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THE EFFECT OF THE DATE AND DEPTH OF CORM PLANTING ON THE QUALITY TRAITS OF *SPARAXIS TRICOLOR* KER.-GAWL. FLOWERS GROWN IN THE CONDITIONS OF THE LUBLIN DISTRICT

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ABSTRACT

A field experiment was conducted in the years 2000-2003. The corms of *Sparaxis tricolor* were planted in spring at the following dates: 20.04, 29.04, 10.05 and 20.05 at 3 depths of planting: 4, 6 and 8 cm. The greatest number of inflorescence stalks growing from 1 corm was obtained planting *Sparaxis* at the earliest of the studied dates. The length of the main shoot, the length of the spike, the number of inflorescences in a spike as well as the diameter of the first flower were also the biggest when the corms were planted at the turn of the second and third 10-days' period of April. More inflorescence stalks were obtained planting the corms at the depth of 4 cm. Deeper corm planting at the depth of 6-8 cm had a positive effect on the diameter of the first flower in the inflorescence and the length of the leaves. The studies observed a positive effect of earlier planting on the formation of inflorescence stalks containing at least 5 flowers in a spike. Their proportion range in particular years was from 15 to 40% for *Sparaxis* planted on 20 April and it decreased to 6-17% when the corms were planted on 20 May.

Key words: *Sparaxis tricolor*, planting date, planting depth, flowering.

INTRODUCTION

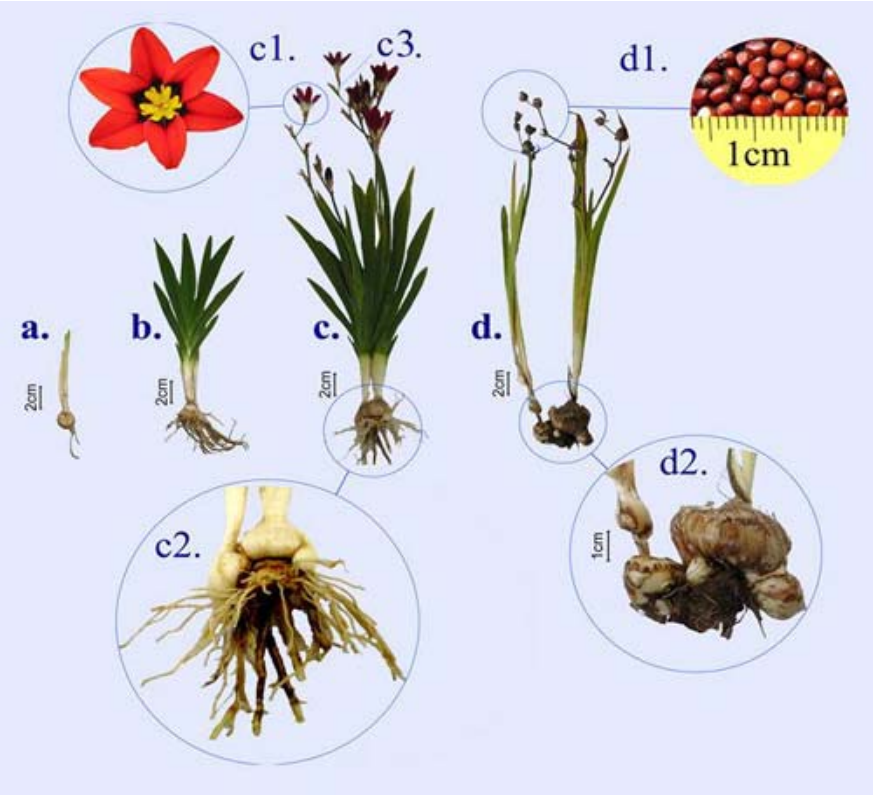
Sparaxis tricolor is a representative of the Iridaceae family. In natural conditions it occurs only in a limited area of South Africa [7]. Big ornamental values of the colourful flowers and a long period of flowering encourage the cultivation of this species in household gardens and in green areas. These plants are characterized by small requirements as to the temperature (14-16°C) since their growth and flowering in the natural environment fall for winter months and the beginning of spring. In the period of hot and dry summer *Sparaxis* falls into dormancy. In the conditions of the central European climate too high temperatures, exceeding 17°C, can have – especially in the first 6 weeks of growth – a negative effect on the flowering, even causing the decay of the inflorescence stalks [11]. That is why the Chair of Ornamental Plant of the Agricultural University of Lublin undertook studies the aim of which was to determine the optimum date and depth of planting the corms of *Sparaxis* in the open ground for the Lublin district.

MATERIALS AND METHODS

A two-factor field experiment was established in a random blocks scheme. The planting dates were the first factor. The corms of *Sparaxis* were planted with 10-days' intervals at the following dates: 20.04, 29.04, 10.05 and 20.05. Three depths of planting – 4, 6 and 8 cm – were ere the second factor. Before planting, the corms were kept for 20 minutes in a 1% solution of Kaptan 50 WP. In the year 2000 corms with > 4 cm in circumference, and in 2001 and 2003 the corms with > 5 cm in circumference were used 30 corms were planted in three rows of the area of 1 m^2.

The plots were fertilized with Azofoska in the quantity of 25·m^{-2} in spring before the planting. During the plants' vegetation the plants were fed with ammonium saltpeter in the quantity of 10 g·m^{-2} and Azofoska 25 g·m^{-2} (doses provided once). Throughout the vegetation period the plots were manually weeded. The plants were sprayed against aphids and grey mould in the period of vegetation. In 2002 and 2003 the plants were watered between May and the middle of June when the soil got too dry.

Fig. 1. Growth and development phases of *Sparaxis tricolor* Ker-Gawl. a – plant 2 weeks after corm planting, b – plant 4 week after corm planting, c – plant 8-9 weeks after corm planting, c1 – flowers, c2 – clone of descendant corms 8-9 week after planting, c3 – a spike of the main inflorescence, d – plant 12-14 week after corm planting, d1 – seeds, d2 – clone of descendant corms 12-14 week after corm planting



During the vegetation the studies examined the following: the number of inflorescence stalks growing out of 1 corm, the height of the main inflorescence (cm), the length of the main inflorescence spike (cm), the diameter of the first flower in the main inflorescence (cm), the number of flowers in the main inflorescence spike, the number of flowers in the lateral inflorescence spike, the length of the leaves (cm). The measurements were taken on 10 objects in each repetition. The results were statistically analyzed by means of variance analysis for double cross classification, using Tukey's multiple confidence intervals (significance level at 0.05). Besides, the number of flowers in lateral inflorescence spikes was determined proportionally in relation to the total number of inflorescence stalks growing out of 1 corm (fig. 1).

RESULTS

The planting date significantly differentiated the number of inflorescence stalks formed by the plants of Sparaxis. The greatest number of inflorescence stalks from 1 corm was formed by *Sparaxis* plants planted to the ground at the earliest date (7,4). Delaying the planting significantly decreased the number of inflorescence on a plant (up to 3.1 for 20.05) (photo 1-4). Shallow planting of corms at the depth of 4 cm had a positive effect on the number of

inflorescences, with a smaller number of stalks formed by plants planted at the depth of 8 cm. Big differences in the flowering abundance were observed in particular years of the cultivation. The greatest number of inflorescences were formed by *Sparaxis* plants in 2001 (9.7), while the smallest – in 2000 (1.6) (tab. 1).

Photo. 1. *Sparaxis tricolor* obtained from the first date of planting (20th April) in the year 2001

Photo. 2. *Sparaxis tricolor* obtained from the second date of planting (29th April) in the year 2001

Photo. 3. *Sparaxis tricolor* obtained from the third date of planting (10th May) in the year 2001

Photo. 4. *Sparaxis tricolor* obtained from the fourth date of planting (20th May) in the year 2001

The length of the main stalk was related to the date of in-ground planting of the corms. The longest main stalks were formed by *Sparaxis* planted on 20 April (26.1 cm). Delaying the planting caused the shortening of the stalk, with the shortest ones obtained when *Sparaxis* was planted on 20 May (19.8 cm). The planting depth in the range between 4 and 8 cm did not have any effect on the length of the inflorescence stalk of *Sparaxis* plants. The length of the main inflorescence differed in particular years. The longest inflorescences were formed in 2001 (29.3 cm), while the shortest in 2003 (19.0 cm).

Table 1. The influence of date and depth of *Sparaxis tricolor* corm planting on the inflorescence stalk quality features (means of the year 2000-2003)

Term and depth of corm planting		Number of inflorescence stalks from one corms	Length of the inflorescence shoot, cm	Spike length, cm	Number of flowers per spike	Diameter of first flower, cm	Length of leaves, cm
20.04	4 cm	8.0	26.3	10.0	5.0	6.0	18.4
	6 cm	7.3	25.9	10.1	5.0	6.1	19.8
	8 cm	6.9	26.0	10.3	5.0	6.0	19.8
29.04	4 cm	5.2	23.8	8.6	4.3	5.5	17.8
	6 cm	5.0	23.5	9.1	4.3	5.7	18.1
	8 cm	4.6	23.6	8.8	4.1	5.7	18.1
10.05	4 cm	3.7	20.9	7.5	3.8	5.0	18.1
	6 cm	3.7	21.4	7.9	3.8	5.2	19.3
	8 cm	3.6	22.4	7.5	3.8	5.2	19.7
20.05	4 cm	3.2	19.4	6.9	3.2	5.0	18.3
	6 cm	3.0	20.1	6.8	2.9	5.0	18.3
	8 cm	3.1	20.1	6.7	3.0	5.0	18.2
Mean of a date of planting	20.04	7.4a*	26.1a	10.1a	5.0a	6.0a	19.4a
	29.04	4.9b	23.6b	8.8b	4.3b	5.7b	18.0b
	10.05	3.7c	21.6c	7.6c	3.8c	5.1c	19.0a
	20.05	3.1d	19.8d	6.8d	3.1d	5.0c	18.3b
Mean of a depth of planting	4 cm	5.0a	22.6	8.3	4.1	5.4b	18.2b
	6 cm	4.8ab	22.7	8.5	4.0	5.6a	18.9a
	8 cm	4.6b	23.0	8.3	4.0	5.5ab	19.0a
Mean of the Years	2000	1.6c	20.0b	6.7c	2.9c	5.2b	19.1b
	2001	9.7a	29.3a	10.7a	5.9a	6.0a	22.0a
	2003	3.1b	19.0c	7.6b	3.3b	5.1c	15.0c

*Values indicated with the same Lester are not significantly different

The planting date significantly differentiated the length of the main inflorescence spike. The best effect on a given feature was exerted by early planting of the corms on 20 April (10.1 cm). Delaying the planting caused the shortening of the length of the spike length (tab. 1). The shortest spikes were formed by plants planted on 20 May (6.8 cm). The studies found out no differences in the spike length depending on the depths of planting. *Sparaxis* plants had varying lengths of the main stalk spike in particular years of the cultivation. The longest spikes were formed in 2001 (10.7 cm), while the shortest in 2000 (6.7 cm).

The number of flowers in a spike was related to the planting date. The greatest number of flowers in an inflorescence was found in *Sparaxis* planted on 20 April: 5.0. The number of flowers in inflorescence was reduced to 3.1 in *Sparaxis* planted in successive dates, when the corms were planted on 20 May (tab. 1). The studied lengths of planting did not differentiate the number of flowers in inflorescence. The number of flowers in inflorescence differed in particular years. The highest number of flowers in a spike was observed in plants cultivated in 2001 (5.9), while the lowest – in the first year of studies (2.9).

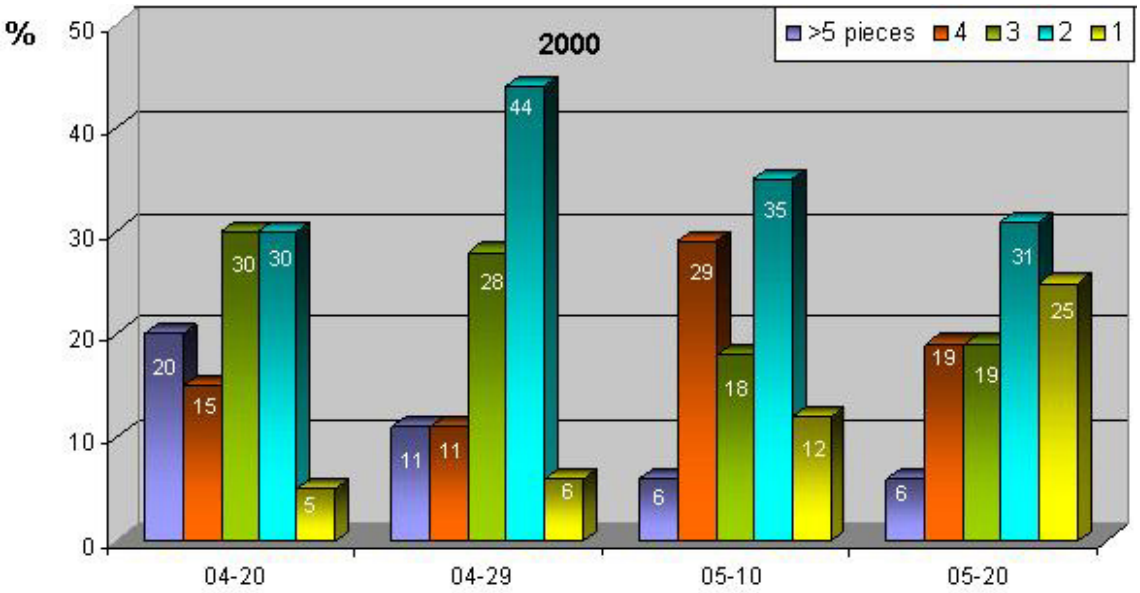
The dates of planting affected the diameter of the first flower in a spike. The greatest diameter (6.0 cm) was found for *Sparaxis* flowers, when the corms were in-ground planted on 20 April, while the smallest diameter of flowers (5.1 and 5.0 cm) was obtained planting the corms in May.

The formation of flowers with a greater diameter was favoured by corms planting at the depth of 6 and 8 cm (tab. 1). The years of the cultivation differentiated the diameter of the first flower in inflorescence. The biggest flowers were obtained growing the plants in 2001 (6.0 cm), while in the first and third years the diameter of the flowers was 5.1-5.2 cm, on average.

The date of planting the corms affected the length of *Sparaxis* leaves. The longest ones (18.0 and 18.3 cm – tab. 1) were observed in plants grown from the corms planted on 29 April and 20 May. Planting at the depth of 6 and 8 cm had an effect on longer leaves formed by *Sparaxis* as compared to shallower planting of the corms. Longer leaves were formed by plants cultivated in 2001 (22.0 cm) as compared to the years 2000 and 2003, when the leaves were the shortest (15.0 cm).

Analyzing the ornamental value of inflorescences on the basis of the number of flowers in inflorescence, the studies in 2000 found in a relatively low proportion of inflorescences with 5 and more flowers in a spike. In *Sparaxis* planted the earliest they constituted about 20% of all the stalks and their number decreased to only 6%, when the corms were planted in May.

Fig. 2. Rates of inflorescence stalk in different number of flowers on spike in the total inflorescences growing from one corms of *Sparaxis tricolor* in the year 2000



In the first year of studies, irrespective of the date of planting, the biggest proportion was made of inflorescence stems containing 2 and 3 flowers in a spike. Inflorescence stalks with 1 flower in *Sparaxis* planted on 20 April constituted 5% of all the stalks, while in plants planted on 20 May – 25% (fig. 2).

In 2001 (fig. 3) inflorescence stalks with 5 and more flowers constituted 40% of inflorescences when the corms were planted in both April dates, but their proportion decreased to 21% for *Sparaxis* planted on 10 May and to 14% when the planting date was 20 May. The proportion of stalks with 2 flowers in a spike increased with delayed planting of corms from 14 to 30%, while the percentage of stalks with 1 flower increased from 4.5 to 12% when the corms were planted on 20 May.

Fig. 3. Rates of inflorescence stalk in different number of flowers on spike in the total inflorescences growing from one corms of *Sparaxis tricolor* in the year 2001

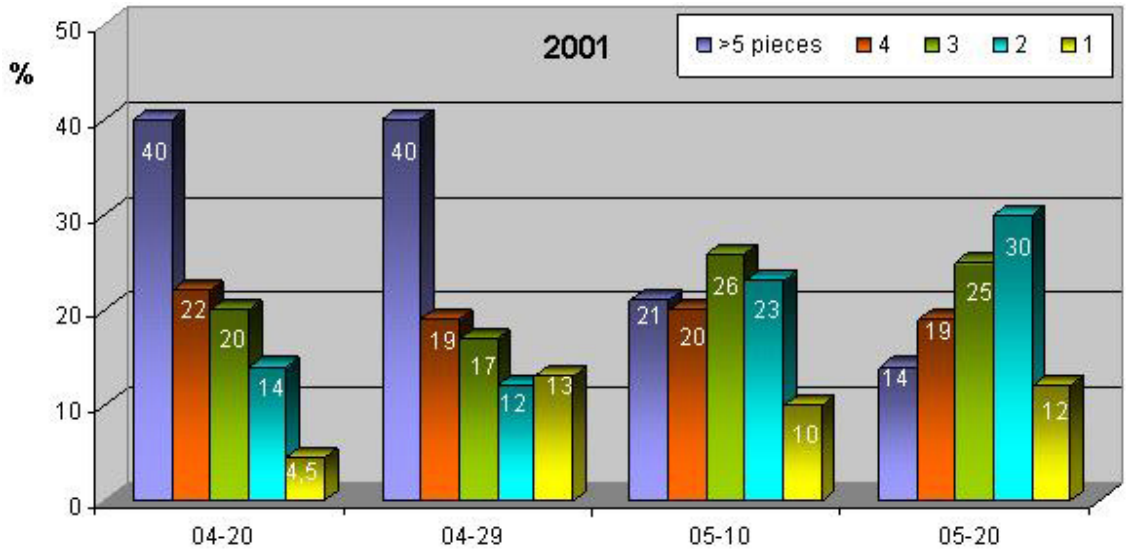
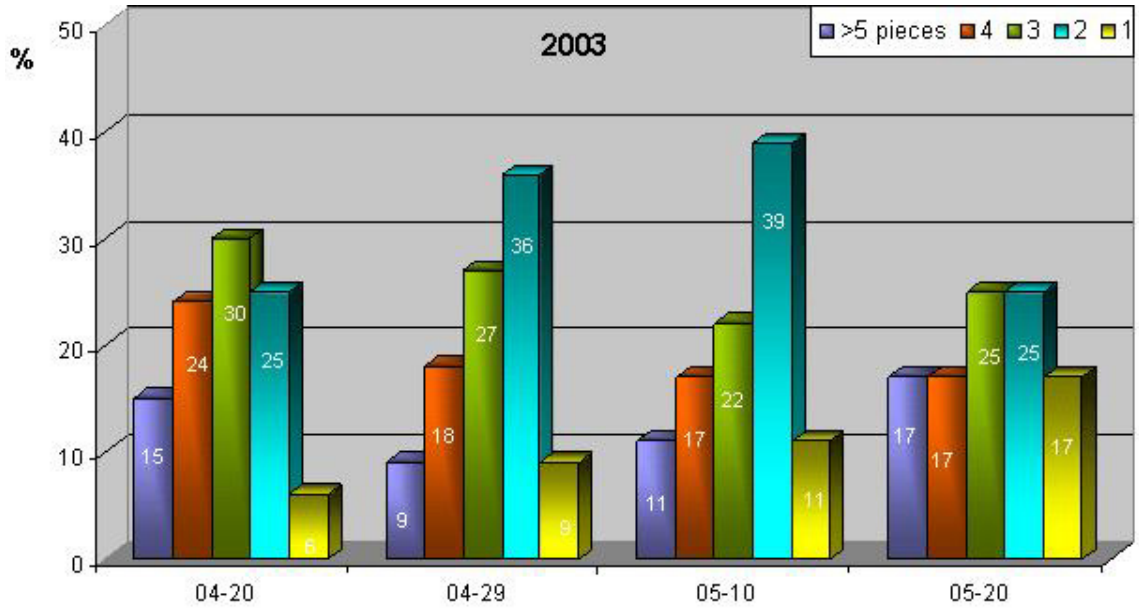


Fig. 4. Rates of inflorescence stalk in different number of flowers on spike in the total inflorescences growing from one corms of *Sparaxis tricolor* in the year 2003



In 2003 the most ornamental stalks were formed by *Sparaxis* planted the earliest, which was analogous to the year 2001, but the proportion of stalks with the biggest number of flowers was only 15%, with the majority of stalks with 3 flowers in a spike (30%). Plants grown from corms planted on 29 April and 10 May mainly formed inflorescences with 2 flowers in a spike (36 and 39%). When the corms were planted on 20 May, 50% inflorescences were made up of stalks with 2 and 3 flowers. Like in previous years, in 2003 too delayed planting increased the proportion of stalks with 1 flower in a spike from 6% to 17% (fig. 4).

DISCUSSION

The studies showed that in case of *Sparaxis* the planting date is one of the most important factors affecting the quality of inflorescence stalks. Plants obtained from corms planted to the ground between the second and third 10-days' periods of April formed the most of inflorescence stalks, which were characterized by the best parameters: height, length of the spike, number of flowers in a spike as well as the diameter of the first flower as compared to inflorescences obtained at later dates of planting. Kapczyńska et al. [14] also state that *Sparaxis* planted earlier formed longer inflorescence stalks; however, the number and diameter of flowers were not related to the planting date.

The studies conducted on the agrotechnology of gladiolus in Indies [3, 12, 16, 19, 20, 22], although not reflecting the climatic conditions in Poland, prove a significant effect of the planting date on the quality of the obtained flowers. Delaying the planting of gladiolus caused the shortening of spikes and a reduction of the number of flowers as well as a decrease of the inflorescence weight and the durability of flowers after cutting. Gladiolus prefers considerably higher temperatures during their cultivation as compared to *Sparaxis*. As follows from the studies by Grabowska [9] and Tonecki [23], in our country they can be planted even till the end of June with no negative effect on the quality of inflorescence stalks, although a delay of planting can decrease the number of plants forming inflorescence. Similar results were obtained by Laskowska and Kocira [17] in the cultivation of two-colour *Acidanthera*, which has similar requirements to gladiolus and better quality inflorescences were obtained planting the plants in the second 10-days' period of May as compared to the earlier planting in April. However, it can be related to weather conditions and the area of cultivation. Piskornik and Koziara [21] obtained inflorescences of better quality, planting *Aidanthera* at very early dates, while delaying the planting affected the decrease of the inflorescence stalks weight and the diameter of flowers. Armitage and Laushman [1, 2] showed a positive effect of earlier planting on the flowering of anemone, *Crocosmia* and Dutch iris. The plants' reaction to the planting date differed in the studied species. In the case of *Acudanthera*, *Brodiea* and garlic the same authors found no significant effect of this factor on the quality of inflorescence, while tuberose flowered better when planted at later dates.

Freesia has very similar requirements to those of *Sparaxis*. It follows from the studies by Kim et al. [15] that earlier planting of corms has a positive effect on the length of inflorescence stalks and the number of flowers in a spike. Delaying the planting makes the flowering worse, causing deformation of the flowers. The effect of the planting date was related to the size of freesia corms used for planting; smaller corms required earlier planting, while big ones gave the highest yield, planting them a little later.

The earliness of planting depends on the soil type and weather conditions. Sandy soils with small thermal capacity and high coefficient of thermal conductance get warm faster and they get dry in spring faster as compared to loamy and clay soils, especially the peat ones [24]. In the authors' own studies the earliest planting date fell on 20 April, which was related to the possibility of spring cultivation of soils formed from loess-like formations. No injuries caused by frost were found out on *Sparaxis* plants in particular years of studies. Further studies considering those problems would be advisable in order to find out the possibility of earlier planting of *Sparaxis* corms in spring on other soil types.

The cultivation of *Sparaxis* at the depth of 4-8 cm does not considerably influence the course of the flowering. It was found out that the plants planted at the depth of 4 cm form more inflorescence stalks than the plants planted at the depth of 8 cm, which referred mainly to April dates of planting. Those differences disappeared in plants planted later. Bigger flowers and longer leaves were obtained planting the plants at the depth of 6-8 cm. Kapczyńska [13] also did not observe any differences in the course of flowering of *Sparaxis* planted at the depth of 4, 6 and 8 cm. Plants grown from the corms planted at the depth of 6cm formed longer inflorescences and flowers of bigger diameter; however, more shallow planting influenced the decrease of the number of inflorescences. In the cultivation of freesia the best effect on the flowering and the quality of inflorescences was exerted by planting the corms at the depth of 6 cm as compared to shallow planting at the depth of 3 cm and deep planting at 12 cm [18]. Choi et al. [5, 6] also found a more positive effect of deeper planting of freesia (at the depth of 5-7 cm), *Frittilaria thunbergii* (at the depth of 3 cm) and lily [4] on the length of the leaves and inflorescence stalks as compared to shallower planting.

The authors' own studies confirm a more positive effect of deeper planting on the flowers' diameter; inflorescence stalks of plants planted at the depth of 8 cm were slightly longer but no negative effect of shallow planting was confirmed on the number of inflorescences. Gladiolus planted at the depth of 5-7 cm formed more inflorescence stalks with a bigger number of flowers in a spike as compared to deep planting at 10-18 cm [8]. Maitra and Roychowdhury [19] find out that planting gladiolus at the depth of 8 cm had a positive effect on the quality features of inflorescences: length of the spike, number of flowers in inflorescence, diameter of flowers and their durability after cutting as compared to shallow planting (at the depth of 2-6 cm). Similar relations were observed in the cultivation of two-colour *Acidanthera* planted at 4-12 cm. Plants grown from the corms planted deeper had more flowers in a spike and a bigger diameter of flowers [17].

Grunert [10] recommends planting *Sparaxis* at the depth of 5-7 cm. The authors' own studies confirm that differentiated depth of planting within the range of 4-8 cm does not cause any significant differences in the growth and flowering of the plants.

CONCLUSIONS

1. The best flowering of *Sparaxis tricolor* plants was obtained from the corms with the circumference > 5cm, planted between the second and third 10-days' periods of April. In favourable conditions, 7.3 inflorescence stalks are obtained from one plant, on average. Delaying the planting reduces the number of inflorescence stalks, shortens their length and the length of the spike, the diameter of flowers as well as the number of flowers in inflorescence.
2. Early date of planting the corms has a positive effect on the formation of inflorescence stalks containing at least 5 flowers in a spike. With delayed planting date the plants form inflorescences with a smaller number of flowers, which lowers the ornamental value.
3. Shallow planting of the corms at earlier dates has a positive effect on the number of inflorescence stalks growing from corms. Deeper planting of the corms at the depth of 6-8 cm positively increases the diameter of the first flower in a spike and the length of the leaves.

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