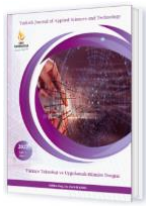
Türkiye Teknoloji ve Uygulamalı Bilimler Dergisi



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Yonca (*Medicago sativa* L.) Popülasyonlarına Ait Tohumların Bazı Fiziksel Fizyolojik Özelliklerinin Belirlenmesi

Determination of Some Physical-Physiological Properties of Seeds of Alfalfa (*Medicago sativa* L.) Populations

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Özet

Yonca en önemli yem bitkisidir. Bu nedenle yonca üzerinde çok sayıda araştırma yapılmıştır. Bu çalışma, 2020-2021 yılları arasında Bingöl Üniversitesi Ziraat Fakültesi Biyosistem ve Tarla Bitkileri laboratuvarlarında kontrollü koşullar altında yonca popülasyonlarına ait tohumların fiziksel ve fizyolojik özelliklerinin belirlenmesi amacıyla yürütülmüştür. Çalışmada bitki materyali olarak Bingöl ilinde yetiştirilen 16 popülasyon ve dört standart çeşit olmak üzere toplam 20 yonca genotipi kullanılmıştır. Çalışmada, yonca tohumlarının uzunluk, genişlik, yüzey alanı, ortalama aritmetik ve geometrik çapları, küresellikleri, çimlenme oranları ve süreleri araştırılmıştır. Yonca genotiplerine ait tohumların ortalama 1.265 mm uzunluğa, 0.732 mm genişliğe ve 0.761 mm^2 yüzey alanına sahip olduğu belirlenmiştir. Genotiplere ait tohumların ortalama aritmetik çapı 0.970 mm, geometrik çapı 0.456 mm ve küresellik değeri 0.334 olarak belirlenmiştir. Sonuç olarak yonca popülasyonlarına ait tohumların standart çeşitlerin fiziksel ve fizyolojik özelliklerine sahip olduğu saptanmış olup, elde edilen verilerin ıslah çalışmalarında ve mekanizasyon uygulamalarında değerlendirilebileceği öngörülmektedir.

Anahtar Kelimeler: Yonca, yem bitkileri, tohum büyüklüğü, tohum özellikleri.

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Abstract

Alfalfa is the most important forage crop. For this reason, a lot of research has been done on alfalfa. This study was carried out to determine the physical and physiological characteristics of the seeds of alfalfa populations under controlled conditions in the Biosystem and Field Crops laboratories of the Faculty of Agriculture of Bingol University between the years 2020-2021. In the study, a total of 20 alfalfa genotypes, of which 16 populations and four standard varieties, grown in Bingol Province were used as plant material. In the study, length, width, surface area, mean arithmetic and geometric diameters, sphericity, germination rates and times of alfalfa seeds were investigated. It was determined that the seeds of the alfalfa genotypes had an average length of 1.265 mm, a width of 0.732 mm and a surface area of 0.761 mm^2. The mean arithmetic diameter of the seeds belonging to the genotypes was 0.970 mm, the geometric diameter was 0.456 mm and the sphericity value was 0.334. As a result, it has been determined that the seeds of alfalfa populations have the physical and physiological characteristics of standard varieties, and it is foreseen that the obtained data can be evaluated in breeding studies and mechanization applications.

Keywords: Lucerne, forage crops, seed size, seed characteristic.

1. Introduction

Alfalfa is the most widely grown forage crop in the world. *Medicago sativa* species constitute 90-95% of alfalfa grown in the World (1-2). Because alfalfa grass is high in protein, dry and green grass is delicious for any animal. Alfalfa grass is called the "queen of forage crops" because it is rich in minerals and vitamins (3).

Alfalfa is mostly grown for green grass, hay and silage (4). In some countries, it is used for grazing animals (5-6). Alfalfa is preferred by producers due to its positive features such as rapid development, perennial nature and harvesting by cutting and its structure that does not allow the development of weeds (7). According to 2021 data, 19.3 million tons of green grass is produced on 6.7 million decares in Turkey. Green grass yield is 2.895 kg and seed yield is 59 kg per decare (8).

Since alfalfa seeds are very small in general, the seed bed should be prepared very well in alfalfa cultivation. The soil should be well crumbled, pressed and free of weeds (2). The alfalfa has a spiral-shaped fruit resembling a pod that is twisted 1-5 times around itself. There are approximately 3-7 seeds in the fruit. The appearance of the seeds resembles kidney or bean (5). The alfalfa seed to be used must be superior in terms of physical, biological and genetic values. At the same time, if several years of alfalfa seed is to be used, it is important that it is well stored, free of mold and odor (9).

For a successful cultivation of alfalfa, it is necessary to plant the alfalfa with a seed drill. Under normal conditions, 0.4 kg of seed per decare is sufficient, but when uncontrollable conditions (climate, soil and irrigation) are encountered, more seed (3-7 times) approximately 1.2-2.8 kg of seed per decare can be used (9). In addition to knowing the characteristics of the region where alfalfa cultivation will be carried out, knowing the morphological and physiological characteristics of the seed is important in terms of providing more economical production.

Shape-size properties of seeds are included in the characteristic features of seeds because they are different in each. Data such as length (mm), width (mm) and thickness (mm) may vary according to

the geography of the plants, especially the genotypes. Soil characteristics (pH, salinity, drought, etc.), especially climate, significantly affect the journey from seed to plant formation (10).

Physiological properties of seeds vary as well as other characteristic properties. Many general conditions such as the environment in which plants are grown, climate and geography cause differences on seeds. For this reason, studies are carried out to meet the needs of the plants planned to be grown as much as possible and to obtain the highest yield with the least loss. In cases where it is necessary to meet the basic requirements of the seeds, it is possible to apply products (hormones, fertilizers, etc.) or methods (such as film coating, pelletizing) that support seed development.

It is aimed that the data obtained in this study will provide a basis for future breeding studies, prevent seed waste by using the required amount of seed in sowing operations to be carried out with the help of agricultural mechanization, selecting the appropriate sowing pattern (preventing ground-bending), new tool-machine designs-production and the use of necessary equipment.

This study was carried out to determine the physical and physiological characteristics of seeds of 20 alfalfa (*Medicago sativa* L.) genotypes, 16 populations and 4 standard varieties, grown in Bingol.

2. Material and Method

This study was carried out between 2019-2020 in the laboratories of Bingol University Faculty of Agriculture Biosystem Engineering and Field Crops. In the study, 16 alfalfa populations (Çeltiksuyu, Çevirme, Garip, Arslanbeyli, Kumgeçit, Mutluca, Küçüktekören, Kültür Mahallesi, Meşedalı, Ortaköy, Bağlıisa, Şenköy, Servi, Sarıçiçek, Taşlıçay, and Yelesen) were used as plant material, with 16 alfalfa populations and four cultivars (Basbag, Bilensoy, Elçi and Kayseri) grown in the province of Bingol were examined.

2.1 Climatic and soil characteristics of Bingol province

According to the climate data for the years 1961-2019 taken from the General Directorate of Meteorology (MGM, 2020); In general, it is seen that the monthly average temperature value of Bingol province is 12.1^{0}C, the hottest months are July and August, and the coldest months are January and February (Figure 1).

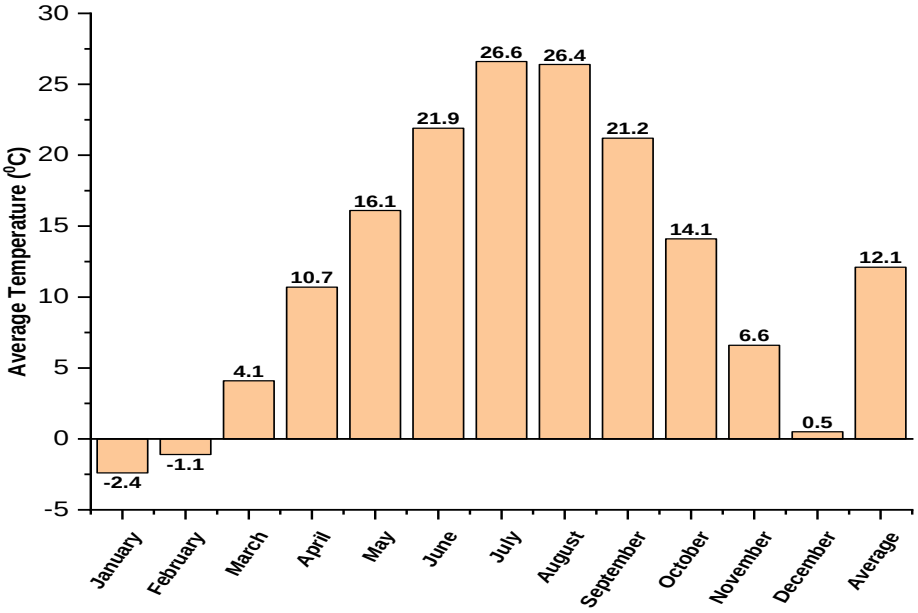

Figure 1. Average temperature values of the long-term average of the province of Bingol (^{0}C)

The total amount of precipitation in Bingol province for many years is 949.1 mm. It is seen that the highest precipitation falls in December and January, and the lowest precipitation falls in July and August (Figure 2).

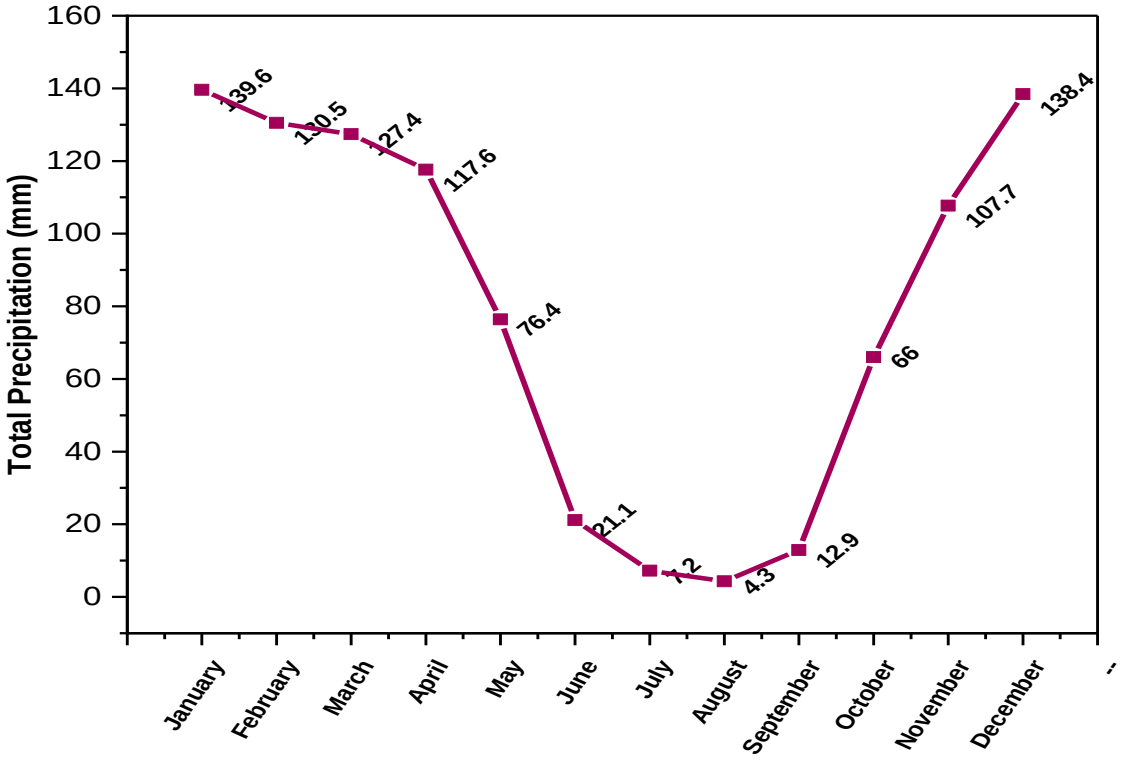

Figure 2. The average annual rainfall in the province of Bingol (mm)

The lands of Bingol province in general; it shows a clay-loam structure, neutral or near-neutral reaction, no salinity problem, slightly calcareous to medium calcareous, low organic matter, insufficient phosphorus and sufficient potassium.

2.2 Physical properties of alfalfa seeds

After the researches, seeds are generally expressed as long, medium and short in terms of geometric characteristics and round, oval and long in terms of shape characteristics (Table 1) (11).

Table 1. Classification of seeds according to their geometric characteristics and shapes

Seeds according to their geometric characteristics	**Grain width/Grain length (b/a) (mm)**
Long	< 0.6
Medium	0.6 – 0.7
Short	> 0.7
Seeds according to their shapes	**Length (a), Width (b), Thickness (c) (mm)**
Round	a ≈ b ≈ c
Oval	a/3 < b ≈ c
Long	c < b < a/3

In this study, 100 alfalfa seeds taken from each genotype were examined in a laboratory environment with the help of a stereo microscope (Nikon SMZ 745T) with its own software (12). Their length (mm), width (mm) and surface area (mm^2) values were measured (13). Then, the obtained data were placed in the following equations and the average arithmetic and geometric diameter (mm) and sphericity parameters of the seeds were determined (14-17).

Average Arithmetic Diameter:

$$D: (L + W)/2 \quad (1)$$

D: Seed Average arithmetic diameter (mm). L: Seed Length value (mm). W: Seed width value (mm).

Average Geometric Diameter:

$$Do: (L\ x\ D\text{^}2)^{1/3} \quad (2)$$

D_0: Seed Average geometric diameter (mm). L: Seed Length value (mm). D: Seed Average arithmetic diameter (mm).

Sphericity:

$$\Phi: \frac{Do}{L} \quad (3)$$

Φ: Seed sphericity value. Do: Seed Average geometric diameter (mm). L: Seed Length value (mm).

The thousand-grain weight (g) of the seeds is also included in the basic characteristic features. In this study, alfalfa seeds sampled from twenty different genotypes were counted in triplicate and weighed with Radwag AS 220.R2 analytical balance (to 0.0001 g sensitivity) (18-19).

2.3 Physiological properties of alfalfa seeds

Germination rate and germination time were determined within the physiological properties of seeds taken from twenty different clover genotypes. For this purpose, randomly selected seeds with four replications were first pre-cooled according to ISTA (2007) rules. Then, the germination process of the seeds was carried out in a BİNDER brand incubator for 11 days at 20-25 °C, at 55-60% humidity. The data obtained as a result of the daily counting process were evaluated. (*Average germination rate* (%): $(\Sigma\, n/N\, x\, 100)$; *Average germination time* (day): $\Sigma(gxXnx)/(\Sigma nx)$)(n: *Number of germinated/emergent seeds*, N: *total number of seeds*; g_x: *day of germination*, n_x*: Number of seeds germinated on the day of counting*, Σn_x: *Total number of germinated seeds*) (20-21).

2.4 Statistical analysis

In this study, alfalfa seeds from twenty different genotypes were examined in a randomized trial plot design with triplicate. The obtained data were evaluated statistically using the SPSS V.21 program. Firstly, the difference of seeds was determined at $p<0.05$ level by One-Way ANOVA test; Afterwards, TUKEY test was applied to the values.

3. Results and Conclusion

3.1 Length, width and surface areas of seeds

It was determined that the seeds of the alfalfa genotype had an average length of 1.265 mm, a width of 0.732 mm, and a surface area of 0.761 mm^2. Bağlıisa (1.318 mm) and Elçi (1.322 mm) genotypes, which are in the same group statistically, are the tallest alfalfa seeds; Küçüktekoren (1,203 mm) genotype was found to be the shortest alfalfa seed. In terms of width parameter, Çeltiksuyu (0.767 mm) and Elçi (0.765 mm) are the largest alfalfa genotypes; Servi (0.683 mm) genotype was determined to be the narrowest alfalfa seed. While Elçi (0.833 mm^2) is ahead of the other genotypes in terms of surface area, Küçüktekören (0.699 mm^2) and Servi (0.689 mm^2) were determined as the genotypes with the lowest values (Table 2).

Soya et al. (2004) and Avcıoğlu et al. (2009) stated that since the colors of alfalfa seeds change from yellow to brown, they are 2.0-2.5 mm long, 1.2-1.4 mm wide, and the outer surfaces of the seeds have a shiny and flat structure. According to Yagcioglu (2015) seed classification, seeds belonging to twenty different alfalfa genotypes were determined to have long and oval seed structure.

Table 2. Length, width and surface area values of alfalfa seeds belonging to different genotypes

No	Seed Genotype	Length (mm)	Width (mm)	Surface area (mm^2)
1	Başbağ	1.291^{abc}	0.765^{ab}	0.821^{ab}
2	Bilensoy	1.274^{abcde}	0.744^{abcd}	0.775^{bcdef}
3	Elçi	**1.322^{a}**	**0.765^{a}**	**0.833^{a}**
4	Kayseri	1.274^{abcde}	0.735^{abcde}	0.775^{bcdef}
5	Çeltiksuyu	1.280^{abcde}	**0.767^{a}**	0.802^{abcd}
6	Çevirme	1.232^{efg}	0.711^{defg}	0.711^{fg}
7	Garip	1.288^{abcd}	0.735^{abcde}	0.778^{abcdef}
8	Arslanbeyli	1.274^{abcde}	0.748^{abcd}	0.782^{abcde}
9	Kumgeçit	1.280^{abcde}	0.744^{abcd}	0.786^{abcde}
10	Mutluca	1.260^{bcdef}	0.736^{abcde}	0.757^{defg}
11	Küçüktekören	**1.203^{g}**	0.719^{defg}	**0.699^{g}**
12	Kültür Mah.	1.271^{abcde}	0.729^{abcdef}	0.763^{cdefg}
13	Meşedalı	1.240^{cdefg}	0.727^{bcdef}	0.731^{efgh}
14	Ortaköy	1.235^{defg}	0.705^{efg}	0.717^{fg}
15	Bağlıisa	**1.318^{a}**	0.757^{abc}	0.815^{abc}
16	Şenköy	1.252^{cdefg}	0.692^{fg}	0.725^{fgh}
17	Servi	1.212^{fg}	**0.683^{g}**	**0.689^{g}**
18	Sarıçiçek	1.229^{efg}	0.723^{cdef}	0.724^{fgh}
19	Taşlıçay	1.308^{ab}	0.748^{abcd}	0.808^{abcd}
20	Yelesen	1.248^{cdefg}	0.712^{defg}	0.723^{fgh}
Average		**1.265**	**0.732**	**0.761**

*: $p \leq 0.05$

3.2 Average arithmetic and geometric diameter with sphericity

The average arithmetic-geometric diameter and sphericity values of these seeds were determined by using the measurements of the twenty different genotypes of alfalfa seeds. According to the data obtained; the average arithmetic diameter value of alfalfa seeds was calculated as 0.970 mm, geometric diameter 0.456 mm and sphericity value 0.334. It was determined that the Elçi genotype gave the highest statistical value compared to the other alfalfa seeds, and the Servi and Küçüktekören genotypes were in the group with the lowest value (Table 3).

3.3 Germination rate and time

In the study, germination rates and germination times obtained as a result of daily counts and under controlled environment conditions, according to ISTA (2007) rules are given in Table 4. The average germination rate of the genotypes was 90% and the germination time was determined as 1.726 days. According to the obtained data, it was determined that all genotypes, except Kültür and Taşlıçay genotypes, did not germinate without showing any disease symptoms among the seeds belonging to the examined alfalfa genotypes. It was determined that the genotypes had germination rates between 82-98% (Kayseri and Kumgeçit) and between 1.651-1.818 days (Şenköy and Küçükten) (Table 4).

Table 3. Average arithmetic-geometric diameter and sphericity values of alfalfa seeds with different genotypes

No	Seed Genotypes	Average Arithmetic Diameter (mm)	Average Geometric Diameter (mm)	Sphericity
1	Başbağ	1.028^{abc}	0.461^{abc}	0.354^{abc}
2	Bilensoy	1.009^{abcde}	0.441^{abcdef}	0.342^{abcde}
3	Elçi	**1.043^{a}**	**0.486^{a}**	**0.365^{a}**
4	Kayseri	1.004^{bcdef}	0.435^{bcdefg}	0.338^{bcdef}
5	Çeltiksuyu	1.023^{abc}	0.453^{abcd}	0.351^{abc}
6	Çevirme	0.972^{fgh}	0.394^{fgh}	0.316^{fgh}
7	Garip	1.011^{abcd}	0.446^{abcde}	0.343^{abcd}
8	Arslanbeyli	0.440^{abcd}	$1.011^{abcdefg}$	0.342^{abcd}
9	Kumgeçit	1.012^{abcd}	0.442^{abcdef}	0.343^{abcd}
10	Mutluca	0.998^{cdefg}	0.426^{cdefg}	0.334^{cdefg}
11	Küçüktekören	**0.961^{gh}**	**0.377^{h}**	**0.310^{gh}**
12	Kültür Mah.	1.000^{cdef}	0.431^{bcdefg}	0.335^{cdef}
13	Meşedalı	0.983^{defgh}	0.407^{defgh}	0.324^{defgh}
14	Ortaköy	0.970^{fgh}	0.393^{gh}	0.315^{fgh}
15	Bağlıisa	1.038^{ab}	0.479^{ab}	0.360^{ab}
16	Şenköy	0.972^{efgh}	0.404^{efgh}	0.318^{efgh}
17	Servi	**0.947^{h}**	**0.367^{h}**	0.300^{h}
18	Sarıçiçek	0.976^{defgh}	0.396^{fgh}	0.319^{defgh}
19	Taşlıçay	1.028^{abc}	0.469^{abc}	0.354^{abc}
20	Yelesen	0.980^{defgh}	0.406^{defgh}	0.322^{defgh}
Average		**0.970**	**0.456**	**0.334**

*: $p \leq 0.05$

Table 4. Germination rates and times of different alfalfa genotypes

No	Seed Genotypes	Germination Rates (%)	Germination Time (day)
1	Başbağ	86	1.746
2	Bilensoy	91	1.663
3	Elçi	92	1.779
4	Kayseri	82	1.762
5	Çeltiksuyu	86	1.726
6	Çevirme	95	1.687
7	Garip	91	1.694
8	Bağlıisa	93	1.775
9	Kumgeçit	98	1.717
10	Mutluca	92	1.792
11	Küçüktekören	82	1.818
12	Meşedalı	91	1.679
13	Ortaköy	96	1.706
14	Bağlıisa	84	1.769
15	Şenköy	89	1.651
16	Servi	86	1.682
17	Sarıçiçek	97	1.680
18	Yelesen	86	1.743
Average		**90**	**1.726**

4. Conclusion

In the study, it was seen that Elçi, one of the standard varieties, had the highest length, width and surface area values. Among the populations, Bağlıisa gave values close to standard varieties in terms of length and surface area, and Çeltiksuyu in terms of width. It was determined that the standard variety that gave the highest value in terms of mean arithmetic diameter, geometric diameter and sphericity was Elçi. Among the populations, Celtiksuyu, Garip, Arslanbeyli, Kumgeçit, Bağlıisa and Taşlıçay genotypes were found to be in the same statistical group as the Elçi cultivar. In terms of germination rate and speed, it has been determined that many populations give superior values to the standard varieties.

As a result, it was determined that the seeds of the populations examined in this study had similar values with the physical and physiological characteristics of standard seed varieties. It is predicted that these values will be useful especially in the breeding studies to be carried out for these populations. In addition, it is thought that producers will produce with less seed loss by utilizing these characteristics. It is predicted that appropriate mechanization choices will be made by supporting the producers economically.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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