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EVALUATION OF SEEDLING DEVELOPMENT AND PHYSICAL CHARACTERISTICS, VIABILITY AND GERMINATION OF SEEDS IN SOME LAMIACEAE TAXA

Belgin COŞGE ŞENKAL[1]*, Tansu USKUTOĞLU[1]

[1]Yozgat Bozok University, Faculty of Agriculture, Department of Field Crops, 66900, Yozgat, Türkiye

Abstract: The Flora of Türkiye is very rich in the members of the Lamiaceae family. This study, it was aimed to investigate some physical characteristics, viability, germination performance of their seeds, and initial seedling development of 16 taxa belonging to the Lamiaceae family collected from the natural area. According to the results, the highest and lowest viability value was recorded in *S. aethiopis* (82.86%) and in *S.yosgadensis* (10.71%), respectively. The root length values of the taxa changed between 25.57mm (*T.sipyleus*)-66.82mm (*S.aethiopis*) at the end of the 21st day. The shoot lengths of the seedlings were determined to vary between 3.12mm (*T.sipyleus*)-22.41 mm (*P.armeniaca*). The seed width and length values of taxa varied between 0.911-2.788mm and 0.999-5.055mm, respectively. Values varying between 0.432-0.865 were calculated according to the geometric properties determined by proportioning the width and length dimensions of the seeds. The obtained results will be useful for studies on the cultivation of these taxa.

Keywords: Lamiaceae, Tetrazolium, Shoot length, Vigor index, Sphericity

***Corresponding author:** Yozgat Bozok University, Faculty of Agriculture, Department of Field Crops, 66900, Yozgat, Türkiye
E mail: belgin.senkal@bozok.edu.tr (B. COŞGE ŞENKAL)
Belgin COŞGE ŞENKAL https://orcid.org/0000-0001-7330-8098
Tansu USKUTOĞLU https://orcid.org/0000-0001-6631-1723

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1. Introduction

Türkiye is situated at the intersection of the most important gene centers of the world (the Mediterranean and the Near East) due to its geographical location. At the same time, it is rich in terms of both plant species number and habitat types as a natural result of its wide variety in topography, climate, and geomorphology. According to the research results made in recent years, 9753 shows native species distributed in Türkiye. 3 035 of them are endemic, and when subspecies taxa are added, it is stated that there are 11 707 taxa, 3 649 of which are endemic (31.82%) (Guner et al., 2012). Türkiye is one of the important gene centers of the Lamiaceae family. The most important genuses of this family are *Thymbra*, *Thymus*, *Origanum*, *Satureja*, *Mentha*, *Teucrium*, *Ballota*, *Stachys*, *Salvia*, *Ajuga*, *Prunella*, *Melissa*, *Lamium*, *Sideritis,* and *Marrubium*. Most of the members of the Lamiaceae family are rich in essential oils and other secondary metabolites; they have usage areas in medicine, pharmacy, food, cosmetics, and perfumery, etc. (Nieto 2017, Karpiński 2020).

Knowing the physical properties of seeds is necessary for designing and developing the equipment necessary for the transportation, storage and processing of seeds (Zewdu 2011). It is of great importance to know the seed properties of plants especially used in food, treatment, cosmetics, etc. On the other hand, information on seed viability is of great importance for both producers and conservation of seeds in gene banks. Seed quality is a general term that includes the genetic, and physiological properties of the seed and determines the product performance and yield in relation to the potential of the variety. In measuring seed quality; various parameters are used such as genetic and physical purity, vitality, vigor, uniformity of seed size, seed-borne diseases and pests ,and other factors affecting seed performance in the field (Sun et al., 2007). Of these parameters, seed viability has a very important place in the concept of seed quality. Because, in a non-viable seed, talking about other quality features will not matter in practice. Depending on the ability to germinate and form a normal seedling, any seed is considered alive or lifeless.

There are many tests used in determining seed viability. However, the germination test and tetrazolium test are the most important vitality tests used in seed laboratories worldwide. The purpose of the germination test; is to learn about the viability of that population by using a seed sample that was randomly taken from a seed population. According to seed physiologists, germination is defined as the exit of the radiculate (root) from the testa (seed coat). However, the seed that is considered to have germinated (the radicula extending from the testa to a few mm or up to 1 cm) can form a normal or abnormal seedling in the future (Rajjou et al., 2012). Among the biochemical tests used to determine seed viability, the tetrazolium test is the most popular and provides faster predictions of viability compared to a standard germination test. The standard germination test evaluates seedling growth and development, and also proves photosynthetic activity. In contrast, the tetrazolium test is a measure of respiratory activity and reveals signs of life or metabolic activity in seeds (Elias et al., 2012).

In this study, it was aimed to investigate some physical characteristics, viability, germination performance of their seeds, and initial seedling development of 16 taxa belonging to 6 genera (*Salvia*, *Marrubium*, *Teucrium*, *Phlomis*, *Thymus,* and *Stachys*) from the Lamiaceae family collected from the natural area.

2. Materials and Methods

2.1. Plant materials

The aerial parts of the taxa (herbage) in the research were collected from the natural area during the full flowering period. The location information and gathering date of taxa are given in Table 1. Species identification of the collected plants was made at Yozgat Bozok University, Faculty of Arts and Sciences, Department of Biology. According to the species identification results, mature seeds were collected from taxa in the natural area during the seed maturity period. Until the analyzes were carried out, the seeds were placed on paper bags and kept in closed cabinets under room conditions.

Table 1. Location information and collection dates of taxa

Taxa	Location	Full flowering
Salvia absconditiflora (sin: *Salvia cryptantha*) (Montbret&Aucher ex Benth.) Greuter&Burdet *	35° 31' 1.596"E-39° 23' 52.5834"N 1324m	May 30
Salvia aethiopis L.	35° 14' 4.6314"E-39° 24' 47.52"N 1130m	June12
Salvia ekimiana Celep & Doğan*	35°48'28.55" E-39° 34'32.42"N 1810 m	June17
Salvia verticillata L. subsp. *amasisca* (Freyn&Bornm.) Bornm.	35° 26' 40.4514"E-39° 24' 44.0634"N 1217m	June13
Salvia sclarea L.	7° 30' 56.0874"E-43° 56' 16.4394"N 1837m	June 23
Salvia viridis L.	35°09' 34"E-39°35' 13" N 1135m	May 28
Salvia candidissima Vahl. subsp *occidentalis* Hedge	34° 29' 42.1074"E-39° 29' 38.4714"N 1323m	June 23
Salvia virgata Jacq.	34° 27' 50.688"E-39° 28' 28.1994"N 1216m	July 05
Salvia dichroantha Stapf	31°12' 23"E-40°28' 16" N 853m	June 12
Salvia tomentosa Mill.	31°11' 57"E-40°29' 00" N 816m	June 15
Salvia yosgadensis Freyn & Bornm.*	34° 30' 32.6154"E-39° 30' 5.976"N 1517m	May 30
Marrubium parviflorum Fisch. & C.A.Mey. subsp. *parviflorum*	34° 27' 38.412"E-39° 28' 38.316"N 1238m	June 02
Teucrium chamaedrys L. subsp. *chamaedrys*	39° 28' 3.252"E-34° 28' 40.4394"N 1349m	June 22
Phlomis armeniaca Willd.	35° 26' 40.632"E-39° 24' 46.296"N 1207m	June 23
Thymus sipyleus Boiss.	35° 26' 40.632"E-39° 24' 46.296"N 1207m	June 22
Stachys annua (L.) subsp. *annua*	34° 28' 46.6314"E-39° 28' 7.5714"N 1391m	June 22

*Endemic

2.2. Determination of weights and size properties of seeds

Damaged seeds and foreign materials in all seed samples were eliminated before starting the measurements. The seeds were weighed on a sensitive scale and their weight was recorded. The length and width of the seeds were measured with a LEICA M125 (KL1500 compact) stereo microscope. Using the data obtained through length and width measurements, the seeds of taxa; arithmetic mean diameter (equation 1), geometric mean diameter (equation 2), volume (equation 3), spheroid (equation 4), and sphericity (equation 5) values were calculated (Lorestani 2012, Bayram et al., 2016).

Da = (L+2D)/3 (1)

Dg = (LD2)1/3 (2)

AVk = π.L.D2/6 (3)

ϑ = 1-D/L (4)

Ø = (LD2)1/3/L (5)

Where; L= length; D: width

2.3. Classification of Seeds According to Their Geometric Properties

Seed width (W) / seed length (L) values of seeds belonging to each taxon were determined and classifications were made according to Table 2.

Table 2. Classification of seed samples according to their geometric properties (Dumanoglu et al., 2019).

Classification	W / L (mm)
Long (L)	0.6
Medium (M)	0.6-0.7
Short (S)	>0.7

2.4. Viability and Germination Tests

Tetrazolium test and germination tests were carried out to determine the viability rates of seeds collected from the natural area.

2.5. Tetrazolium Test

The viability of the seeds of the taxa Tetrazolium test has been determined and 50 seeds have been used (AOSA, 2000). The seeds were first swollen at room temperature for 1-2 days in water and kept at 25 °C for 2 hours in 1% 2, 3, 5- Triphenyl Tetrazolium Chloride (TTC) solution (pH 6-7). At the end of the period, the seeds were washed several times with pure water and examined under a stereo microscope. The viability of the seeds according to the staining of red was determined (AOSA 2000, Sagsoz 2000, Baydar 2013). Loose-structured, embryos, endosperm, and seeds with an unpainted region of more than 50% at the root end were considered lifeless (Sagsoz 2000, Santos et al., 2007). The viability of the seeds belonging to the species was determined as %.

2.5. Germination Test

Standard germination tests were set up in petri dishes with 4 replicates using 20 seeds each. Drying paper was cut under and over the Petri dishes and the seeds were germinated in a humid environment. Before the germination test, seeds were surface sterilized with 1% sodium hypochlorate (Subası and Guvensen 2010). The seeds were left to germinate in the petri dishes at 16 ± 2 °C in a dark 16 ± 2 °C and 8-hour light environment at 24 ± 2 °C in the climate cabinet. Counts were made at the end of 7, 14, and 21 days and the average germination rate was determined. The root of the root (radicule) 2 mm is considered as germination criteria and germination percentages are determined. At the end of the 21st day, the shoot length and root length were measured and leaf numbers were recorded. The seedling vigor index (SVI) of taxa was calculated using the equation (equation 6) below.

SVI= [average shoot length + average root length] × germination rate (6)

All analyzes and measurements were made in four replicates and the results are given as the mean. The important differences recorded as a result of the analysis of variance were subjected to the Least Significant Difference (LSD) Test and correlation analysis was used in bilateral relations. The MINITAB 19 package program was used in the statistical analysis.

3. Results

The viability and germination test results of taxa are presented in Table 3. According to the viability test results, no vitality was observed in any of the *S. cryptantha* seeds used in the study. Among the other 15 taxa, the highest viability value (82.86%) was recorded in *S. aethiopis* and the lowest value (10.71%) was recorded in *S. yosgadensis*. No germination occurred in the seeds of *S.ekimiana* and *S. tomentosa* species whose viability values were 30.77% and 27.78% respectively. On the other hand, no germination was observed in the seeds of *S. candidissima* subsp. *occidentalis*, *M. parviflorum* subsp. *parviflorum* and *T. chamaedrys* subsp. *chamaedrys* taxa on the 7th day when the first count was made. In *S. verticillata* subsp. *amasisca*, *S. candidissima* subsp. *occidentalis* and M. parviflorum subsp. parviflorum taxa, the first recorded germination value, and the last recorded value were the same. In other words, the values recorded on the 7th or 14th day did not change on the 21st day. In *S. aethiopis*, *S. dichroantha*, *S. virgata,* and *T. sipyleus* species, it was determined that the germination values on the 7th day changed very little on the 21st day. The germination values of *S. sclarea*, *S. viridis*, *S. yosgadensis*, *T. chamaedrys* subsp. *chamaedrys*, *P. armeniaca* and *S. annua* subsp. *annua* taxa increased significantly from the first count (7th day) to the last count (21st day). For example, in *P. armeniaca*, the germination value of 11.25% on the 7th day increased to 58.75% on the 21st day (Table 3).

Except for three taxa that could not be measured, root length values changed between 25.57 mm (*T. sipyleus*) - 66.82 mm (*S. aethiopis*) at the end of the 21st day. The shoot lengths of the seedlings were determined to vary between 3.12 mm (*T. sipyleus*) -22.41 mm (*P. armeniaca*). The number of leaves in shoots was recorded as 2.0 (*T. sipyleus*) -5.6 (S. annua subsp. annua) (Table 4).

Table 3. The viability and germination values of taxa

Taxa	Viability (%)	Germination Rate (%)		
		7th day	14th day	21st day
S. cryptantha	-	-	-	-
S. aethiopis	82.86	68.75	70.00	70.00BC
S.ekimiana	30.77	-	-	-
S. verticillata subsp. *amasisca*	60.00	20.00	20.00	20.00E
S. sclarea	64.29	78.75	81.25	82.50AB
S. viridis	76.00	86.25	93.75	93.75A
S. candidissima subsp. *occidentalis*	26.32	-	1.25	1.25G
S. virgata	34.62	36.25	37.50	37.50D
S. dichroantha	78.72	32.50	35.00	37.50D
S. tomentosa	27.78	-	-	-
S. yosgadensis	10.71	1.25	2.50	2.50G
M. parviflorum subsp. *parviflorum*	65.52	-	1.25	1.25G
T. chamaedrys subsp. *chamaedrys*	14.29	-	1.25	3.75FG
P. armeniaca	63.64	11.25	42.50	58.75C
T. sipyleus	47.83	15.00	16.25	16.25EF
S. annua subsp. *annua*	63.64	13.75	17.50	17.50E

-no germination occurred in seeds

A-GThe difference between the averages shown with the same letter is statistically insignificant at the 5% level. (LSD (0.05) =13.482).

Table 4. The observations on initial seedling development of taxa

Taxa	Root length (mm)	Shoot length (mm)	The number of leaves
S. aethiopis	66.82A	5.50F	4.2B
S. verticillata subsp. *amasisca*	55.88BC	9.16CD	2.5CD
S. sclarea	47.75D	13.53B	4.4B
S. viridis	51.02CD	7.07E	2.9C
S. candidissima subsp *occidentalis*	-	-	-
S. virgata	61.46AB	12.73B	4.1B
S. dichroantha	57.37BC	7.92DE	2.1D
S. yosgadensis	39.03E	9.47C	4.0B
M. parviflorum subsp. *parviflorum*	-	-	-
T. chamaedrys subsp. *chamaedrys*	-	-	-
P. armeniaca	57.56BC	22.41A	2.7C
T. sipyleus	25.57F	3.12G	2.0D
S. annua subsp. *annua*	60.88AB	10.45C	5.6A

-The observation could not be obtained since there was not enough germination.

A-GThe difference between the averages shown with the same letter is statistically insignificant at the 5% level.

(LSD $_{\text{(Root Length) (0.05)}}$=7.891; LSD $_{\text{(Shoot Length) (0.05)}}$=1.378;LSD $_{\text{(The number of leaves) (0.05)}}$=0.549)

A moderate positive relationship was found between root length (RL) and shoot length (SL, r=0.330), and leaf number (LN, r=0.377) (Figure 1). According to the result of the research, seedling vigor index values were between 121.3% and 5445.9%. Among the taxa, the lowest SVI value was determined in *S. dichroantha* species. The highest value was recorded in *S. viridis* species (Figure 2).

The seed width and length values of taxa varied between 0.911-2.788 mm and 0.999-5.055 mm, respectively. The highest seed weight was 0.00910g, followed by *P. armeniaca* with 0.00868 g (Table 5). It has also been found that seed length and width are positively correlated with seed weight (Figure 3).

The highest volume value was recorded in *S. cryptantha* species. This species was followed by *P. armeniaca* with a difference of 0.9578 mm3. Apart from these two species, the highest volume value was found in *S. tomentosa* species. The volume values of five taxa (*S. viridis*, *S. candidissima* subsp. *occidentalis*, *S. dichroantha*, *M.*

parviflorum subsp. *parviflorum*, *T. chamaedrys* subsp. *chamaedrys*, *T. sipyleus*) were found to be less than 2 mm in average. The volume values of the seven taxa (*S. aethiopis*, *S.ekimiana*, *S. verticillata* subsp. *amasisca*, *S. sclarea*, *S. virgata*, *S. yosgadensis*, and *S. annua* subsp. *annua*) took values between 2-6 mm on average. In the taxa included in the study; geometric mean diameter, arithmetic mean diameter, and sphericity values were recorded in the range of 0.9068-2.9619 mm, 0.9090-3.1423 mm, and 0.5718-1.6287%, respectively. When the spheroid values of taxa were examined, only the value of *T. sipyleus* species was positive (0.1361%), while the values of other taxa were negative and varied between -0.1280 and -0.5348%. (Table 6).

Values varying between 0.432-0.865 were calculated according to the geometric properties determined by proportioning the width and length dimensions of the seeds. *S. aethiopis* (0.614) and S. yosgadensis (0.617) medium (M), *S. viridis* (0.536), *M. parviflorum* subsp. *parviflorum* (0.498) and *P.armeniaca* (0.432) are long (L) seeds and other taxa with values between 0.729-0.865 are in the short (S) seeds class (Table 7).

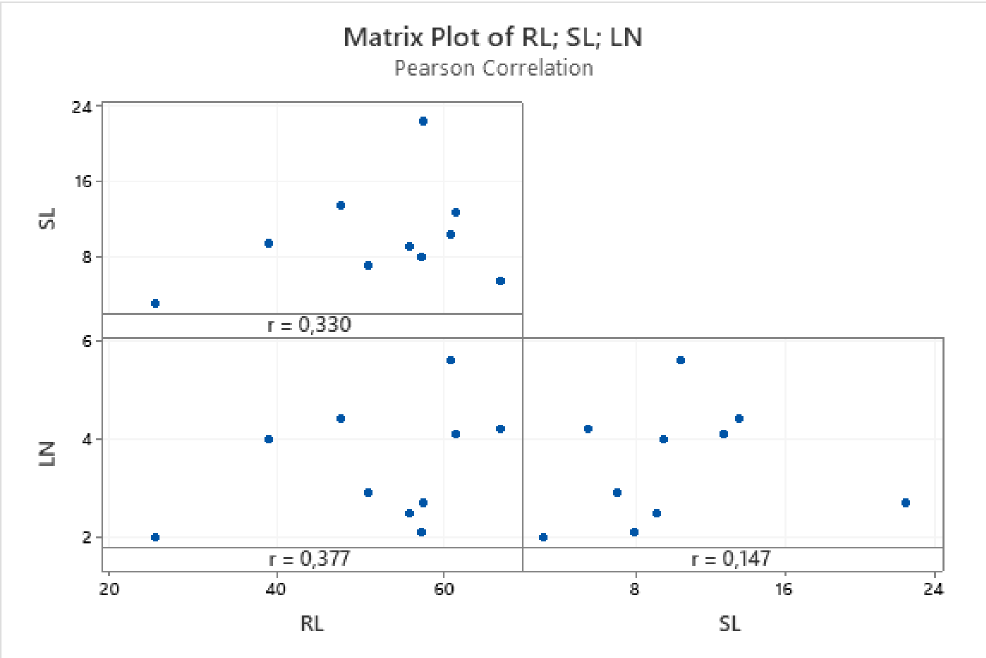

Figure 1. Pearson's correlation coefficients between root length (RL), shoot length (SL),) and leaf number (LN).

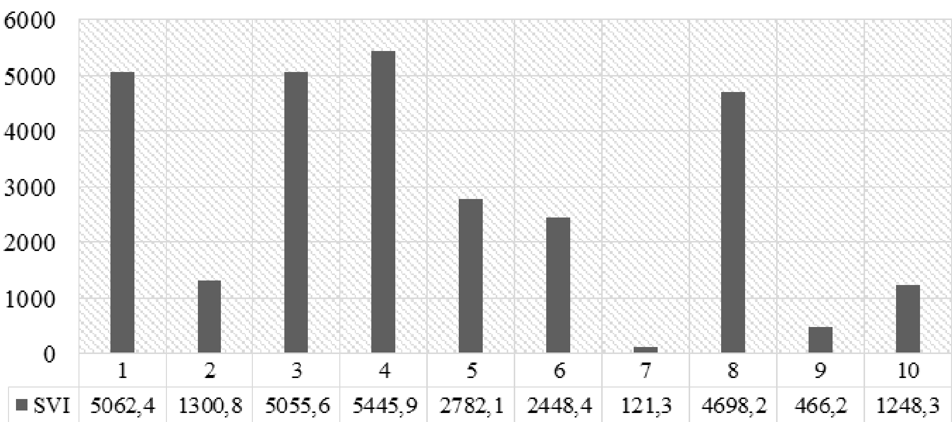

Figure 2. Seedling vigor index (SVI) values of taxa (%). 1= *S. aethiopis,* 2= *S. verticillata* subsp. *amasisca,* 3= *S. sclarea,* 4= *S. viridis,* 5= *S. virgata,* 6= *S. dichroantha,* 7= *S. yosgadensis,* 8= *P. armeniaca,* 9= *T. sipyleus,* 10= *S. annua* subsp. *annua.*

Table 5. The length, width, and weight values of the taxa seeds

Taxa	Width (mm)			Length (mm)			Weight (g)
	Min.	Max.	Mean	Min.	Max.	Mean	Mean
S. cryptantha	2.284	3.618	2.788	2.362	4.081	3.343	0.00662
S. aethiopis	1.366	2.076	1.593	2.250	2.736	2.594	0.00278
S. ekimiana	1.565	2.372	2.051	2.294	3.199	2.740	0.00341
S. verticillata subsp. *amasisca*	1.032	1.683	1.450	1.697	2.106	1.964	0.00062
S. sclarea	1.645	2.366	1.970	1.589	2.919	2.596	0.00433
S. viridis	0.900	1.126	1.048	1.821	2.077	1.954	0.00256
S. candidissima subsp *occidentalis*	1.646	2.041	1.861	2.174	2.612	2.409	0.00150
S. virgata	1.194	1.693	1.527	1.190	2.173	1.989	0.00910
S. dichroantha	0.955	1.474	1.213	1.467	1.879	1.664	0.00029
S. tomentosa	2.003	2.623	2.357	2.392	2.986	2.756	0.00474
S. yosgadensis	1.300	2.695	1.907	2.458	3.066	2.841	0.00292
M. parviflorum subsp. *parviflorum*	0.722	1.162	0.911	1.521	1.960	1.829	0.00037
T. chamaedrys subsp. *chamaedrys*	0.924	1.548	1.216	1.079	1.795	1.480	0.00114
P. armeniaca	1.770	2.466	2.186	4.366	5.958	5.055	0.00868
T. sipyleus	0.766	0.963	0.864	0.688	1.175	0.999	0.00023
S. annua subsp. *annua*	1.256	1.665	1.512	1.704	2.102	1.890	0.00269

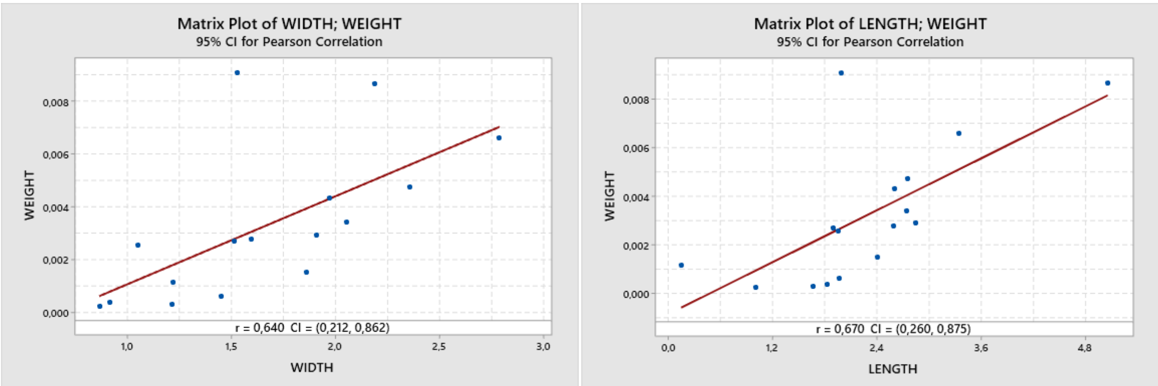

Figure 3. Pearson's correlation coefficients between seed weight, seed wight and seed length.

Table 6. Some physical properties of taxa seeds

Taxa	V (mm³)	GMD (mm)	AMD (mm)	Sphericity (%)	Spheroid (%)
S. cryptantha	13.6057	2.9619	2.9730	0.8756	-0.5348
S. aethiopis	3.4466	1.8741	1.9266	0.7224	-0.2286
S. ekimiana	6.0350	2.2588	2.8806	0.8244	-0.3835
S. verticillata subsp. *amasisca*	2.1621	1.2523	1.6213	0.8168	-0.2291
S. sclarea	5.2751	1.3743	2.1786	0.8319	-0.3736
S. viridis	1.1236	1.2898	1.3500	1.2898	-0.0245
S. candidissima subsp *occidentalis*	1.2613	2.0281	2.0436	0.8419	-0.3574
S. virgata	2.4283	1.6676	1.6810	0.8384	-0.2649
S. dichroantha	1.2819	1.3477	1.3633	0.8099	-0.1280
S. tomentosa	8.0167	2.4831	2.4900	0.9009	-0.4923
S. yosgadensis	5.4096	2.1779	2.2183	0.7666	-0.3192
M. parviflorum subsp. *parviflorum*	0.7947	1.1492	1.2170	0.6283	0.0486
T. chamaedrys subsp. *chamaedrys*	1.1458	1.2983	1.3040	0.8772	-0.1459
P. armeniaca	12.6479	2.8907	3.1423	0.5718	-0.2346
T. sipyleus	0.3904	0.9068	0.9090	0.9077	0.1361
S. annua subsp. *annua*	2.2623	1.6287	1.6380	1.6287	-0.2708

V= volume GMD= geometric mean diameter, AMD= arithmetic mean diameter

Table 7. Classification according to the geometric characteristics of seeds belonging to taxa

Taxon	W/L	Classification	Taxon	W/L	Classification
S. cryptantha	0.834	S	*S. dichroantha*	0.729	S
S. aethiopis	0.614	M	*S. tomentosa*	0.855	S
S. ekimiana	0.749	S	*S. yosgadensis*	0.671	M
S. verticillata subsp. *amasisca*	0.738	S	*M. parviflorum* subsp. *parviflorum*	0.498	L
S. sclarea	0.759	S	*T. chamaedrys* subsp. *chamaedrys*	0.822	S
S. viridis	0.536	L	*P. armeniaca*	0.432	L
S. candidissima subsp *occidentalis*	0.773	S	*T. sipyleus*	0.865	S
S. virgata	0.768	S	*S. annua* subsp. *annua*	0.800	S

4. Discussion

Viability and germination tests were carried out in taxa whose seeds can be collected from the natural environment. A tetrazolium test was used to determine the viability of seeds. Tetrazolium test is a method that provides practical determination of seed viability and can get results in less time than the germination test (McDonald and Contrrnas 2002). As a result of the Tetrazolium test, the vitality values of the taxa varied between 0-82.86% and no viable seeds were found in *S. cryptantha* species. In the germination experiment, no germination occurred in the seeds of the two Salvia taxa (*S. ekimiana* and *S. tomentosa*). Contrary to our findings, 31.33% germination was recorded in the seeds of the S. tomentosa species (Ozcan et al., 2014). As is known, the seeds belonging to the Salvia genus have a mucilaginous seed coat causing dormancy. Dormancy is an important factor in preventing germination (Finkelstein et al., 2008). In studies performed with different sage species, the germination strength value was 31% in *S. fruticosa* (Sonmez et al., 2019), 25.50% in *S. pomifera* (Ozcan et al., 2014), 76% in S. cyanescens, 29% (Yucel and Yılmaz 2009), in *S. verticillata* (Tursun 2020) and in 41% *S. sclarea* (Joshi and Pant, 2010) was recorded. While the germination value of *M. vulgare* was determined as 88% (Dadach et al., 2015), this value was very low 1.25% in *M. parviflorum* subsp. *parviflorum*. There is a great variation in germination values among the species. For example, while the germination value of *Phlomis armeniaca* included in this study was 58.75%, the germination value of the *P. italica* species used in the study carried out by Galmés et al., (2006) was recorded as 8.7%. In our study, the highest germination values were recorded on the 21st day.

Seed quality can be expressed as the degree of excellence of the characters or traits that determine the performance of the seed when it is sown or stored. The standard germination test is a basic and acceptable test in quality controls. This test can be used to predict germination under optimum field conditions (Hampton 2002). However, optimum conditions for germination rarely occur in the field. For this reason, there is a need to use tests that can evaluate the seed/seedling vigor, which is an expression of the characteristics that enable seeds to perform germination activities and performances in different environmental conditions and especially in conditions below optimum (ISTA 2003). In general, the seed with high vigor shows a uniform and rapid germination and emergence in the field in unsuitable soil conditions or cold early sowing periods. In our study, the SVI values of taxa varied greatly and the highest value was obtained from *S. viridis* (5445.9%).

Information on the physical and aerodynamic properties of agricultural products is needed for the design and adjustment of machinery used during harvesting, separation, cleaning, transportation and storage of agricultural materials and for their transformation into food and feed (Nalbandi et al., 2010, Tavakoli et al., 2014). For this reason, features useful during design should be known and these properties should be determined under laboratory conditions. The most important physical properties considered during the separation and cleaning of medicinal and aromatic plant seeds as other field crop seeds are geometric properties such as size and shape (Tavakoli et al., 2014). In theoretical calculations, medicinal plant seeds are assumed to be spherical or elliptical due to their irregular shape (Nalbandi et al., 2010). It was determined that the physical properties of seeds belonging to medicinal and aromatic plant species such as Salvia sp. (Ixtaina et al., 2008; Bayram et al., 2016, Tavakoli et al., 2014, Yılar and Altuntas, 2017), *Foeniculum vulgare* L. (Ahmodi et al., 2009), *Momordica charantia* L. (Golukcu et al., 2014), *Cuminum cyminum* L. (Singh and Goswami 1996), and *Coriandrum sativum* L. (Coskuner and Karababa 2007) were examined in the literature reviews.

5. Conclusion

Taxa included in this study are not cultured, however, they show naturally occurring in Türkiye. These taxa in the natural flora are used by the local people for various purposes. In the future, the possibility of using these taxa in different areas may come to the fore. There are many medicinal and aromatic plants, but there is limited research on the physicochemical properties of their seeds. However, it is important to determine the physical properties of medicinal and aromatic plant seeds due to their potential use in industries such as food, cosmetics, medicine, chemistry, etc. For this reason, we are of the opinion that these findings will make important contributions to the current literature.

Author Contributions

B.C.Ş. (100%) wrote the manuscript and conceived the original idea, organized, analyzed, and interpreted the data. T.U. (100%) carried out the experiment and structured the paper and edited the manuscript. All authors reviewed and approved final version of the manuscript.

Conflict of Interest

The authors declared that there is no conflict of interest.

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