Scientific Research Publishing

American Journal of Plant Sciences, 2022, 13, 1090-1099
https://www.scirp.org/journal/ajps
ISSN Online: 2158-2750
ISSN Print: 2158-2742

Ontogenesis of *Elytrigia trichophora* (Link) Nevski in the Conditions of Uzbekistan (Biometric Indicators)

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How to cite this paper: Mahmudov, V., Mahmudov, A.V. and Abduraimov, O.S. (2022) Ontogenesis of *Elytrigia trichophora* (Link) Nevski in the Conditions of Uzbekistan (Biometric Indicators). *American Journal of Plant Sciences*, **13**, 1090-1099.
https://doi.org/10.4236/ajps.2022.138073

Received: May 13, 2022
Accepted: August 8, 2022
Published: August 11, 2022

Abstract

The article is devoted to the study of the biomorphological features of *Elytrigia trichophora* under conditions of introduction in the mountain semi-desert zone and the determination of their economic prospects for introduction into rainfed crops. The research results showed that, in the Tashkent area, the number of generative shoots is almost the same, but they are 30 - 31 cm long and the number of partial bushes is 4 - 5 more than in Chartak. The root system lengthens by 18 - 25 cm per year, and the number of roots of the first order in the third year of vegetation increases to 93.6 ± 2.31 pieces, they branch up to the III-IV order. The duration of medium-aged generative plants in the Chartak area is 5 - 6 years, and in the Tashkent area, it is 1 - 2 years longer.

Keywords

Ontogenesis, Latent, Virginile, Seedlings, Juvenile, Immature, Generative Periods, Cereals, Chartak, Tashkent, *Elytrigia trichophora*

1. Introduction

Animal husbandry in Uzbekistan is based mainly on natural pastures, suitable for use throughout the year and providing cheap feed. However, the pastures of the desert and semi-desert zone are low-yielding and do not meet the needs of the growing livestock. The livestock farms of the densely populated Fergana Valley are especially affected by the lack of fodder. Here, fodder production can be increased by radical phytomelioration of low-productive foothill lands surrounding the Fergana oasis and used as autumn-winter-spring pastures.

The main stages of the ontogeny of some meadow, forest, and steppe loose shrub grasses are considered with varying degrees of detail in the works of T.I. Serebryakova [1], I.M. Ermakova [2] [3], V.I. Egorova [4], E.I. Kurchenko [5], A.A. Uranova [6], H.F. Shomurodov [7], etc. However, data on the features of the ontogeny of loose-soddy grasses introduced into the mountain semi-desert have not been found in the literature.

2. The Purpose of the Work

Study of the biomorphological features of *Elytrigia trichophora* under conditions of introduction in the mountain semi-desert zone and determination of their economic prospects for introduction into rainfed crops.

3. Methodology

The biomorphological features of plants under culture conditions were studied in the phases of ontogeny [8]. The small life cycle or ontogeny of the shoot was described according to the phases proposed by T.I. Serebryakova [1]. According to the method of M.S. Shalyta studied the root system of individuals of each age state in plants of the first year on a monthly basis, the second and subsequent years—at the end of the growing season [9].

4. Results and Discussions

The prospects for the introduction of wild-growing drought-resistant perennial grasses in the conditions of Uzbekistan have been established. In rainfed crops, *Elytrigia trichophora* undergo a full cycle of ontogeny. The main stages of development are described, and the process of shoot formation and vegetative reproduction of plants is studied. Improvement of conditions at the early stages of ontogeny promotes the early growth of axillary buds, which leads to a reduction in the duration of the juvenile stage. The possibility of introduction in the conditions of mountain semi-desert, where at least 250 mm of precipitation falls, has been proved.

Periods of ontogenesis

4.1. Latent Period

The fruit of *Elytrigia trichophora* is a caryopsis, oval, brown-yellow in color, with a longitudinal depression (groove), on a cone with a short white omission. The grain length is 5 - 6 mm, width is 1 - 1.5 mm. The absolute weight of 1000 seeds from natural conditions (the Angren river basin) is 4.2 grams, from the Chartak area 4.2 grams, and from the Tashkent area 5.2 grams. Laboratory germination at the optimum temperature for germination of seeds from natural thickets is 73%, from the Chartak site 82.1%, and from the Tashkent one a little higher than 83.8% at high temperatures (300˚C - 350˚C) germination significantly decreases 35% - 43% (Table 1). The energy of seed germination is 17.1% - 25%.

Field germination of seeds from the Chartak site in the dry first year was 13%,

Table 1. Laboratory germination of *Elytrigia trichophora* seeds at different germination temperatures.

Growth conditions	Germination temperature, ˚C						
	5	10	15	20	25	30	35
Natural thickets	41.2	68.3	70.3	70.4	54.5	50.4	35.1
Chartak section	46.1	81.2	82.1	68.3	56.1	52.6	43.2
Tashkent section	45.0	80.0	83.8	69.5	59.9	52.8	42.6

in the favorable second year 38.3%, and in the Tashkent one it was slightly higher, respectively 25.3% and 46.7%.

In a dry spring, the ungerminated seeds of *Elytrigia trichophora* will germinate the next year if the spring is favorable. So, in the Chartak area, with a favorable spring (second year), 7 - 12 seedlings were noted in one linear meter from the seeds of sowing in the fall of the first year.

4.2. Virginile Period

4.2.1. Seedlings

Seedlings of *Elytrigia trichophora* are uniaxial, rosette plants 3 - 5 cm long, have a coleoptile, 1 - 2 short leaves and an embryonic root. Coleoptilus is 0.9 - 1.6 cm long, its aerial part is whitish-violet in color, and its underground part is membranous, white, and naked. Two purple veins are clearly visible on the coleoptile. The sheaths and leaves are pubescent with simple hairs, the sheaths are brown-purple in color, and the leaves are dark green. The length of the leaf blade is 1 - 3.5 cm, the width is 0.8 - 1.5 mm.

The germinal (3.5 - 6 cm) and 1 - 2 adventitious (0.6 - 2 cm) roots are well expressed. The connection with the grain is preserved.

On the Chartak site, the first seedlings appeared in early March (08.03), massive to in mid-March, with a sum of positive air temperatures of 148˚.

On the Tashkent site, mass seedlings were noted 4 - 5 days earlier, with a sum of positive temperatures of 160.5˚.

The duration of the age state of the seedling in the Chartak area is 30 - 42 days (from early March to mid-April), and in the Tashkent area—6 - 10 days less.

4.2.2. Juvenile Plants

Juvenile plants are represented by one short shoot with 2 - 3 (4) leaves forming a rosette. At the beginning of this stage, the underground part of the coleoptile dries up. Average height of juvenile specimens is 6 - 7 cm. Vaginas and leaves are pubescent. The length of the leaf blade of the first leaf is 3 - 3.7 cm, the second 4 - 6 cm, the third 1 - 2 cm, and the fourth 0.5 - 1 cm. The sheaths of the leaves, like those of the seedlings, are brown.

The root system of juveniles is 4 - 5 times longer than that of seedlings. In the Chartak area, it reaches 29 - 31 cm deep and the roots branch up to the second order. The number of roots of the first order is 3 (4). The length of the roots of

the second order is 1 - 4 cm.

In the Tashkent area, the roots are half as long as in the Chartak area. Roots of the first order 3 - 4 (5); their length is 15 - 18 cm, branching up to the third order. The length of the roots of the second order is 0.8 - 4 cm, the third order is 0.3 - 2 cm.

At this stage, there is no connection with the caryopsis, but the remains of the caryopsis remain. Drying of the coleoptile in the Chartak and Tashkent areas was noted in the first half of April.

The duration of the juvenile stage in the Chartak area is 25 - 55 days and in the Tashkent area 20 - 42 days.

4.2.3. Immature Plants

In immature plants, the tillering process begins and several rosette vegetative shoots of the second order are formed. At this stage, the death of the lower leaves is observed. Roots of the first order are 4 - 6 cm long and they are 1 - 2 more than in juvenile plants.

In the first year of life, the remnant of the caryopsis (lemma), as in juvenile plants, is preserved, and the next year it is absent.

On the Chartak site, the entry into the immature stage in *Elytrigia trichophora* in the first year of vegetation with the amount of April precipitation of 0.6 mm and soil moisture in the horizon of 0 - 30 cm 7.3% was noted from May 5 - 8, and in the conditions of wet spring in the second year vegetation period, when 44 mm fell in April and soil moisture was 13.5%, this was observed 20 - 25 days earlier. Branching at this stage is only intravaginal. On the main shoot in the first year of life, 2.2 ± 0.08 shoots of the second order are formed. In the second year of life, the number of shoots doubles, and they branch up to the fourth order. Leaves 18.6 ± 0.52 cm long and 5.8 ± 0.24 mm wide, with sheaths pubescent with long hairs. The root system branches up to the third order, the roots of the first order reach 40.4 ± 1.13 cm in length. The number of adventitious roots is 5.3 ± 0.19, they are unequally developed: 2, 5, 12, 25, 40.4 cm in length. Branching mainly occurs at a depth of 8 to 30 cm.

In the Tashkent area, plants begin to bush 10 - 12 days earlier than in the Chartak area. Tillering is more active, more shoots are formed, and they are larger (**Table 2**).

The duration of this age state in the Chartak area is from the first month (from the beginning of May) to the first year, depending on meteorological conditions. So, for example, in the first year, 15% of the plants remained in the immature age state. In a favorable year in the first year, all plants reached the virginal age state.

In the Tashkent area, the duration of the immature stage is 15 - 25 days.

4.2.4. Mature Virginal Plants

This age state is characterized by an increase in the size of leaves, shoots, and internodes, as well as the number of dead leaves (**Table 3**).

Table 2. Biometric indicators of *Elytrigia trichophora* in the immature age state (in the first year of vegetation).

Area	First order escape				Second order escape	
	Length, cm	Leaf plate			Length, cm	Number, pcs.
		Number, pcs.	Length, cm	Width, mm		
Chartak	10.3 ± 0.37	6.8 ± 0.23	7.6 ± 0.28	4.1 ± 0.15	5.2 ± 0.19	2.2 ± 0.08
Tashkent	12.5 ± 0.39	8.9 ± 0.32	8.1 ± 0.27	4.1 ± 0.15	7.3 ± 0.24	3.7 ± 0.13

Area	Second order escape			Root		
	Leaf plate			Number of roots of the first, order, pcs.	Length, cm	The number of dead, pcs.
	Number, pcs.	Length, cm	Width, mm			
Chartak	3.3 ± 0.31	3.9 ± 0.16	2.7 ± 0.09	4.2 ± 0.15	30.5 ± 1.05	2.3 ± 0.18
Tashkent	4.2 ± 0.17	5.4 ± 0.19	3.2 ± 0.12	7.8 ± 0.24	22.4 ± 0.71	3.1 ± 0.12

Table 3. Biometric indicators of *Elytrigia trichophora* in the virginale age state (in the first year of vegetation).

Area	First order shoot				Second order shoot	
	Length, cm	Leaf plate			Length, cm	Number, pcs.
		Number, pcs.	Length, cm	Width, mm		
Chartak	22.8 ± 0.53	9.1 ± 0.31	8.3 ± 0.27	4.8 ± 0.12	8.1 ± 0.27	3.1 ± 0.11
Tashkent	29.1 ± 0.69	9.7 ± 0.33	17.4 ± 0.41	5.8 ± 0.16	14.4 ± 0.46	4.2 ± 0.13

Area	Second order escape			Root		
	Leaf plate			Number of roots of the first, pcs.	Length, cm	The number of dead, pcs.
	Number, pcs.	Length, cm	Width, mm			
Chartak	3.9 ± 0.13	5.2 ± 0.18	4.0 ± 0.15	6.9 ± 0.19	35.7 ± 0.96	3.7 ± 0.15
Tashkent	4.4 ± 0.13	10.1 ± 0.35	5.2 ± 0.17	9.8 ± 0.29	30.2 ± 0.84	4.1 ± 0.17

The main shoot reaches 23 cm and branches up to the second order (Table 3). In addition, at the end of this stage, the appearance of a rhizome was observed. On the Chartak site, by June 10 of the first year, 40% of plants were in this age state, 50% on June 16, and 85% on June 25. In the second year, only 5% of virginal plants remained.

At the end of October, after summer dormancy, virginal plants formed 2.8 ± 0.11 rosette shoots 14.3 ± 0.48 cm long, bearing 5.6 ± 0.19 leaves, of which 2 - 3 are scaly. The root system reaches 36.1 ± 1.05 cm deep.

In the second year of life, virginal plants form 11.8 ± 0.33 vegetative shoots up to 26.6 ± 0.81 cm in length. The shoot bears 6.8 ± 0.24 leaves 12.7 ± 0.36 cm long, 7.3 ± 0.24 mm wide. Drying of autumn leaves begins in March. In mid-April, 1 (2) young plagiotropic rhizomes located in the soil at a depth of 2 - 3 cm begin to form on shoots p + 1 (which were formed in autumn) from the lower axillary buds.

Thus, the rhizomes of *Elytrigia trichophora* of underground origin are hypo-

geogenic. The growth of the rhizome by the beginning of summer dormancy (beginning of July) reaches 3 - 5 cm in length, in autumn it resumes and the internodes reach 1.5 - 2 cm. The next year, in early April, the direction of rhizome growth changes to orthotropic and they come to the soil surface, giving rise to shoots of the second and third orders. In the orthotropic section of the rhizome, the internodes are shortened, as a result of which the leaves are brought together into a rosette.

In a favorable spring, already in the first year of vegetation, virginal plants form rhizomes.

The root system reaches 50.2 ± 1.81 cm in length, and branches up to the third order. The number of roots of the first order is 22.1 ± 0.71 pcs.

In the third year of vegetation, all plants enter the generative period of ontogeny.

In the Tashkent area in the first year of vegetation, only 5% - 10% of the plants remain virginal, and the next year all specimens reach the generative period. Plants in the first year of vegetation branch up to the third order and form rhizomes.

The duration of the virginal age state in the Chartak area ranges from 30 - 40 days to 2.5 years, and in the Tashkent area from 15 days to one year.

5. Generative Period of Ontogeny

5.1. Young Generative Plants

In the dry year of the first year in the Chartak area, only 4% - 5% of plants formed generative shoots, in the second year they were observed in 93% - 95% of plants. In the wet second year, already in the first year of vegetation, 90% of plants showed the appearance of generative shoots.

In this period, the plant forms 5.1 ± 0.18 partial bushes connected by underground rhizomes, called communication rhizomes. In addition, the number of runs increases to 2 - 4. The morphological differences between the generative individuals of the first, second and third years of vegetation in different areas can be judged from the data in Table 4. In the third year of life, the number of generative shoots increases by almost 1.6 times, and the number of vegetative shoots decreases by half, compared with the second year of vegetation. The root system also becomes more powerful. In the second year of vegetation, only shoots are formed, their length is up to 5 cm, and communication rhizomes are observed in the third year of vegetation. Communication rhizomes are formed in the amount of 1 - 2, their length is 4 - 7 cm, and the number of internodes is 5 - 6. Each node contains a kidney covered with a scaly sheet. Most of these kidneys are dormant.

Partial bushes of the mother plant are located close together, forming a loose turf, its diameter in the second year of life is 3 - 4 cm, and in the third year 5 - 6 cm. Partial bushes formed by communication rhizomes are located at a distance of 4 - 8 cm from the mother plant and from each other. In total, on the Chartak

Table 4. Biometric indicators of *Elytrigia trichophora* in a young generative age state.

Vegetation year	The number of partial bushes, pcs.	Vegetative shoot					Generative shoot	
		Length, cm	Number, pcs.	Leaf plate			Length, cm	Number, pcs.
				Number, pcs.	Length, cm	Width, mm		
1 year	1	11.3 ± 0.35	3.1 ± 0.12	6.8 ± 0.31	9.3 ± 0.28	4.2 ± 0.15	30.1 ± 0.98	1.1 ± 0.05
2 year	1	10.2 ± 0.39	8.8 ± 0.31	8.7 ± 0.31	14.1 ± 0.49	4.8 ± 0.18	70.4 ± 1.91	10.6 ± 0.35
3 year	4.1 ± 0.16	9.7 ± 0.32	4.5 ± 0.17	5.3 ± 0.19	11.6 ± 0.39	4.8 ± 0.18	80.4 ± 2.81	16.7 ± 0.46

Vegetation year	Generative shoot					Root	
	Spica			Leaf plate			
	Length, cm	Width, mm	Number, pcs.	Length, cm	Width, mm	Number of roots of the first order, pcs.	Length, cm
1 year	5.3 ± 0.19	3.9 ± 0.13	8.7 ± 0.33	11.2 ± 0.37	5.1 ± 0.21	13.4 ± 0.44	41.3 ± 1.44
2 year	19.7 ± 0.62	4.1 ± 0.15	9.8 ± 0.29	18.5 ± 0.48	6.7 ± 0.22	28.3 ± 0.99	49.2 ± 1.72
3 year	20.2 ± 0.67	5.0 ± 0.19	8.8 ± 0.32	19.1 ± 0.65	7.6 ± 0.27	36.6 ± 1.24	96.3 ± 3.17

foothills, plants form 4.1 ± 0.16 partial bushes, and the length of the rhizome does not exceed 15 cm.

The roots in the third year of vegetation reach 96.3 ± 3.17 cm in length, the number of roots of the first order is 36.6 ± 1.24 pieces, and they branch up to the third order.

In autumn, young generative plants after summer dormancy form 16.4 ± 0.54 rosette shoots 12.1 ± 0.39 cm long, they bear 5.8 ± 0.21 leaves, of which 2 - 3 (4) are scaly.

In the Tashkent area, the appearance of generative shoots in the first year of life was observed in 90% - 95%, and in the second year, all plants entered the generative phase. As can be seen from Table 5, the plants of the Tashkent area are larger, the length of generative shoots is 20 - 25 cm longer, the number of shoots and communication rhizomes is also 2 - 3 more and they are longer, up to 20 cm. In addition, in more humid conditions of the Tashkent area, turf looser, since the internodes of the underground part of the shoot are somewhat longer than in the Chartak area.

The duration of the age state in the Chartak area is 2 - 3 years, and in the Tashkent area 1 - 2 years.

5.2. Middle-Aged Generative Plants

In the Chartak area, in *Elytrigia trichophora*, this age stage is observed from the 3rd year of vegetation in 40% of plants. As can be seen from Table 6, the number of generative shoots increases to 30.2 ± 0.84 and they reach a maximum length of 84.3 ± 2.86 cm. In the third year of vegetation, the number of partial bushes increases to 10.9 ± 0.37 pcs., the connection between them is preserved due to the strength of communication rhizomes. The root system deepens to

Table 5. Biometric indicators of *Elytrigia trichophora* in a young generative age state in the Tashkent area.

Vegetation year	The number of partial bushes, pcs.	Vegetative shoot					Generative shoot	
		Length, cm	Number, pcs.	Leaf plate			Length, cm	Number, pcs.
				Number, pcs.	Length, cm	Width, mm		
1 year	1	18.7 ± 0.65	4.1 ± 0.15	7.1 ± 0.24	9.6 ± 0.31	4.7 ± 0.16	60.6 ± 1.91	2.9 ± 0.11
2 year	4.6 ± 0.16	12.4 ± 0.44	8.9 ± 0.35	8.2 ± 0.28	13.9 ± 0.45	4.9 ± 0.21	110.7 ± 2.65	13.2 ± 0.47

Vegetation year	Generative shoot					Root	
	Spica		Leaf plate				
	Length, cm	Width, mm	Number, pcs.	Length, cm	Width, mm	Number of roots of the first order, pcs.	Length, cm
1 year	12.7 ± 0.38	4.7 ± 0.17	9.8 ± 0.33	12.1 ± 0.36	5.2 ± 0.19	29.6 ± 1.05	35.2 ± 1.19
2 year	20.5 ± 0.68	5.0 ± 0.19	10.1 ± 0.37	19.6 ± 0.65	5.7 ± 0.21	46.3 ± 1.48	50.4 ± 1.72

Table 6. Biometric indicators of *Elytrigia trichophora* in the middle age generative age state.

Area	Vegetation year	Number of partial bushes, pcs.	Vegetative shoot					Generative shoot	
			Length, cm	Number, pcs.	Leaf plate			Length, cm	Number, pcs.
					Number, pcs.	Length, cm	Width, mm		
Chartak	3 year	10.9 ± 0.37	10.5 ± 0.34	4.8 ± 0.17	5.6 ± 0.19	12.7 ± 0.34	4.9 ± 0.19	84.3 ± 2.86	30.2 ± 0.84
Tashkent	2 year	9.3 ± 0.31	13.2 ± 0.43	11.4 ± 0.37	8.7 ± 0.29	13.8 ± 0.49	4.9 ± 0.18	115.6 ± 3.93	26.5 ± 0.82
	3 year	15.1 ± 0.52	9.4 ± 0.31	6.6 ± 0.19	4.9 ± 0.22	13.5 ± 0.47	4.1 ± 0.14	115.1 ± 3.74	30.7 ± 0.94

Area	Vegetation year	Generative shoot					Root	
		Spica			Пластинка листа			
		Length, cm	Width, mm	Number, pcs.	Length, cm	Width, mm	Number of roots of the first order, pcs.	Length, cm
Chartak	3 year	20.7 ± 0.64	5.0 ± 0.19	9.1 ± 0.30	19.7 ± 0.67	7.8 ± 0.24	50.1 ± 1.62	101.3 ± 3.71
Tashkent	2 year	22.7 ± 0.72	5.1 ± 0.21	10.9 ± 0.35	23.6 ± 0.73	6.9 ± 0.27	68.3 ± 2.19	51.2 ± 1.84
	3 year	18.3 ± 0.51	5.0 ± 0.18	10.4 ± 0.33	16.1 ± 0.58	7.9 ± 0.29	93.6 ± 2.31	98.7 ± 3.24

101.3 ± 3.71 cm and they branch up to the third order.

In the Tashkent area, the number of generative shoots is almost the same, but they are 30 - 31 cm long and the number of partial bushes is 4 - 5 more than in Chartak.

The root system lengthens by 18 - 25 cm per year, and the number of first-order roots in the third year of vegetation increases to 93.6 ± 2.31 pieces, they branch up to the III-IV order (Table 6).

The duration of the age state in the Chartak area is 5 - 6 years, and in the Tashkent area, it is 1 - 2 years longer.

6. Conclusions

According to the treated result, it was proved that the possibility of the introduction of *Elytrigia trichophora* in the conditions of the mountain semi-desert, where less than 250 mm of precipitation falls.

Elytrigia trichophora is more adapted to drought and high temperatures. The flowering phase takes place at high temperature and low humidity. With a lack of moisture during the passage of the vegetative phases, the tillering phase lengthens, and generative shoots are not formed. With the onset of the xerothermic season, the growing season stops.

Thus, in long-term vegetative cereals, seasonal rhythms are restructured according to the ephemeroid type, which determines the possibility of their life activity in the conditions of the lower foothill.

The reaction to harsh xerothermic conditions is the lengthening of the virginal period of ontogenesis, and the reduction of the generative period.

Elytrigia trichophora is characterized by intravaginal branching of shoots, which is an adaptation to xerothermic conditions and sharp temperature fluctuations. During the summer period, axillary buds are protected from drought by dried pre-leaf and 1 - 2 rudimentary leaves.

In *Elytrigia trichophora*, a gradual opening of flowers in the spike during the day is observed, which determines a lower percentage of seeding, as the potential for pollination is reduced.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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