CORVINUS UNIVERSITY OF BUDAPEST
DEPARTMENT OF FLORICULTURE AND DENDROLOGY

Cultivating Possibilities and Botany of *Aster linosyris* (L.) BERNH., a Hungarian Native Perennial Species

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1. ANTECEDENTS AND OBJECTS

An about 1400 species (60 % of Hungarian native species) are native herbaceous perennials from witch 446 species and 235 cultivars are on sale as ornamentals in Hungary. These are an about 31 % of Hungarian native perennials (hemichryptophyta – according to Raunkiaer) and 18 % of Hungarian native species.

Research on using native species as ornamentals is care for a lot of countries; due to native species are important potential ornamental plants and bases of breeding. Controlled propagation and growing of native species on botanical gardens serves for gene preservation, protection and maintenance of endangered species. Controlled horticultural growing of protected species is regulated in different ways in different countries.

From 2002. to 2006. the following 15 Hungarian native perennials and one cultivar using as ornamentals were examined besides *Aster linosyris* (L.) BERNH., the main species of my dissertation: *Aster amellus* L., *Aster amellus* L. 'Rudolf Goethe', *Inula oculus-christi* L., *Inula britannica* L., *Inula ensifolia* L., *Inula hirta* L., *Inula helenium* L., *Doronicum orientale* HOFFM., *Hieracium pilosella* L., *Artemisia campestris* L., *Carlina acaulis* L., *Eryngium planum* L., *Prunella grandiflora* (L.) SCHOLLER, *Scutellaria hastifolia* L., *Dianthus deltoides* L. and *Sesleria sadleriana* JANKA.

The main using area of examined species is as bedding perennials, moreover *Inula ensifolia*, *Hieracium pilosella*, *Carlina acaulis* and *Dianthus deltoides* can be used as rockery plants. *Scutellaria hastifolia* can be used in shade to deputize for grass; however *Sesleria sadleriana* can be used in beds or border. *Inula helenium* can be used as background plant or in large beds in parks. *Hieracium pilosella* and *Scutellaria hastifolia* are quick spreading species, they can became weeds in a 2-3 years. *Aster amellus*, *Inula oculus-christi*, *Inula helenium*, *Doronicum orientale* and *Eryngium planum* can be used as cut flowers; *Eryngium planum* as dry flower, too. *Inula ensifolia*, low individuals of *Doronicum orientale*, *Hieracium pilosella*, *Prunella grandiflora* and *Dianthus deltoides* can be grown as pot plants, as well. Morphological features fit *Inula hirta* and *Inula britannica* for pot plant and cut flower, but both of them grow few inflorescences per stem, so the ornamental values of them is worse than appropriate.

Widespread using of native plants instead of adventives in accordance to their growing and appropriating possibilities and ecological demands would be desirable. Native ornamental plants can better adapt to native ecological and climate conditions than adventives and have chance little bit of being pollutant or invasive plants because of barrier factors, such as pathogens or parasites.

Cultivated possibilities, further application area, propagation and cultivated methods and growing abilities for cut flower of a Hungarian native perennial of dry steppe, *Aster linosyris* (L.) BERNH., were looked for in this work. Another aim was to get knowledge of histological structure of *Aster linosyris*. Researches were done at Corvinus University of Budapest, Faculty for Horticultural Sciences, Department of Floriculture and Dendrology, 2002–2006.

Settings of objects, according to the 5 theme have been as follows:

1. Investigation of morphological and growing features of *Aster linosyris* (L.) BERNH.:
   - getting knowledge of morphological features of wild plants,
   - study of growing features of the plants in wild, pots and early spring cuttings.
2. Propagation experiments:
   - general observations on the efficiency of generative and vegetative propagation,
   - effect of the time of cutting propagation on rooting and wintering,
   - investigation of the effects of some rooting hormones,
   - determination of appropriate cutting size,
   - determination of appropriate part of the stem for cutting collection,
   - accumulation of experimental plants number.

3. Growing experiments:
   - possibilities of open ground growing for cut flower,
   - forcing possibilities for cut flower,
   - possibilities of growing pot plants,
   - effects of wintering, propagation and growing methods,
   - to get knowledge of blossom in various growing conditions.

4. Vase life experiments:
   - effects of flowering stage of inflorescences on vase life,
   - determination of vase life,
   - investigation of the effects of some ingredients.

5. Histological investigations:
   - comparison of histological structure of root and adventitious root,
   - investigation of secondary structure and secondary thicken process of root,
   - investigation of initiation method and primary structure of the rhizome,
   - investigation of the secondary structure of the mature rhizome,
   - investigation of primary structure and secondary thicken process of stem,
   - investigation of histological structure of the leaf,
   - observing of initiation of generative buds,
   - investigation of histological structure of inflorescences and flowers.

2. MATERIALS AND METHODS

Researches were done at Corvinus University of Budapest, Faculty for Horticultural Sciences, Department of Floriculture and Dendrology, Buda Arboretum and Soroksár Experimental and Research Farm, in 2002–2006., according to setting of objects.

2.1. Investigation of morphological and growing features of Aster linosyris (L.) BERNH.

Investigation of morphological and growing features of *Aster linosyris* (L.) BERNH. were done on wild population of a natural habitat in Hármashatár-Mountains (Budapest), on pot plants origin from the wild and divided, in 2003–2006. in Buda Arboretum.

Treatments: control (wild lived plants, 30 stocks), pot plants origin from the wild, divided, two pinched at 5 cm height (19 stocks), pot plants origin from the wild, divided, without pinching (59 stocks), pot plants grown from early spring cutting (19 stocks).

Measured data: number of stems (look like to be one genet), height of stem (the biggest height of it), height of main inflorescence, number of nods (till the main inflorescence), height of the lowest reproductive lateral sprout, number of nods till the lowest reproductive lateral sprout, number of inflorescences per stem, begin of generative phase, begin of flowering.

2.2. Propagation experiments

Sowing investigation of *Aster linosyris* (L.) BERNH. were done in 2003 and 2004. Sowing times were: 21.03.2003., 18.12.2003., 09.04.2004. and 20.10.2004. Sowing place was Buda Arboretum and Soroksár Experimental and Research Farm (in 20.10.2004.). The seeds origin: from the wild, from own experimental plants and from Jelitto.

Sowing method: sprinkled; media: sterile, riddled, ~pH 7, peat based mix (Stender propagation media); in 10×20×5 cm plastic box; covered with the same media.

Measured data: germinate seeds rate (according to tactile sensation); germinating rate and time; mortality rate of seedlings (rate of potted plants to germinated seed).

Setting of objects of *Aster linosyris* (L.) BERNH. **cutting** experiments were as follows: effect of the time of cutting propagation on rooting and wintering, investigation of the effects of

some rooting hormones, determination of appropriate cutting size, determination of appropriate part of the stem for cutting collection.

Origin of the cuttings was: from wild population of a natural habitat (Hármashatár-Mountains, Budapest); from plants grown in open-ground circumstances or forced, propagated in the year or the year before of cutting propagation from seed or by vegetative propagation. Stock plants were after sprout or in vegetative growing phase during spring and early summer, and in generative phase during late summer – in the data of cutting collection. Media: 50 % sand, 50 % perlite or sterile, riddled, ~pH 7, peat based mix (Stender propagation media). Fungicide: liquid propamocarb (Previcure).

Measured data: rooting rate (%), rooting time, number of roots per cutting (measured only on the rooted cuttings), length of the longest root.

Effects of cutting time were examined 15 times in 2003–2006. in spring (from February to April), early summer (May, June), late summer (July, August). Stock plants: forced or from native habitat.

Effects of some rooting hormones were examined 12 times in 2003–2006. Rooting hormones were: 0,1%, 0,4%, 0,8% β-indol-butilic-acid, 0,5% α-naftil-acetic-acid, RadiStim2 and RadiStim3 (α-naftil-acetic-acid). Number of cuttings: min. 40 per treatments.

Determination of appropriate cutting size was done 3 times (27.05.2003., 03.06.2003. and 17.06.2006.). Length of cuttings: 3, 6, 9, 12, 15 cm; number of cuttings: min. 40 per treatments.

Determination of appropriate height of cuttings on the stocks was examined 5 times in 2004 and 2005. Parts of stem for cutting collection: top, middle, low; number of cuttings: min. 200 per treatments (in 2004) and min. 32 per treatments (in 2005).

2.3. Growing experiments

Growing experiments were done in 2003–2006. according to 4 groups: possibilities of open ground growing for cut flower, forcing possibilities for cut flower, possibilities of growing pot plants, effects of wintering, propagation and growing methods.

Measured data: number of stems, height of stem, height of main inflorescence, height of the lowest reproductive lateral sprout, number of nods (till the main inflorescence), number of nods till the lowest reproductive lateral sprout, number of inflorescences per stem or per pot.

Habit: bushy (lateral branches in the lowest 10 cm of the stem, height less than 50 cm), short stem (lower than 50 cm, without lateral branches in the lowest 10 cm of the stem), tall (taller than 50 cm, without lateral branches in the lowest 10 cm of the stem).

For getting knowledge of the flowering features begin of generative stage, green bud stage and begin of flowering time were noticed in the case of all of the experiments and in the wild (Hármashatár Mountains, Budapest) from 2003. to 2006.

Media for the pot plants was: peat (acidic, Baltic), clay, sand (7:2:1), added fertilizer (4 g/l Osmocote Exact 4–6 months), pH 6,5 (added limestone powder – Futor). Soil is sandy in the Soroksár Experimental Farm and clayey in the Buda Arboretum. Sizes of pots were 12, 14, 20 and 24 cm diameter. Places of the growing experiments were the two glasshouses of Buda Arboretum and Soroksár Experimental Farm. Wintering places were Buda Arboretum and Soroksár Experimental Farm (open ground) and the two glasshouses of the Buda Arboretum (temperature during winter: 2 ˚C and 12 ˚C).

Places of **open ground growing for cut flower** were Buda Arboretum (40 plants in 2 repeats) and Soroksár Experimental Area (21 plants in 3 repeats and 42 plants in 3 repeats). Control group: wild population of a natural habitat (Hármashatár Mountains; 30 plants).

Forcing experiments for cut flower took place in the glasshouses of Buda Arboretum from 13.02.2004. and 15.02.2005. Supplemental light (20.000 lux) were occupied every days during forcing from 18-06 hours. Number of plants: min. 24 per treatments.

Possibilities of growing **pot plant** were investigated in two different ways: growing plants from early spring cuttings (in 2003. and 2004. 19 and 24 pots; 1, 2 or 3 cuttings per pots); and in open ground beds cut back in various height (50, 35, 20 and 25 cm) and number (1×, 2×, 3×) during summer in 2005. Times of cut back: 21.06.2005., 19.07.2005., 16.08.2005. Number of plants: 21 plants in 3 repeat per treatments.

Effects of wintering, propagation and growing methods were investigated as follows. Propagation methods: early spring cutting (in the year of growing); propagation from seed, cutting or stock division (the year before growing). Wintering methods: open ground or glasshouses of the Buda Arboretum (temperature during winter: 2 ˚C and 12 ˚C). Stock plants of early spring cuttings wintered in glasshouse heated 2 ˚C. Time of early spring cutting: 14.02.2004. Place of growing: Soroksár Experimental Area.

2.4. Vase life investigations

Picking times for vase life investigations were 16.10.2003., 23.10.2003., 24.05.2004., 30.08.2005., and 28.09.2005. Stems have origin from natural habitat (Hármashatár Mountains), forcing or open ground experiments.

Treatments: 200 ppm 8-HQS (8-hidroxi-chinolin-sulphate), 5 g/m^3 1-MCP (1-metil-cyclo-propene) and control (without any treat). Stages of inflorescences: green bud stage, yellow bud stage, early flowering stage, and full flowering stage. Number of stems: min. 10 per treatments.

Picking height: 10 cm above ground (~10. nod); length of the stem min. 60 cm; flowering time lasted from picking to dropping petals in 60 %.

2.5. Histological investigations

Parts of plants for histological investigations have origin from wild plants or from grown plants; various ages (1-4 years) and stages (after sprout, growing stage or generative stage.)

Roots were cut in cotyledon or one leafed stage in cross section. Adventitious roots were cut near the top (in 1–2 cm distance), in cross and longitudinal section. Young rhizome were cut in cross section and flayed, matured rhizome were cut in cross section in 4 different part of it, from 4–5 mm distance from soil surface and each of it. Stem were cut near the top (in 0,5–2cm distance), just after sprout, in the intensive growing stage and in the generative stage. Cut height was near the 10–15. nods. Stem epidermis was flayed near the 60. nod. Cross sections of the leaf were done 0,5–2 cm distance under the top, in the middle of the leaf. Leaf epidermis was flayed near the middle of the leaf both from the dorsal and ventral side. Investigation of the initiation of generative buds was done in three weeks periods, in longitudinal sections. Cross and longitudinal sections were done from the inflorescences and cross sections from the stamens and stigmas in closed bud stage.

3. RESULTS

3.1. Investigation of morphological and growing features of Aster linosyris (L.) BERNH.

The main morphological features characterized *Aster linosyris* (L.) BERNH., living in the wild: number of stem 3,8 db, height of stem 78,5 cm, height of main inflorescence 72,8 cm, nods till main inflorescence 94 db, length of internodes 0,77 cm, height of the lowest reproductive lateral sprout 67,6 cm, nods till the lowest reproductive lateral sprout 79 db, number of inflorescences per stem 23,7 db. Vegetative growing stage lasted from middle May to early August, generative stage began at the end of June, green bud stage began in middle August. The main flowering time was in middle September.

Plants grown in glasshouse from early March can be characterized as follows: vegetative growing stage lasted to early June, generative stage began at early May and flowering time began in early June. Second flowering time, in the case of the plants, cut back after the main flowering began in 8–9 weeks after it. Plants grown from early spring cuttings can be characterized as follows: intensive vegetative growing began only in the middle of May and at the end of July plants were in green bud stage. Multiplication of nods follows similar rhythm as growing except in the case of plants from early spring cuttings; in this case it was much quicker.

3.2. Propagation experiments

Propagation of *Aster linosyris* (L.) BERNH. is better by cuttings than by seeds. **Propagation by seeds** can be characterized as follows: germinate seeds rate (according to tactile sensation) is only 13 %, rate of germination is low (39 %), germination time is 7 days. Mortality of seedlings is high (48 %) and seedlings can be flower only in the second year after sowing.

Date of **cutting propagation** is the best from February to April; rate of rooting is above 90 %, rooting time is 9 days. From May to June rate of rooting is 86,5 %, rooting time is 20 days; from July to August rate of rooting is 54,5 %, rooting time is 37 days. Initiation of the rhizome begins only after rooting. Absence of rhizome initiation (in the case of cutting propagation after July) caused the winter death of cuttings. Average number of cuttings can be collected from a stock is 4,2 and collecting of cuttings was possible every 18 days.

Rooting hormones rose the rate of rooting as follows: control (without treat) — 80,2 %; 0,5 %-α-naftil-acetic-acid — 92,8 %; 0,1 %-β-indol-butilic-acid — 87,4 %; 0,4%-β-indol-butilic-acid — 85 %; 0,8%-β-indol-butilic-acid — 91,5 %; RadiStim2 (α-naftil-acetic-acid) — 86,5 %, RadiStim3 (α-naftil-acetic-acid) — 91,3 %. Results of rooting of the different cutting-size: 15 cm – 67,3 %, 12 cm – 75 %, 9 cm – 88,3 %, 6 cm – 85 %, 3 cm – 30 %. Height of the cuttings on the stock didn't influence expressively the rate of rooting: rooting rate in spring (top, middle, low) 98 %, 94 % and 91 %; in summer 57,6 %, 54,3 % and 51,5 %.

3.3. Growing experiments

Number of stems in **open ground growing** were 3, 3,7 and 1,9 (in 2005.) in the three experimental area (Soroksár 1, 2 and Buda Arboretum); and 3,8 in the control area (a natural habitat). Wintering of *Aster linosyris* happens in rhizome and in the buds on it, rhizome net discontinue every year. Height of stem in the wild, according to 3 years' data was 79,8 cm, while in open ground growing was 97,9 cm. Height of main inflorescence was 74,5 cm in the wild and 91,5 cm in growing. Numbers of nods till the main inflorescences were 94 pc in the wild and 119 pc in growing. Height of the lowest reproductive lateral sprout was 69,3 cm, inflorescences initiated in the top 7 % of the stem. These data varied in growing 80,5 cm and 14 %. Numbers of nods till the lowest reproductive lateral sprout were 81 pc in the wild and 101 pc in growing. Number of inflorescences per stem 23,5 pc (min. 5, max. 49 pc) in the wild and 76,9 pc (min. 20, max. 159 pc) in growing.

Stem length was 20 cm till end of March-early April in **glasshouse growing** for early flowering cut flowers and 46 cm with the use of supplemental light. At the end of May average stem length was 64 cm and 61 cm with the use of supplemental light. Flowering began at early June and at the end of May with the use of supplemental light. Numbers of inflorescences per stem were 23-27 pc in average, min. 5, max. 65. Height of main inflorescence was 62 cm and 54 cm with supplemental light, numbers of nods were 73 pc and 55 pc with supplemental light. Height and number of nods of the lowest reproductive lateral sprout was 58 cm and 65 nods, while 38 cm and 37 nods with the use of supplemental light. Length of the internodes was 0,88 cm without and 1,03 cm with supplemental light.

Pot plants can be characterized as follows: habit was characteristically bushy, average height was about 30 cm. Numbers of nods were 38 pc, number of inflorescences per pot were 37,5 pc, min. 15, max. 68 pc.

Open ground grown plants **cut back in summer** showed the following features: length of the lateral sprouts was the least in the case of 3 times cut back plants (14,7 cm), total height of them: 35,1 cm. Length of the lateral sprouts in the case of the 1×50 cm, 1×20 cm height and the 2 times cut back plants were near the same (20,8, 20,6 and 21,6 cm). Number of nods on the new sprout in the case of 1 times cut back plants were ~28 pc, length of the internodes were 0,81 cm. In the case of 2 times cut back plants number of nods were 15,6 pc, length of internodes 1,38 cm; in the case of 3 times cut back plants 7,2 pc and 2 cm. Cut back reduced every time the number of inflorescences per stem: control – 71,8 pc, 1× and 2× cut back plants – ~23 pc, 3× cut back plants – 10 pc.

Results of **experiments for wintering, propagation and growing** methods: wintered plants had similar morphological features, but in the first year after propagation plants significantly vary according to propagation method. There were no flowering in the case of plants propagated from seeds, and plants propagated from cuttings flowered only if propagation time was before April. Divided plants behaved similar to two years old plants. Plants wintered in open ground or in 2 °C heated glasshouse formed no rosettes. In the glasshouse growing began at the end of December – early January; the first cutting time turned on early January, the second in the middle of February. 65 % of the plants wintered in 12 °C heated glasshouse formed and remain in rosettes; reputed winter cold is necessary for stem growing and flowering. 87 % of the plants propagated from early spring cuttings became bushy.

3.4. Vase life investigations

Best vase life occurred if pinching happened in coloured bud or early flowering stage. No flowering showed if pinched in green bud stage. Vase life was more than 12 days in every treatment; the best was treated with 1-MCP, then with 8-HQS and control. In 2005 vase life of the stems treated with 1-MCP was 16,2 and 16,9 days, control 14,6 and 15,2 days. In the spring of 2004 the vase life of forced stems treated with 1-MCP was15,6 days, control 13,4 days. In the October of 2003 vase life of the stems treated with 1-MCP was 14,6 and 14,7 days, treated with 8-HQS was 13,6 and 12,5 days, control 12,2 and 12,4 days. Effect of the 1-MCP proved to be significantly better than control. Effect of 8-HQS in comparison with control or effect of 1-MCP in comparison with 8-HQS hasn't significantly differed in every time.

3.5. Histological investigations

Histological structure of the **root**s of seedlings and of adventitious roots differs from each other in the stele. Xylem system of the vascular cylinder is diarch in the case of seedlings' roots and triarch (12 %), tetrarch (86 %) or pentarch (2 %) in the case of adventitious roots. Parallel to the development of vascular system pith cells develop look like elements of xylem and secondary structure formed.

Rhizome of *Aster linosyris* is 2,6 cm long and 0,8 cm thin; is created in August, in the case of cutting only after rooting. Creating of the rhizome can be happened if cutting time is in spring; but if it is in August, some difficulties occur. In the case of cutting in August rooting rate and creating of rhizome is worst, too; rooted but no rhizome formed cuttings die during winter. Vascular system of the young rhizome is collateral dicotyledonous, epidermis has no stoma – look like young stem. Vascular system of the matured rhizome forms continuous ring in the upper part of it, and pith cells have prominent thickening in the middle part of the pith. In the lower part of the rhizome a heterogeneous structure of primary cortex can be observed.

Outline of the young **stem** is slightly wavy, mainly have 8 ribs. Structure of the primary cortex is heterogeneous: besides of parenchyma it has hypodermic collenchyma in the ribs and chlorenchyma between ribs. Vascular system of the young stem is collateral dicotyledonous, type of the secondary thickening is Ricinus-type. Vascular system of the stem of forced plants remained is bundles during secondary thickening.

Structure of the **leaf** is isolateral heterogeneous, palisade parenchyma is 2-3 cell rows. Stomata have no subsidiary cells; take place in a 2-4 cell distance to each other and can be found in both upper and lower epidermis. Epidermal cells have just the same form in both epidermis, cell walls of the lower epidermis is a little bit wavier. Initiation of the **generative** lateral sprouts begins after 30. leaf has developed. Histological structure of generative organs is simple, pollen have some exine pattern.

3.6. New results

Morphological and growing features of *Aster linosyris* (L.) BERNH.

Aster linosyris (L.) BERNH. can be characterized by the following features in the wild:

- height of stem 78,5 cm,
- number of inflorescences per stem 23,7 db,
- height of main inflorescence 72,8 cm,
- nods till main inflorescence 94 db,
- length of internodes 0,77 cm,
- height of the lowest reproductive lateral sprout 67,6 cm,
- nods till the lowest reproductive lateral sprout 79 db.

Main growing phases in the wild of *Aster linosyris* (L.) BERNH. were established:

- main growing period (from May to June)
- begins of reproductive phase (from end of June to early July, about 650 degree-days active air temperature sum)
- begins of green bud phase (from end of July to early August)
- begins of flowering (end of August, early September, 1200 degree-days active air temperature sum)

Aster linosyris (L.) BERNH. have no continuous rhizome-net, connection among stems break by the time of new rhizome initiation. The time of new rhizome initiation is early August in the case of mature plants.

Propagation experiments

Efficacy of **sowing** were established as follows:

- rate of germinate seeds: 13 %, from the whole: 13 %,
- rate of germinating 39 %, from the whole: 5 %,
- mortality rate of seedlings 48 %, from the whole: 2,5 %.

From 100 seeds 2 plants can be grown if seeds origin from the wild, and 19 plants if seeds are selected. Seedlings do not flower in the first year. Instead of sowing cutting propagation is offered.

Following features of **cutting propagation** were obtained:

- optimal cutting time (from February to April),
  - ► rooting rate: 90 %, rooting time: 9 days,
- optimal rooting hormone,
  - ► 0,8% β-indol-butilic-acid (B3) — rooting rate: 91,5 %,
  - ► 0,5 % α-naftil-acetic-acid (Incit5) — rooting rate: 92,8 %,
  - ► RadiStim3 (α-naftil-acetic-acid) — rooting rate: 91,3%,
- optimal cutting size (6–9 cm).

Rooting rate was better if stocks had been forced.

- Initiation of the rhizome begin only after rooting in cuttings,
- time of the rhizome initiation is early August,
- in the case of end of July – early August cutting time:
  - ► rooting rate falls (54 %),
  - ► rooting time rise (37 days) → time of the rhizome initiation is late September – early October (short day period),
  - ► 50 % of the rooted cuttings formed rhizome; without rhizome cuttings die during winter.

Rooting rate had not been influenced by the height of cuttings on the stock, but it had influenced the initiation of the rhizome in the case of the cutting time was after July.

Growing experiments

Growing possibilities of *Aster linosyris* for **open ground grown cut flower** have been established. Morphological features of them were as follows:

- height of stem 97,7 cm,
- number of inflorescences per stem 76,9 db,
- height of main inflorescence 90,3 cm,
- nods till main inflorescence 131 db,
- length of internodes 0,68 cm,
- height of the lowest reproductive lateral sprout 80,2 cm,
- nods till the lowest reproductive lateral sprout 113 db.

Forcing possibilities to late May – early June have been established according as follows:

- ► beginning of glasshouse growing: ~ 15th February,
- ► time of glasshouse growing: 15–16 weeks,
- ► active air temperature sum: at least 1200 degree-days,
- ► effect of the supplemental light (20.000 lux; daily, from 18–06 hours): 12–14 days earlier flowering time.

Growing possibilities for **pot plants** have been established according as follows:

- ► cutting time: from February to March,
- ► growing: open ground in pots,
- ► expected flowering time: from July to August.

Short plants can be grown with summer cut back; but no bushy habit. Cut back in late August reduce number of inflorescences.

Effects of wintering, propagation and growing methods

- Effect of the propagation method succeed only in the first year,
  - ► develop of the seedlings is worst than it is of the cuttings,
  - ► seedlings can be not, cuttings can be flowered at the end of the first summer.
- Proposed wintering place: open-ground or ~0°C glasshouse,
- winter cold is necessary for develop of flowering stem,
- 65 % of the plants wintered in 12 °C heated glasshouse remain in rosettes,
- effect of two spring pinching: lower stem height; more bushy habit plants.

Vase life investigations

- Lengths of minimum vase life is 12 days,
- green bud harvested inflorescences do not flower,
- average vase life with the use of 8-HQS are 13,1 days,
- average vase life with the use of 1-MCP are 15,6 days.

Histological investigations

A difference was observed between the histological structure of the stele of real and adventitious roots: stele of the real roots are diarch, stele of the adventitious roots are triarch (12 %), tetrarch (86 %) or pentarch (2 %).

Histological structure of the rhizome showed relation to it of the stem: both are collateral dicotyledonous, with a Ricinus-type secondary thickening. Structure of the leaf is isolateral heterogeneous, initiation of the generative lateral sprouts begins after 30. leaf has developed.

4. CONCLUSION

According to results cutting propagation is offered instead of sowing, because of the rate of germinate seeds is low (13 %), rate of germinating is low (39 %), mortality of seedlings is high (48 %) and seedlings can be flowered only in the second year. Contrary to this rooting rate of the cuttings is above 90 % and rooting time id 9 days (during the optimal time of cutting propagation: from February to April). Lacking of initiation of a new rhizome in the case of late summer cuttings occurred winter death of them (49,7 %).

According to results the best rooting hormones are 0,5 % α-naftil-acetic-acid (Incit5), 0,8% β-indol-butilic-acid (B3) and RadiStim3 (α-naftil-acetic-acid). Because of the lower prise using α-naftil-acetic-acid is offered. Optimal cutting size is 6–9 cm; height of cuttings on the stock do not influence rooting rate.

Open ground grown plants outgrew wild plants and number of inflorescences was more, too. Natural flowering time of *Aster linosyris* (L.) BERNH. is September; forcing is possible to middle May with the use of supplemental light or to early June without supplemental light. Time of the flowering is in connection with active air temperature sum: both in the wild and in forcing 1200 degree-days is necessary for it.

Pot plants can be grown with early spring (February, March) cutting propagation; expected flowering time is August, September; characteristically features: bushy habit, ~30 cm stem height, an average 39 inflorescences per plant. More beautiful habit, if two or three cuttings per pots are planted. Bushy habit is not hereditary feature.

An interesting relation is observed in the view of active air temperature sum measured in open air and forcing conditions. Active air temperature sum till the flowering time of wild plants (1st September, in open ground circumstances) in the Soroksár experimental area was 1237 degree-days; in forcing at the same flowering stadium was 1202 degree-days (12th May). Besides by active air temperature sum flowering is seems to be influenced by day length, light intensity, HID lighting sum and the growing of the stem and increase of number of nods.

Vase life of *Aster linosyris* (L.) BERNH. is minimum 12 days. According to experiments using of both 8-HQS and 1-MCP can be offered. With the use of them vase life can be lengthened at approximately 1,5–2,4 days. Effect of 1-MCP was in all cases significantly better than control. Inflorescences, harvested in green bud stadium do not flower.

According of vase life of 12–15 days and morphological features it can be said that *Aster linosyris* is suitable for cut flower using. Because of small inflorescences it can be used rather mix bouquets as looser. Green buds form nice stars and are long lasting, remains close in the bouquets, so it can be an interesting use of them as cut foliage.

Histological structures – as well as morphological features – notify ecological demands of the plants, so get knowledge of them can be useful in growing.

Leaf structure is isolateral heterogeneous, stomata can be found in same number both in the upper and lower surface: shows the place of the leaf (acute angle to the stem). Besides of the leaf a hypodermic chlorenchyma can be found in the stem, too, which is a light demand showing feature. Strength of the stem is ensured by xylem: 2/3 part of the secondary thickened stem is xylem part.

5. PUBLICATIONS ON MATTER OF DISSERTATION

Articles in journals

Journals with IF-worth:

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Journals without IF-worth:

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Tar T. (2005): Őshonos évelők lehetséges alkalmazási módjai és termesztésük sajátságai. IV. Kárpát-medencei Biológiai Szimpózium, Budapest, pp. 353-359.

Tar T., Gracza P., Schmidt G. (2005): Az *Aster linosyris* (L.) BERNH. és az *Aster amellus* L. szöveti viszonyainak összevetése. IV. Kárpát-medencei Biol. Szimp., Budapest, pp. 361-367.

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Tar T., Újvári M., Dorogi Zs. (2003): Különféle serkentőszerek hatása őshonos fészkesek dugvány-gyökeresedésére, II. Erdei Ferenc Tud. Konferencia, Kecskemét, pp: 477-482.

Hungarian conferences (abstract):

Tar T., Gracza P., Schmidt G. (2005): *Aster* fajok összehasonlító szövettani vizsgálata, Lippay János-Ormos Imre-Vas Károly Tudományos Ülésszak, Budapest, pp. 94-95.

Tar T., Gracza P., Schmidt G. (2005): Vadnövények szöveti szerkezetének vizsgálata szelekciós nemesítésük céljából, XI. Növénynemesítési Tudományos Napok, Összefoglalók, Magyar Tudományos Akadémia, Budapest, p.: 127.

Tar T., Schmidt G., Dorogi Zs., Újvári M. (2005): Szelekciós kísérletek őshonos fészkesek vázatartósságára és virágnyílására, XI. Növénynemesítési Tudományos Napok, Összefoglalók, Magyar Tudományos Akadémia, Budapest, p.: 128.

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International conferences (abstract)

Tar T. (2004): Flowering and vase life of some *Asteraceae* species, Proceedings of Abstracts, International Conference on Horticulture, Lednice, pp.: 52-53.