupt.

Cone length: (0 - 0.5) 0.8 - 1.1 - 1.4 - (1.6) mm

Rostrum length: (2) - 3 - 4 - 5.5 (6) mm

Pappus length: 4.5 - 5.5 mm

Fruit spinulosity: minute and acute below the cone; quite long , acute in the upper part of fruit; with scanty spinules in the upper part of fruit; finely spinulose in the upper part; with scanty, minute, thin and acute spinules in upper part; scantily spinulose to smooth fruits.

Our observation of plants from Košice

Leaves: from almost entire to abundantly dentate (cf. Fig. 3).

Inner bracts: black to black-green with marked narrow to wide white margin (up to 0.35 mm), 1.0 - 1.3 - 1.5 - 1.8 - (2.3) mm wide (Fig. 4c).

Outer bracts: very narrow, 0.5 - 0.7 - 1.0 - (1.2) mm wide , brown-grey coloured, often purplish, clasped semipatent to patent, with quite wide to wide, white,

sometimes brownish - membraneous margin (margin wide up to 0.2 - (0.4) mm). (cf. Fig. 4b).

Exterior ligules: orange.

Scapes: sometimes violet coloured.

Fruit colour: grey-brown (yellowish).

Pappus colour: brownish-yellow coloured to yellow-brown-(red) coloured, usually red tinge is noticeable.

Fruit length (including cone): (3.7) - 4.5 - 4.7 - 5.5 - (6.5) - {7.0} mm.

The transition of body to cone : in some cases marked, in the other cases gradually narrowed.

Cone length: (0.1) - 1.0 - 1.2 - 1.5 - (1.8) -{2.5} mm.

Rostrum length: {1.7} - (2 - 2.5) - 2.8 - 3.2 - (3.5) - {4.2-5} mm.

Pappus length: (5) - 5.3 - 5.5 - 6 mm .

Fruit spinulosity: long and densely spinulose (spinules long up to 0.4 mm) to almost smooth.

The most of the characters observed and measured are in accordance with literature data. More significant differences were found in the rostrum length - shorter (2.8 - 3.2 mm) than in literature (3 - 5.5 mm) and in the pappus length - slightly longer (5.3 - 6 mm) in the populations from Košice city in comparison with literature data (4.5 - 5.5 mm).

Karyology of the species

Material and methods

For the analysis of both chromosome number and karyotype, seed samples from the specimens from three localities (under the road bridge on the road to Prešov, opposite to Magnesite Plant, Košice, 20. 10. 1990; Pri Hrušove street in Ťahanovce, 30. 9. 1990; Želiarska Str. 36, Ťahanovce, 13. 10. 1992; all leg. V. Mikoláš) were used. The specimens are deposited in KO. Meristems were obtained from root tips. As a pretreatment agent 0.05% colchicine was employed for 1.5 h, material was fixed in acetic ethanol (1:3) and acetic-orcein squashes were made. The slides were framed with Noyer's rosin - lanolin cement (cf. NĚMEC 1962), the best metaphase plates were chosen and photographed at the magnification 3.2 x 100. The photographs were compared with corresponding metaphase plates under the microscope and details were drawn, so that they could be used in further karyotype studies. 11 metaphase plates were chosen for detailed analysis - the chromosome length and arm index (the relation of longer arm to shorter) were employed to identify the chromosomes, to arrange homologous pairs according to the length and to construct a preliminary idiogram. Silver staining of nucleoli according to HOWELL and BLACK (1980) was employed to confirm the satellite number.

Fig. 3. Variability of leaves of *Taraxacum bessarabicum* (HORNEM.) HAND. - MAZZ. in Košice.

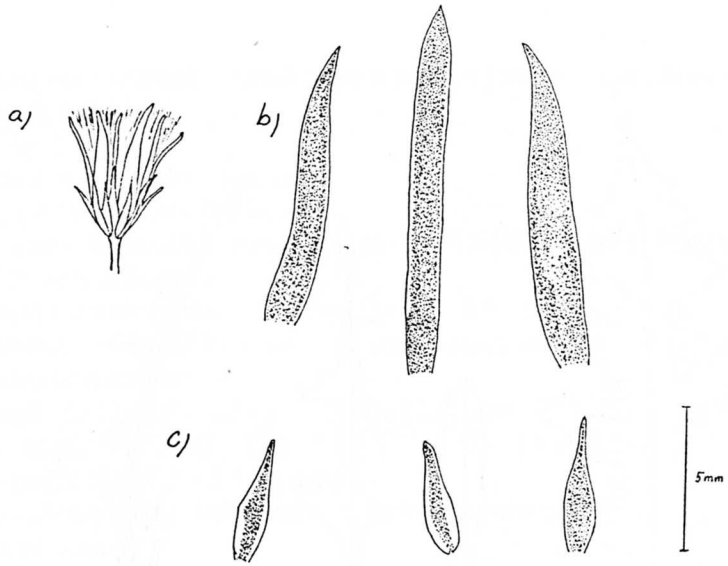

Fig. 4. *Taraxacum bessarabicum* (HORNEM.) HAND. - MAZZ. a) capitulum, b) outer bracts, c) inner bracts.

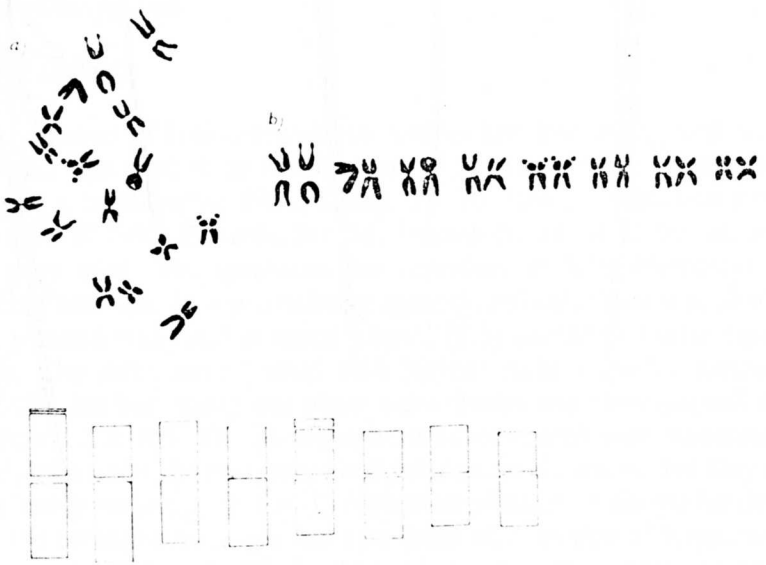

Fig. 6. *Taraxacum bessarabicum* (HORNEM.) HAND. - MAZZ. a) c-metaphase, b) chromosomes arranged in homologous pairs, c)draft idiogram.

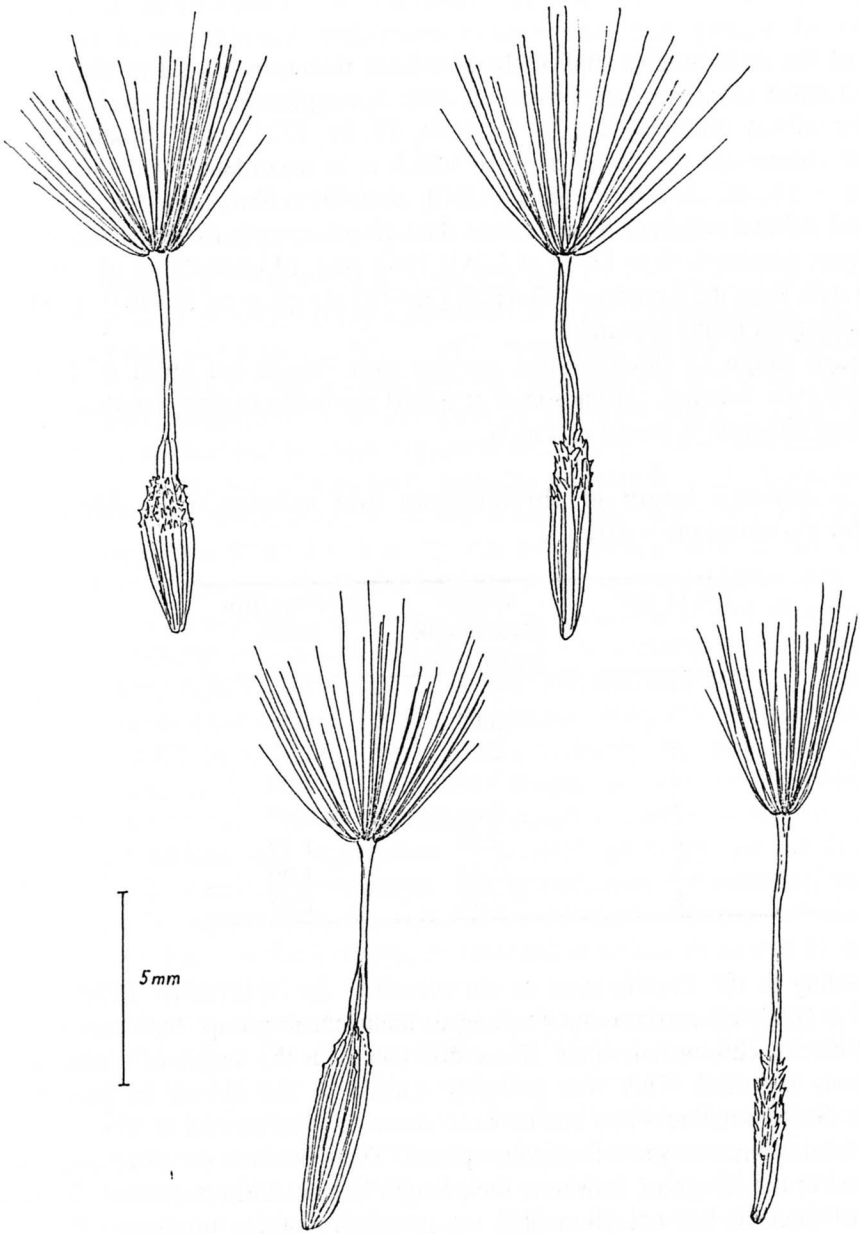

Fig. 5. Variability of fruits of *Taraxacum bessarabicum* (HORNEM.) HAND. - MAZZ. in Košice.

Results

All of the seed samples studied (besides from the above localities also from Hlinkova street [Duklianskych hrdinov street], 2 samples near the road viaduct above the railway track, Košice, 26. 10. 1991, 17. 11. 1991, leg V. Mikoláš) had the same chromosome number 2n = 16 which is in accordance with literature data: 2n = 16, cf. AGAPOVA [ed.] (1990), data from Armenia, Kazakhstan, southern Ural and southern Siberia, next data (5 references) from the Europe - 2n=16 were summarized in LÖVE et LÖVE 1961 (see. MÁJOVSKÝ et al. 1987); addition data from the territory of Slovakia (2n=16) are given by DVOŘÁK (1979) from Podunajská nížina lowlands.

Average length of chromosomes, average arm indices are given in Tab.1; metaphase plate drawing, chromosomes arranged according to their length and the preliminary idiogram is shown on Fig. 6.

Tab. 1 - Average length of chromosomes and average arm indices of particular chromosome pairs.

No. of pair	average chromosome length (mm)	average arm index
1	3.30	1.14
2	3.03	1.65
3	2.67	1.20
4	2.66	1.50
5	2.61	1.08
6	2.38	1.49
7	2.21	1.09
8	2.31	1.32

According to the classification of chromosomes by NEMTZEVA 1970 (see. PAUSHEVA 1980) all chromosomes belong to metacentric group. Satellites were observed on 5th chromosome pair. Some differences in the length of secondary constrictions occurred. This was probably caused in the course of material treatment. Small satellite - like bodies were observed also on one or two of the longest chromosomes in some metaphase plates. Their position on chromosomes is indicated in the idiogram, however, their length has not been measured. Silver staining of nucleoli has not eliminated the possibility of the presence of four satellites in the karyotype studied.

When compared with DVOŘÁK (1979), some differences occurred: the differences in morphology were observed - in the case of DVOŘÁK (op. cit.) two submetacentric chromosomes occurred and TARNAVSCHI 1938 (see. op. cit.)

gives even subtelocentric and telocentric chromosomes in the material from Romania. In our case only metacentric chromosomes were present. No notes on more than one satellite pair are given by DVOŘÁK (op. cit.). In our case, the chromosomes were little longer as well. This was probably caused by the different pre-treatment.

Eco-phytocoenological conditions of the localities with *Taraxacum bessarabicum* in Košice (in comparison with the species *Puccinellia distans*)

The species is indisputably well-naturalized on its habitats in Košice and it behaves as an epekophyte (fully naturalized in unnatural vegetation), up to very slight hemiagrophyte (the species partly penetrating natural vegetation), when only close flora of Košice is taken into the consideration. But from the point of view of East-Slovakian flora we can speak about kenapophyte (a species growing besides natural communities also in pioneer synanthropic ones) to leimonapophyte (apophyte penetrating to perennial synanthropic stands - cf. SUDNIK-WÓJCIKOVSKA, KOŹNIEVSKA 1988). It occurs always within the reach of pollution by Slovak Magnesite Plant (cf. Fig. 2) and as a subhalophyte it has unlimited possibilities of the growth on the habitats with very loosen plant cover. With regards to its halophility and production of great number of diasporas with pappus that enable it to spread efficiently, it can be included among plants of s-r strategy. Very high variability of the species was observed in Košice. Its origin, however, is not clear enough, because the species belongs to obligatory autogams (HUGHES et RICHARDS 1988). A part of this variability, esp. of leaves may due to plasticity caused by habitat conditions, ontogenetic stage or by phenological phase. Genetic variability can be further widened and modified more or less only by recombinations and segregation in meiosis, provided that at least little heterozygosity occurs in populations, and by mutations, the increased number of which can be supposed in the polluted environment. Primary introduction of several pure lines on the territory, or repeated introduction cannot be excluded, too.

The influence of magnesite pollution on the vegetation and flora in Slovakia was studied by HAJDÚK (cf. e.g. 1961, 1974), KALETA (1974, 1984a, 1984b etc.) and KRIPPELOVÁ (e.g. 1974, 1981). One of the most important species, that remarkably expands on such localities is *Puccinellia distans* (nomenclature of the species is usually according to DOSTÁL 1989). This species was discovered in Košice already by HOLUB (1956) as quite plentiful in the whole town. HAJDÚK (1961) found out significant changes of the vegetation within the reach of magnesite pollution by the plant in Ťahanovce. Some places lacked vegetation at all, or only resistant species *Agrostis stolonifera, Elytrigia repens, Carex distans, Puccinellia distans* remained. HAJDÚK (1974) even gives the latter species from pine forests near Ťahanovce (Viničná hill). Ruderal and weedy

species are prevailing in phytocoenoses here and associations are convergently transformed under the influence of magnesite pollution (HAJDÚK 1961). This author gives also (op. cit., p. 414) positive indicators of air and soil pollution by magnesite pollutants : *Agrostis stolonifera, Puccinellia distans, Elytrigia repens.* KALETA (1974) mentions the following resistent species (from the surroundings of Jelšava in eastern Slovakia, where magnesite plant is present, too): *Agrostis stolonifera, Calamagrostis epigejos, Cirsium arvense, Convolvulus arvensis, Carex hirta, Deschampsia cespitosa, Elytrigia repens, Equisetum arvense, Melandrium pratense*, and, above all (again) *Puccinellia distans* which is a positive indicator and forms monocoenoses here.

KALETA (op.cit.) mentions also *Taraxacum* sect. *Ruderalia* (as *T. officinale*) as a tolerant species. The same author (KALETA 1984a, 1984b), while studying the degeneration of meadow associations (Jelšava) discovered the prevalence of *Carex distans, Elytrigia repens, Puccinellia distans, Convolvulus arvensis*, or, as the case may be, *Falcaria vulgaris* and *Chenopodium glaucum*. Monocoenoses of *Carex distans*, *Puccinellia distans* and *Elytrigia repens* are formed. Forest associations are degrading to associations with *Elytrigia repens, Sonchus arvensis, Puccinellia distans, Silene vulgaris* and *Calamagrostis epigejos* as well.

The distribution and phytocoenological behaviour of the species *Puccinellia distans* was studied (on the territory of Košice) by KRIPPELOVÁ (1974). The species was also found on magnesite dump on Bankov NW. of Košice (MIHALIČOVÁ 1970) and it is spreading in nearby Prešov city as well (KRČOVÁ 1992). KRIPPELOVÁ 1971 (sec. KRIPPELOVÁ 1981) described the association *Puccinellio-Chenopodietum glauci*, which is evaluated by Kopecký, within his deductive method (cf. e.g. KOPECKÝ 1978), as a derived community *Puccinellia distans* - [*Chenopodion glauci / Polygonion avicularis*](KOPECKÝ et HEJNÝ 1991, p. 368). According to KRIPPELOVÁ (1981) this association arises by impoverishment of richer associations of *Polygonion avicularis*. This association is final (climax) one on the soils with the influence of magnesite pollution. It can be followed (under the influence of further pollution) only by bare land. The average number of species in this association is 4 (maximum 7, minimum 2). The occurrence of the association in Košice can be found in the work cited on map no.8 (prevailing distribution in south to southwestern direction from the pollution resource is related to predominant wind direction in Košická kotlina basin).

Dominance and spreading of the species *Puccinelia distans* in the territory is undisputable. But this species could spread over many localities under the influence of winter road salting and under the influence of another anthropogenous factors as well. Numerous literature dealing with this problem is available (e.g. CUSICK 1982, DETTMAR 1992, DUVIGNEAUD et FASSEUX 1991, IGNATOV et al. 1990, JACKOWIAK 1982, KRACH et KOEPFF 1980, MIREK et TRZCINSKA-

TACIK 1981, PARFENOV et al. 1985 and cf. also references in the following). Significant resistance of the species to $MgCl_2$ was confirmed experimentally (KÜHNBERGER et MAHN 1976, STORDEUR 1980). PYŠEK (1972) mentions that its occurrence in Plzeň is concentrated on places with maximum fly-ash fall first of all. BILONOHA (1992) noted its occurrence on deposits near Lvov (northwestern Ukraine) and analyzed some of ecological reasons of its expansion. Beside the occurrence on neutral to slightly acid soils, he mentions it also on alkaline substrata from this area. On these substrata it shows particularly expansive character. Wide adaptability of the species is expressed by its ability to grow on slightly acid soils as well. BANASOVÁ et HAJDÚK (1986) synthesized data about some causes of the species spreading. The species was reported from the roads margins between Východná and Poprad (in northern Slovakia), first of all on southern margins, in insufficiently aerated soils with increased hardness and high content of alkaline elements. HAJDÚK found it near magnesite plant in Austrian Alps in 1000 meters above sea level (op. cit.). ŠMARDA (1961, p. 148) reports frequent occurrence of the species in the surroundings of Chemosvit plant in Svit (in northern Slovakia). In his opinion, it is caused by the occurrence of spilt salts used by the factory. However, HAJDÚK (1961, p. 414) speculates about the possibility that it is conditional on air pollution by CS_2, H_2S and another aspects of recent spreading of the species under the influence of environment deterioration can be found e.g. in HEINRICH et SCHÄLLER (1987) and WEINERT et AL - HILLI (1987). Great plasticity of the species, its quick development (with late beginning), blooming several times a year (till November), easy spread by anemochory and antropochory and present spread of free (uncovered) areas in the country often with increased salt content enables us, at least partially, to understand its fast expansion in last years (cf. HEINRICH 1984, JACKOWIAK 1984, etc., own observations as well). The expansion of the species is further supported by another factors, e.g. by its resistance to fluorine pollution (cf. HADAČ et al. 1983, KONTRIŠOVÁ 1980).

On the contrary, the distribution of *Taraxacum bessarabicum* is confined to the territories with the influence of magnesite pollution, and it has much smaller distribution in Košice than *Puccinellia distans*. Preliminary studies of eco-phytocoenological conditions on several localities in Košice have been done as well. The species occurred most frequently on sandy and gravelly soils near railway lines and in their close surroundings, and also on sandy embankment of Hornád river and in the chinks of embankment stones that harden its bed. The occurrence analysed confirms its slightly xerophytic nature. Usually it occurs on dry soils or soils more easily drying and sunny habitats. It suffers from the competition of other species, and that is why it does not enter the associations of aggressive species.

Phytocoenologically it is possible to observe relations to *Puccinellio-Chenopodietum glauci*. *Puccinellia distans* is usually present (this species is able, however to enter a number of communities, cf. previous analysis of its expansion), but *Chenopodium glaucum* and *Polygonum aviculare* s. l. are completely absent. These are probably the degradation stages of various associations that converged to very impoverished communities of species tolerant to intensive influence of magnesite pollution. The species can be found first of all on uncovered places, where it spreads, as a subhalophyte and s-r strategist, very well. It often grows in the association with *Puccinellia distans*, less often in incompact monocoenoses. The species *Elytrigia repens*, that is also resistant to magnesite pollution, forces it, as a c-strategist, out to the margins of its tuft, or, as the case may be, to places unoccupied by its individuals. On other localities it grows together with *Agrostis stolonifera*, the community of which it tolerates well. It is the variant on mesophytic habitats. The occurrence of other taxa (as e.g. *Taraxacum* sect. *Ruderalia, Carduus acanthoides, Potentilla anserina, Cirsium arvense, Lactuca serriola, L. saligna* etc.) has the character of surviving rests of vegetation of former stages, or these are the species with halophyte resistance, or, at least, tolerance (e.g.. *Potentilla anserina, Lactuca saligna*). The examples of the communities of the species investigated in Košice are given in Tab. 2.

Preliminary analyses make it possible to detect relations to certain phytocoenological units, which are, however, often very difficult to determinate. On mesophyte habitats *Taraxacum bessarabicum* grows together with the species of *Agrostietalia stoloniferae* and on the areas with lower coverage the species can be found in dependence on soil moisture and the presence of available diasporas together with species of *Atriplici-Sisymbrion, Onopordetalia* and *Arction lappae* (syntaxa nomenclature cf. BALÁTOVÁ - TULÁČKOVÁ et al. 1986, MUCINA 1986a, MUCINA et KRIPPELOVÁ 1986). It is obvious, that it would be possible to evaluate these communities as a derived ones (s. KOPECKÝ 1978). However, further investigation is required.

Beside the above species, the following ones occurred in the communities with *Taraxacum bessarabicum* in Košice: *Calamagrostis epigejos, Brachyactis ciliata, Senecio viscosus, Conyza canadensis, Kochia densiflora, Artemisia vulgaris, Setaria pumila, Solidago canadensis, Cichorium intybus, Pastinaca sativa, Convolvulus arvensis, Acer negundo* (juv.), *Chenopodium ficifolium, Chenopodium album* and very rarely other species as well.On the uncovered soils with magnesite crust the species investigated enters open communities of a number of species, which have the common property of resistance, or, at least, tolerance to magnesite pollution. Except for this, the fact, that the species investigated is r-s strategist that requires rather drier soils and sunny habitats, is

Tab. 2 - Communities with *Taraxacum bessarabicum* in Košice

Relevé	1	2	3	4	5	6	7
area (m^2)	8	10	10	10	10	10	10
T (coverage) %	95	95	50	90	98	85	85
N (number of species)	2	6	3	3	3	3	8
Taraxacum bessarabicum	2	3	3	5	5	2	2
Puccinellia distans	5	-	4	2	-	2	2
Agrostis stolonifera	-	4	-	-	2	-	2
Taraxacum sect. *Ruderalia*	-	1	-	-	-	-	-
Lactuca serriola	-	+	-	-	-	-	+
Elytrigia repens	-	2	-	-	-	3	4
Atriplex tatarica	-	-	-	+	+	-	-
Rumex crispus	-	-	-	-	-	-	+
Rubus caesius	-	-	-	-	-	-	+
Lycium barbarum	-	-	-	-	-	-	+
Sonchus arvensis	-	+	-	-	-	-	-
Chenopodium glaucum	-	-	+	-	-	-	-

The list of localities of phytocoenological relevés:

1) Above the railway crossing Košíková (Alwinczyho) - Rampová, near railway lines, 8 m^2, exp. 0°, coverage 95%, 10. 9. 1992.
2) Magnezitárska street (Ťahanovce), not far from the crossing with the street Pri Hrušove; 10 m^2, exp. 2° E, coverage 95%, 17. 9. 1992.
3) In the railway line north from Magnesite Plant (Ťahanovce), 10 m^2, exp. 0°, coverage 50%, 17. 9. 1992.
4) Near the road crossing of the railway lines near the road north from Magnesite plant (Tahanovce) , 10 m^2, exp. 1° SW, - coverage 90%, 17. 9. 1992.
5) Dtto, 10 m^2, exp. 2° SW, coverage 98%, 17. 9. 1992.
6) Dtto, on the other (eastern) side of the road, 10 m^2, exp. 0°, coverage 85%, 17. 9. 1992.
7) Between locality 6 and the gate of Magnesite plant, eastern side of road, 10 m^2, exp. 0°, coverage 85%, 17. 9. 1992.

decisive for the species occurrence in certain communities. In this way it entered a number of degraded communities, which show high degree of stability, caused by the stabilizing factor of magnesite pollution. With regard to the fact that they are loosen, they can be entered by other resistant or tolerant species. For example, *Brachyactis ciliata* (LEDEB.) LEDEB. that got in the territory probably only in last ten years (cf. MIKOLÁŠ 1988), can modify the floristic composition of the communities in future and cause thus certain succession of a relatively stable community in a new direction.

A more detailed research of the species *Taraxacum bessarabicum* which paradoxically, as an endangered species of Slovak flora, has become a local antropophyte, is needed to save its populations. Also the study of the species communities and their succession as a result of penetrating of new adventives and the change of main factor (magnesite pollution) action will certainly contribute to better understanding of anthropic changes of flora and vegetation of the towns today and their general improvement.

Acknowledgements.

Authors would like to thank, Mrs.E. Hubocká (Dept. of Exper. Botany and Genetics, P. J. Šafárik University, Košice) for the help with microphotographs, RNDr. J. Kirschner, CSc. for confirming the species *Taraxacum bessarabicum* determination and critical reading of the text, which has considerably helped to improve this and RNDr. A. Krahulcová (both of the latter Botanical Institute of Czech Academy of Sciences, Průhonice) for for critical remark on karyology.

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Received: 25 October 1992
Revised: 25 April 1993
Accepted: 5 May 1993