

## INVESTIGATION OF THE ORNAMENTAL VALUE OF BULBOUS *OXALIS* SPECIES AND CULTIVARS

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**Abstract:** The research was conducted in Püspökladány in balcony boxes. The soil is a mixture of 33% coir pith, 33% black turf, 33% coarse sand and 1% clay. The mixture was also complemented with 3 kg/m<sup>3</sup> Osmocote 6 moth long-acting fertilizer (15-10-12 + 2 MgO + TE). Irrigation was carried out on a need basis, depending on plant phenology and weather. Boxes were also exposed to natural weather and precipitation. In 2016 *O. articulata* var. *crassipes*, *O. deppei*, *O. deppei* 'Iron Cross', *O. depressa*, *O. lasiandra*, *O. triangularis*, it's cultivars 'Mijke', *Xalis*<sup>TM</sup> 'Frosted Jade', 'Burgundy Wine', 'Black Velvet', it's subspecies *papilionacea*, and it's cultivars 'Birgit' and 'Fanny' were tested. They have excellent flowering properties from 17 to 22 weeks, and foliage longevity for 20 to 22 weeks.

**Key words:** flower bulb, *Oxalis*, geophytes, rhizome, ornamental

### INTRODUCTION

Flower bulbs are valuable ornamental perennial plants. They all share a special trait, some kind of storage organ, which helps them to survive adverse conditions, like winter or drought. They come in vast array of forms, all are the modification of stems and leaves [6]. Here I use the botanical term bulb *sensu lato*, which includes true bulbs, corms, tubers, tuberous root systems, rhizomes, pseudobulbs and stolons [3]. These organs fulfill 3 very important task in a plants life: they are the place of water and nutrient storage, and are the means of vegetative propagation. They are all called geophytes by Raunkiaë [10].

These plants can be used in many ways, they can be forced and sold as cut flowers or as potted plants, in dormancy they can be sold with a color picture (termed "capper" in horticulture) by big box stores, or individually as we can see it on the Amsterdam Bollenmarkt. When plants are sold dormant the trade calls this the "dry sales". They can also be planted in parks with annuals, biennials, like pansies, or with perennials in a mixed border [13], in rock gardens [5], under trees, in the grass [3, 4, 5, 11, 12, 13], in balcony boxes [8, 9], on green roofs [4, 7, 8], so they are quite a versatile group of plants. If we pay a visit to Keukenhof, we can see bubs planted in a woodland setting, with ferns and perennials, where bulbs naturalize. There are huge bowls with pansies mixed with tulips, daffodils and hyacinths. In the pavilions we see bulbs as forced cut flowers and ad pot plants, and there are of course the vast amount of beds with a single variety, or mixed with other bulb species. Forcing flower bulbs into flower to sell them as cut flowers or potted plants is a good market, it can double or triple the duration of availability of a plant. Forcing is labor intensive and requires special treatment of bulbs, usually mimicking the natural cycle of temperature changes, cooling and heating, but the end product can be sold on a good price compensating the grower for the trouble [3, 11, 12].

The most well known and most cultivated bulbous ornamentals are tulips, lilies, daffodils, hyacinths, tuberous begonias, *Dahlia*, *Gladiolus*, *Canna*, Dutch iris, calla and *Hippestrum*. All the rest are considered miscellaneous, as they have fewer numbers of cultivars per genera and lower production area. Most of these miscellaneous bulbs are on the border line of being a bulb or a perennial. Neither the Dutch growers (BKD) [2] nor do the AIPH [1] separates the two terms If we combine their production area they give nearly as much as the most well known bulbs. This means that they are economically important crops.

In this research I was measuring two important qualities of the plants, how long do they provide ornamental foliage, and how long does the flowering last. This can also give a clue for the grower and retailer how long is the shelf life of a certain plant, how much time do they have to sell it before it turns unattractive and becomes unmarketable.

I was choosing *Oxalis* species, as they propagate well, and have multiple uses. They can be planted in annual beds, and mixed borders, in balcony boxes, rock gardens, green roofs, or sold as a potted plant, like *Oxalis deppei* as lucky clover for new years eve.

### MATERIALS AND METHODS

The research was conducted in Püspökladány. The soil was a mixture of 33% coir pith, 33% black turf, 33% coarse sand and 1% clay. The mixture was also complemented with 3 kg/m<sup>3</sup> Osmocote 6 moth long-acting fertilizer (15N-10P-12K + 2MgO + trace elements). Storage organs were planted in the upper described mixture 3-5 cm deep, in 30 cm long balcony flower boxes, and placed under direct sunlight, outside on a patio. Irrigation was carried out on a need basis, depending on plant phenology and weather. Balcony boxes were also exposed to natural weather and precipitation. The plant material was donated by ZM-Gépész Bt. The longevity of the foliage and flowers were measured on a weekly basis, which follows the methodology what the trade uses when doing their inventory on visually attractive plants. The trial was carried out in 2 consecutive years.

*Oxalis deppei* ‘Iron Cross’, *O. lasiandra*, were planted in week 17, *O. triangularis* and *O. t.* subsp. *papilionhacea* were planted in week 19 in 2015. Because of their good performance in 2015 the plant material was expanded with other species. In 2016 all were planted on 26<sup>th</sup> of April, except *O. articulata* var. *crassipes*, it arrived on 20<sup>th</sup> of May as a potted flowering plant.

### RESEARCH RESULTS

Results of the longevity of decorative foliage and flowering are illustrated on phenograms (Table 1. and Table 2.) for easier interpretability. Foliage longevity is marked with a “■”, flowering is marked with “✖”.

In 2015 *Oxalis deppei* ‘Iron Cross’ had ornamental foliage for 19 weeks, and flowers for 15 weeks. *Oxalis lasiandra* has the same length of flowering and foliage. *Oxalis triangularis* had 21 weeks of flowering and 19 weeks of foliage, subspecies *papilionhacea* had 19 weeks of flowering and 18 weeks of foliage. This year planting was delayed of *O. triangularis* species, and shoots with flowers emerged in the storage, etiolated foliage was burnt because of the sun, this is why their flowering was so early and preceded the decorative foliage.

*Oxalis articulata* var. *crassipes* arrived as a flowering plant on 20<sup>th</sup> of May 2016, and had an ornamental foliage and flowering lasting till the frost for 22 weeks. Flowering came in flushes, but there were always some open flowers. The rhizome of this plant is not drought tolerant, and should not be stored dry. It is best to keep the potting soil somewhat moist during the winter dormancy.

*Oxalis deppei* and its cultivar ‘Iron Cross’: In 2016, when both varieties were tested had no difference in their phenology. Both were flowering for 20 weeks and had ornamental foliage for 22 weeks. They are very durable, easy to propagate plants. The storage organ is a bulb, which in dry conditions grow a water storing thickened taproot. When harvesting the bulbs the taproots should remain attached as they provide nourishment for the bulbs growth during the winter storage. Plants prefer a sunny location, flowers are brick red to pinkish red. The ‘Iron Cross’ cultivar has a dark brown pattern on the base of each leaflet, which is more decorative than the original species. This cultivar is

often sold as “lucky clover” or “four leaf clover” after Christmas. They force small bulbs – under the circumference 4 cm – into leaves in 5-6 cm round pots.

*Oxalis depressa* (syn. *O. inops*): The species is native to S-Africa. The bulbs are very small, and have two pointed ends, this makes the determination of shoot growing point hard, so I planted them sideways. The plant emerged slowly, and the shoots were creeping below soil level till they reached the side of the balcony box, then they emerged. Flowering was the shortest of all *Oxalis* species tested, only 17 weeks, the decorative foliage lasted for 22 weeks. Because of the small size of mature plants – 12 cm with flower stems – it can be used in rock gardens or with combination of miniature annuals or perennials in mixed plantings.

*Oxalis lasiandra*: This plant has a bulb like storage organ, and thickened taproots like *O. deppei*, it behaves the same, but the leaves are nicely dissected, like miniature palm leaves and the flowers have a nice lavender-pink shade. It also has 22 weeks of decorative foliage and 21 weeks of flower.

*Oxalis triangularis* and it’s cultivars: Plants have a scaly rhizome, where leaf scales become thickened, and store water and nutrients. The rhizomes in moderately dry conditions grow a thickened taproot for water storage, but this is only a few centimeters long. The rhizomes do not like drying out during storage, it is best to keep them in mildly damp coir pith, peat, or vermiculite. All cultivars had the same phenology, 22 weeks of ornamental foliage and 21 weeks of flowering. Xalis™ cultivars arrived a week later than the rest, so they were in a week delay compared to other cultivars. These plants are often sold as houseplants, but for good growth they need a cold dry winter rest. In Croatia people keep them as garden perennials as they have a milder winter. The species have a dark purple foliage with soft lavender-pink flowers.

Subsp. *papilionacea* has green foliage with white flowers. The cultivar ‘Mijke’ or ‘Myke’ has more darker leaves with a lighter wine-purple triangle shape center in each leaflet. The cultivar itself is not very stable, one third of the plants can revert back to the species in one growing season, and in micropropagation it is even more variable. Flowers are the same as in the species.

Subsp. *papilionacea* ‘Birgit’ leaves are green, with a reddish hue on the back when emerging, this hue stays only in between the leaf veins on mature leaves giving a nice tiger-stripe motif. Flowers are soft pink. Subsp. *papilionacea* ‘Fanny’ is the same as the former mentioned cultivar, the only difference is on the face of the leaf they have a grayish pattern. Xalis™ cultivars are bred by Retkes József. They have bigger leaves than the other taxa. Cultivars ‘Frosted Jade’ and ‘Black Velvet’ have white flowers, ‘Burgundy Wine’ has pink. Latter has a solid burgundy color foliage, ‘Black Velvet’ has a very deep – almost black – purple color, and is best suited in more shaded areas to prevent leaf scorch. ‘Frosted Jade’ has a grayish green foliage. Latter species can be a bit unstable, they can become gray patterned or marbled.

These cultivars were introduced in 2006 and became the members of the 21 best annual flowers in 2007 in the United States. All of them are Patented and protected by Breeders Rights.

Table 1.

Phenogram of Oxalis species and cultivars in 2015

Taxon/weeks	2015																								
	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	
Oxalis articulata var. crassipes																									
Oxalis deppei																									
Oxalis deppei 'Iron Cross'					+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
								x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	
Oxalis depressa																									
Oxalis lasiandra					+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
								x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	
Oxalis triangularis					+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	
Oxalis triangularis 'Mijke'																									
Oxalis triangularis subsp. papilionacea						+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
				x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	
Oxalis triangularis subsp. papilionacea 'Birgit'																									
Oxalis triangularis subsp. papilionacea 'Fanny'																									
Oxalis triangularis Xalis™ 'Black Velvet' PP/PBR																									
Oxalis triangularis Xalis™ 'Burgundy Wine' PP/PBR																									
Oxalis triangularis Xalis™ 'Frosted Jade' PP/PBR																									

Table 2.

Phenogram of *Oxalis* species and cultivars in 2016

Taxon/weeks	2016																							
	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43
<i>Oxalis articulata</i> var. <i>crassipes</i>		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	
<i>Oxalis deppei</i>		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	
<i>Oxalis deppei</i> 'Iron Cross'		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	
<i>Oxalis depressa</i>		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
							x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	
<i>Oxalis lasiandra</i>		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	
<i>Oxalis triangularis</i>		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	
<i>Oxalis triangularis</i> 'Mijke'		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	
<i>Oxalis triangularis</i> subsp. <i>papilionacea</i>		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	
<i>Oxalis triangularis</i> subsp. <i>papilionacea</i> 'Birgit'		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	
<i>Oxalis triangularis</i> subsp. <i>papilionacea</i> 'Fanny'		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	
<i>Oxalis triangularis</i> Xalis™ 'Black Velvet' PP/PBR			+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
				x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	
<i>Oxalis triangularis</i> Xalis™ 'Burgundy Wine' PP/PBR			+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
				x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	
<i>Oxalis triangularis</i> alis™ 'Frosted Jade' PP/PBR			+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
				x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	

## CONCLUSION

*Oxalis* species and cultivars tested in the trial have excellent properties in regard of ornamental foliage longevity and flowering time. They are very floriferous, provide flowers for 17-22 weeks, ornamental foliage for 21-22 weeks. They are suitable in containers or balcony boxes, as a houseplant or might be used as rock garden plants. Moreover they deserve a place in mixed annual or perennial borders, as they can withstand Hungarian weather outside. They are easy to propagate and are on the budget side of summer flowering bulbs, compared to other bulbs like dahlias, lilies, or other *Oxalis* species, like *O. magnifica* or *O. megallorhiza*. These plants are undemanding, they are best in full sun or partial shade.

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