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THE SEED BIOLOGY OF SOME FODDER LEGUMES PLANTS (FABACEAE) IN THE ARID ZONE OF UZBEKISTAN

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Abstract. The article provides information about the quality of seeds: infestation, germination, humidity and mass of 1000 seeds of some fodder legumes plants. The infestation of seeds in the studied species in natural conditions ranges from 16.9 to 22.4 %, and the moisture content of seeds was 12.9-15.4 %, depending on the species. Hard-seeding is very high, from 80.6 (O.micrantha) to 95.4% (A.sieversianus). Seed dormancy in the studied taxa according to the classification of M. G. Nikolaeva et al. (1985) belongs to the physical group of exogenous dormancy – Af. The rate of water intake to seeds largely depends on the heterogeneity of seeds. Small seeds absorb more water than large ones. In General, small seeds within 2 hours absorb 170-175% of water by weight, large - 4 hours and 160-165 %. In O.micrantha after 7-8 hours there is a secondary increase in water absorption, which indicates the beginning of the growth phase of the embryo processes, which begin with cellular growth. Epigeal germination of plants is observed in the studied species. In O.micrantha at a temperature of 20-22°C on the 3nd day, in O. chorassanica on the 8-9nd day, in A.sieversianus and A. turkestanus on the 10-11nd day pecking is noted.

It effects favourably for the legume seed germination using with solutions of microelement salts and protective- activating resource. It is registred before sowing seeds, using of 0.1% Mo solution increases field seed germination to 10.6-13.4 %, and in the version of worked protective-activating means of ZSS-1b increases to 12.1-15.3%.

In the first days of germination, embryo root grows more intensively and hypocotyl. The accelerated growth rate of the root of seedlings and differentiation of the conducting system determine the speed of rooting during the short spring period of the arid zone. With a rapid deepening of the root, the formation of conducting system is also accelerated.

Keywords: Fabaceae, ecological condition, seed, stratification, seed hardness, germination, microelement, protective-activating means.

Burchoqdoshlar urug’larini mikroelementlar tuzlari eritmalari va himoyalovchi -faollashtiruvchi vositalar bilan ishlash ularning urug' unuvchanligiga ijobiy ta’sir ko’rsatadi. Urug'larni ekishdan oldin 0,1 % li Mo eritmasi bilan ishlash dala urug’ unuvchanligini 7,0-14,1 % ga, ZSS-1b preparati ishlangan variantlarda 5,7 – 15,3 % ga oshishi qayd etildi.

Dastlabki kunlari murtak ildizchasi va gipokotil tezroq o’sadi. O’simta ildizining yuqori tezlikda o’sishi va undagi o’tkazuvchi tizimni differentsiallashuv qurilgan tizamlarida qisqa burhorgi davrda uni ancha chuqurlikka o’rnashib olishini ta’minlaydi. Ildizning tezlikda chuqurlikka kirib borishi bilan birgalikda ildizning yuqori su’ratda shakllanishi qayd etildi.

Tayanch so’zlar: Fabaceae, ekologik sharoit, urug’, stratifikatsiya, qattiqurug’lik, unuvchanlik, mikroelement, himoyalashtiruvchi-faollashtiruvchi vosita.

Introduction

One of the urgent tasks ahead of us is to protect the biodiversity of flora, to preserve it for future generations, as well as its rational and effective use [1-2]. Each family of the flora of Uzbekistan has its own place. One of them is the family Fabaceae Lindl., which includes more than 480 species [3]. More than 90% of family members are valuable fodder, medicinal and honey-succulent plants, which contribute to the increase of soil fertility [4-11]. In particular, representatives of the genus alhagi, licorice, astragalus and gobeliy play an important role in the pharmaceutical industry, preserving glycerin acid and other flavinoid compounds at the root, stem and leaves [12-14].

Representatives of this family of astragalus, onobruchis, psoralea and alhagi are well adapted to grow in the arid zone and steppes. Therefore, it is advisable to use most of them in phytomelioration works in degraded areas [15-17].

The largest genus Astragalus of family of Fabaceae belongs to more than 270 species, which make up 55% of the family [3, 18-19]. Currently, the study of the ecobiology of our flora on a scientific basis, assessment of their reproductive activity, monitoring of cenopopulations of endangered species, identification of the process of seed recovery and factors affecting it, the creation of collective nurseries of beneficial local flora, placement of plant seeds in special gene banks is urgent task [ 20-21].

It should be noted that the recovery of the plant's own population is directly related to its germination [22-25]. Therefore, in recent years, much attention has been paid to the study of seed biology of endangered plants [26].
for this is that the main part of the area where these species are distributed is used for agricultural crops, and in the areas used as pastures in the foothills, the number of livestock is 2-5 times higher than the norm.

In this regard, in 2015-2019 we studied the seed biology of these species and tested some tools that increase seed germination.

The study objects are the hills of the Yangiabad and Zaamin districts (adir region) located on the northern side of the Turkestan mountain range. The area has a complex relief, most of which is covered with boulder, gravel and sandy proluvial deposits, pre-mountain sloping plains. The soil is typical gray soil, unsalted, humus content is around 1-3%. Most of the land is used as pasture for livestock.

These areas enter the lower hill region, where the climate is highly variable. According to the Zaamin AGM, the average annual rainfall in the region is around 390-470 mm, with a relative humidity of 55-58%. The average annual temperature is +13.7°C, including + (27-+28) °C in July and -3-7 °C in January. The maximum temperature is +40 - +42 °C (in July), the minimum is -22 - 26 °C (in January).

The species of astragalus was determined by comparing the "Information System FLORUZ" (2015) developed by the National Herbarium of the Research Institute of Botany of the Uzbek Academy of Sciences and the prototypes stored in the herbarium.

Seed quality was tested according to international requirements [27]. Seeds were sown in a thermostat at a temperature of 22 to 0.1 °C for 14 days. Seed germination was studied by dividing it into germinated, hard and rotten parts [28]. The term “seed germination” was used in the sense given in the work of J.D. Bewley, M.Black [29], the stages of seed germination divided in the case of A.V.Poptsov and others [30].

The objects of research were described based on morphological and biomorphological atlases [31-33].

Results and discussion

The research species A. sieversianus - a perennial plant up to 1.5 meters tall (fig.1). The root of the arrow goes to a depth of 85-120 cm. The stem is large, fleshy and covered with white feathers. The leaves are as complex and odd-pinnate leaf as the above species. The shoot are clustered in 3 to 5 flowers. The flowers are yellow.

Its legume is sedentary, ovoid - round in shape, covered with fluffy, thick white-yellow feathers. The size is 2-3 sm long and 1.5-1.7 sm wide. Seeds are kidney-shaped, 4-8 mm in size, brown. It blooms in May-June and bears fruit in June-August.

Hemicriptophyte, mesoxerophyte propagated by seeds.

Distributed in rocky and sandy-gravelly mountainous areas of the republic. It is considered a medicinal and fodder plant.

A.turkestanus is a perennial herbaceous plant with 8-12 strongly developed I-order branches. Bullet root is 85-100 sm long (fig.2). The compound leaves are 12-19 sm long and odd-pinnate leaf - shaped. Inflorescence 2-5 flowers. The color of the petals is yellow.

Legume fruit is 12-18 mm long and 5-7 mm wide. Fruit of the plant stores 2 to 4 seeds. The seeds are elongated kidney-shaped, 3.5 mm long, brown.

Hemicriptophyte, mesoxerophyte. The plant species blooms in May-June, and the fruiting period is June-July. Propagated by seeds.

Occurs in the foothills of Uzbekistan. As a nutritious forage plant it is eaten with appetite by livestock.
O. micrantha is an annual plant up to 22-35 sm tall (fig.3). The root of the arrow goes to a depth of 35-40 sm. The stem is covered with sparse feathers. The leaves are complex, odd-pinnate leaf - lanceolate, 4-6 sm long. The flowers are 8-12 in clusters. The flowers are pale in color.
Its fruit is semicircular in shape, and the space between the edge of the comb is completely covered with a whiteish-yellow bark. Size is 10-13 mm, width is 7-9 mm. Seeds are kidney-shaped, 4–5 mm in size, brown in color. It blooms in May-June and ripens in June-July.

Therophyte, mesophyte. Propagated by seeds. It grows in rocky and gravelly mountainous areas. It is considered a fodder plant.

*O. chorassanica* - perennial herbaceous plant, with 3–8 order shoots. The stems and leaves are covered with dense white hairs. Arrow root 80–90 cm long (fig.4). The compound leaves are 10-17 cm long, the single-stemmed inflorescence 35-40 cm in size, retains 45-56 flowers. The color of the crown is white-yellow, with reddish veins.

Legum fruit is kidney-shaped, 12-14 mm long and 7-9 mm wide. Legum has a comb-like edge and sharp pointed products. Seeds are 3.5–4 mm long, brown - brown.

Hemicriptophyte, mesoxerophyte. Propagated by seeds. The plant blooms in May-June, and the fruiting period is observed in June-July.

It is a valuable fodder plant found in the foothills of Uzbekistan.

It is important to determine the quality of seeds in the reproduction of plant species and their introduction into production [30, 6, 26]. Seed quality indicators of a plant include seed saturation, moisture, damage and germination [27]. Our investigations showed that the mass of 1000 seeds in our studied species averaged 14.3–42.2 g (Table 1). The moisture content of plant seeds was 13.2-15.4%.

### Seed quality indicators

<table>
<thead>
<tr>
<th>Species</th>
<th>1000 seed mass g</th>
<th>Insect infestation, %</th>
<th>Moisture, %</th>
<th>Germination, %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Sprouted</td>
</tr>
<tr>
<td>A.sieversianus</td>
<td>16,7</td>
<td>21,5</td>
<td>13,2</td>
<td>3,2</td>
</tr>
<tr>
<td>A.turkestanicus</td>
<td>14,3</td>
<td>22,4</td>
<td>14,7</td>
<td>3,4</td>
</tr>
<tr>
<td>O.micrantha</td>
<td>42,2</td>
<td>16,9</td>
<td>12,9</td>
<td>16,7</td>
</tr>
<tr>
<td>O. chorassanica</td>
<td>28,4</td>
<td>19,3</td>
<td>15,4</td>
<td>4,9</td>
</tr>
</tbody>
</table>

Insect infestation of plant species seeds was found to average 16.9 -22.4% during the research period, while the magnitude of this figure varied in some years. In particular, in 2018, seed infestation in *A.sieversianus* was around 34.3% and in *A. turkestanicus* species around 38.6%.

Like all *Fabaceae* astragalus and onobruchis seeds have been reported to be predominantly infested with larvae of the beetle (*Bruchophagus mutabilis* Nik.), Shield beetle (*Cellobius abdominalis* Jac.) and *Chaloidoidea* beetles.

Insect damage to the generative organs is characteristic of all species of the *Fabaceae*, a feature noted in many scientific sources. V.P. Grankina and T.P. Nadezhina [34] estimates that about 40% of the fruits and seeds of the Ural licorice are infested with pests. H.K. Karshibaev and Z.S. Hasanova [35] noted that 16.5-26.5% of the seeds of *V. pachycarpa* and *G. aspera* were infected. O.A. Ashurmetov et al. [36] recognized that the mass of 1000 seeds of licorice was 8 g, the moisture content was around 10%, and the infestation rate was 25.8%.
One of the characteristic features of *Fabaceae* is the hardness of these seeds [37-40]. The hardness property was also observed in all species in the *Fabaceae*, which were the object of study, and it was 80.6-95.4%.

Hardness is associated with the specific structure of the spermoderm which is seed cortex [41-43]. In hard seeds, the process of swelling does not take place. They are extremely resistant to the effects of adverse environmental factors.

L.A. Shamsuvalieva [44] found that there is an inverse relationship between the seed cortex (spermoderma) and the fruit cortex (perikarp), namely, the thicker the cortex of the fruit, the thinner the seed cortex.

According to the classification of M.G. Nikolaeva [45] the hard of Fabaceae seeds belongs to the exogenous Af form of the seed dormancy state. Their main feature is that the seeds do not swell.

Seed germination is one of the delicate stages that determines the fate of a plant species and predicts seed multiplication and recovery. Stages of plant seed germination and factors influencing are studied by M.G. Nikolaeva et all., [46], N.V.Obrucheva [47], N.V.Obrucheva, O.V. Antipova [48] and N.A.Askochenskya [49].

1-In the swelling stage, the seeds absorb water and water vapor and the seed size increases. Water is a necessary external factor for the seed germination [49]. In the studied *Onobrychis* species, the process of swelling lasted from 6-7 hours (*O. micrantha*) to 15-17 hours (*O. chorassanica*), while in the astragalus species it lasted from 25 to 28 hours. During this time, seed weight was reported to increase by 50–75% in esparto species and by 145–150% in astragalus species.

*Medicago tianschanica* Vass., *Psoralea drupacea* Bunge and *Alhagi pseudalhagi* (Bieb.) Fisch, representatives of the family *Fabaceae* data on seed swelling of species are given in the scientific works of O.A. Ashurmetov, H.K. Karshibaev [6]. They observed that seeds collected from hills and deserts were grown in the laboratory, and that the swelling process in these seeds lasted 14 to 16 hours and that the water absorbed by the seeds was 70 to 145% of the seed weight.

During the activation phase, the enzymatic system in the seeds is activated and the nutrients in the reserve are mobilized to the appropriate parts. According to A.V. Poptsov and other scientists [30] the seed begins to breathe rapidly, CO\(_2\) and heat begin to separate. During this period, all the mechanisms that resist seed germination are overcome by the enzymatic system.

The activation phase in the studied *Onobrychis* species lasts from 1.9 hours (*O. micrantha*) to 8.5 hours (*O. chorassanica*), and in the astragalus species from 29.1 hours (*A. sieversianus*) to 34.5 hours (*A. turkestanicus*). At this stage, the seeds stop absorbing water and the enzyme system in the seed becomes active. According to some scientists, the barriers that prevent germination during this period are removed and the seed is ready to germinate [47].

In seeds that have successfully passed the stages of swelling and activation, the last third stage - the growth of the ovary is observed. At this stage in the seeds is observed cracking of the ovary root seed cortex.

The growth of the ovary begins with the elongation of the cells [48]. In this process, the reabsorption of water by the growing ovary is enhanced. In *O. micrantha*, a member of the genus *Onobrychis*, ovarian growth is recorded after 18-20 hours, and in *O. chorassanica* species after 34-37 hours, rupture of the ovule root seed coat is observed in 3 days in *O. micrantha* and 8-9 days in *O. chorassanica*. In astragalus species, this process takes place after 10-11 days.

Butnik A.A. et al. [50] noted that *Astragalus unifoliolatus* Bunge seeds germinate in 7-9 days at a temperature of 22 °C under laboratory conditions. In seed germination, rapid growth of the apex root is noted in most plants under optimal conditions. It helps the root to settle into the soil layer quickly.

There are several ways to overcome the phenomenon of stiffness [46]. Of these, the method of scarification and imposition is the most common. The scarification method is carried out by sandpaper or by chemical means (solution of H\(_2\)SO\(_4\) acid). R. Sankhla, D. Shawan [51], Chemical treatment with H\(_2\)SO\(_4\) acid solution for 15-30 minutes before sowing legume seeds gives good results.
We used the methods of scarification, impregnation, and soaking in boiling water ((96-98°С) (10 + 10 + 10 + 10 and 20 + 10- + 10 minutes). Unprocessed seeds were obtained as a control. High germination was observed in scarified and soaked seeds in boiling water (Table 2).

<table>
<thead>
<tr>
<th>Species</th>
<th>Seed germination, %</th>
<th>Observation</th>
<th>Scarification</th>
<th>Impact</th>
<th>Soaking in boiling water (40 sec.)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Sprouted</td>
<td>Hard</td>
<td>Rotten</td>
<td>Sprouted</td>
</tr>
<tr>
<td>A. sieversianus</td>
<td>3.2</td>
<td>77.2</td>
<td>17.5</td>
<td>5.3</td>
<td>85.2</td>
</tr>
<tr>
<td>A. turkestanus</td>
<td>3.4</td>
<td>67.3</td>
<td>27.9</td>
<td>4.8</td>
<td>80.2</td>
</tr>
<tr>
<td>O. micrantha</td>
<td>16.7</td>
<td>81.5</td>
<td>11.9</td>
<td>6.6</td>
<td>83.3</td>
</tr>
<tr>
<td>O. chorassanica</td>
<td>4.9</td>
<td>66.1</td>
<td>28.0</td>
<td>5.9</td>
<td>84.9</td>
</tr>
</tbody>
</table>

It can be seen from the data in the table, high seed germination is observed by the method of impact and working with boiled water.

According to the observation of S.F. Ponomorenko [41] hardness decreases over time under the influence of external factors. According to the information of A.A. Butnik and other researchers the seeds of Astragalus flexus Fisch. which preserved and scarified in the laboratory retain 4.8% germination in the 1st year, 97.2% in the 4th year, and 91.2% in the 5th year [50].

During the researches the effect of working with micronutrients and plant protection-activating agents on seed germination of astragalus species was studied. The results showed that the highest results in the studied objects were observed in seeds soaked in 0.1% Mn and Mo solutions and in variants treated with ZSS-1b, namely seed germination reached 90.5 - 94.1%, and in variant ZSS-1b. Increased from 91.3% to 95.6% (Table 3). This indicator was 12.1% of seed germination in A. sieversianus species compared to the control variant, 15.3% in A. turkestanus, and 7.0-12.5% in Onobrychis.

It has been found that micronutrients are part of many enzymes and ensure the normalization of biochemical process in plants [52].

<table>
<thead>
<tr>
<th>Species</th>
<th>Seed germination, %</th>
<th>Observation</th>
<th>**B</th>
<th>Cu</th>
<th>Mn</th>
<th>Mo</th>
<th>ZSS-1b</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. sieversianus</td>
<td>83.5</td>
<td>85.3</td>
<td>89.1</td>
<td>84.7</td>
<td>90.1</td>
<td>90.8</td>
<td>92.9</td>
</tr>
<tr>
<td>A. turkestanus</td>
<td>79.1</td>
<td>82.4</td>
<td>88.5</td>
<td>83.1</td>
<td>86.8</td>
<td>90.7</td>
<td>93.1</td>
</tr>
<tr>
<td>O. micrantha</td>
<td>85.6</td>
<td>86.5</td>
<td>87.8</td>
<td>90.3</td>
<td>90.0</td>
<td>90.2</td>
<td>92.3</td>
</tr>
<tr>
<td>O. chorassanica</td>
<td>81.4</td>
<td>84.8</td>
<td>86.2</td>
<td>89.5</td>
<td>88.4</td>
<td>89.9</td>
<td>91.2</td>
</tr>
</tbody>
</table>

Table 3
The field fertility of the seeds of *Medicago tianschanica* Vass and *Glycyrrhiza aspera* Pall which are treated with 0.05% Mo salts is high by 10-19% which is registerated in the research of X.K. Karshiboyev [53]. According to Sh.J. Tojiboyev [54] the role of micronutrients in increasing the resistance of plants to the harmful effects of the external environment and desease is enormous.

**Conclusion**

1. Hardness is characteristic for legumes which are spread in the slope and desert zone. Its quantity is around 92.9-95.6 %. For destroying the hardness, it is soaked in boiled water during 40 minutes or required by the method of impact.

2. It effects favourably for the legume seed germination using with solutions of micronutrient salts and protective - activating resource. It is registreted before sowing seeds, using of 0.1% Mo solution increases field seed germination to 10.6-13.4 %, and in the version of worked preparation of ZSS-1b increases to 12.1-15.3%.

**References:**


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