Available online www.jsaer.com

***Journal of Scientific and Engineering Research*, 2016, 3(6):272-278**

Research Article

ISSN: 2394-2630
CODEN(USA): JSERBR

A research on effect of dıfferent seed sıze on seedlıng emergence and growth dıfferent common vetch (*Vicia sativa* l.) lınes

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Abstract The aim of this study was to evaluate the effect of different 1000 seeds weights on emergence traits and seedling growth in common vetch (*Vicia sativa*) in laboratories of Akdeniz University, Agricultural Faculty, Field Crops Department. The research was conducted in randomized parcels experimental design with 4 replicates. Common vetch line's seeds which have different 1000 seeds weight were used as material. Firstly, seeds were separated 3 groups (small, medium, large) according to 1000 seeds weight and each group was consist 4 common vetch lines (total 12 lines). In study, emergence (emergence proportion, number of emergence day) and seedling (root length, shoot length, root weight, shoot weight, root/shoot ratio for length and weight) traits were investigated. The results showed that the effect of different seed weight was significant on investigated characters especially emergence traits. For example, while emergence percentages of medium and large seeds were determine high, low emergence day numbers were materialized in the same seeds. Also root and shoot traits were affected by different seed weights. On the other hand significant correlations were determined among investigated characters especially between emergence day number and emergence percentage. According to results obtained from study medium and large seeds must be use for good emergence and seedling growth in common vetch farming.

Keywords Common vetch, seed size, emergence ratio, root, shoot, root/shoot

Introduction

Seed is one of the most important components of plant production. Certain environmental factors such as temperature, precipitation and sunny period can not controlled by farmers. But seed selection can be controlled by growers [1]. Usage of good qualified seed is essential for successful farm. In plant production, firstly, suitable cultivars must be determined for a regions and good qualified seed of these cultivars must be found and sown [2].

Seed quality affected by many ecological and genetical factors [3]. 1000 seeds weight must be considered in terms of both agricultural and commercial [4]. The seed weight and size have positive effect on germination and emergence of seedling [5]. This result was observed in many studies [6-8]. But, on the contrary, higher germination and emergence proportion were determined in small seeds in certain study [9-11].

Seed size is set by both genetic and ecological factors [12] and it is considered as an important component which increased the yield [4, 13]. Royo et al. [14] reported that the use of small seed decreased yield by 16% depend on reduced in plant density by 20% in durum wheat (*Triticum turgidum* var. *durum* L.). However, Tawaha and Turk [15] determined that plants produced from heavier seeds (*i.e.* of an average of 0.25 g seed^{-1}) had seed yields, seed weight per plant, 100 seeds weight, number of pods per plant and number of seeds per pod, that were 12, 22, 12, 32 and 20 % greater, respectively, than those produced from lighter seeds.

Generally, large seeds have greater a store of reserve energy than small seeds. Thus, seedlings of large seeds may have greater initial growth rates than small seeds [16]. Also contact of small seeds with soil is difficult [17]. Seedlings produced from heavier seeds are more resistant to frost damage and other unsuited conditions than produced from lighter seeds [4]. Strongly growth and competition force of seedlings are two of the most important factors in plant production. Strongly and fastly growing seedlings can adapt to unsuited conditions. In plants, adequately growth is prevented in case of weak seedlings and no resistant to unsuited ecological conditions. Cultivars which have stronger seedlings are more resistant to these negative conditions. Seedling quality depends on directly seed size and this demonstrated in certain plant such as smooth bromegrass. In such species, seedling vigour can be increased through large seed selection [18]. Endosperm and cotyledon are relatively high in seeds which have high 1000 seed weight, so strong seedlings consist from large seeds. This incident offers advantages to large seed in term of germination mechanism and large seeds because of strong seedling expeditiously emerge from soil cover [19].

Common vetch (*Vicia sativa*) is an important annual forage crops in the world wide. It is not resistant to drought and cold, but it grows well in humid areas which can be irrigated and high precipitation. Green and dry herbage of common vetch have good quality and feeder. Also in order to common vetch grain has a high protein content, grains can be used as intensive fodder in animal feeding [20]. Seeds are used in common vetch cultivation as like in many forage crops. While seed colour varies from dark yellow to brown and black, 1000 seed weight range generally 40-120 g [2]. In this study the effect of different seed size on emergence traits and seedling growth in common vetch lines was evaluated.

Material and Methods

This study was conducted in laboratory conditions in Akdeniz University, Agriculture Faculty. The experiment was conducted as a completely randomized design with four replicates. Twelve common vetch lines which have different seed size were used as material (Table 1). Peat (50%) (pH: 5.2-6, salt content:0.3 mg/lt, nitrogen: 30-80 mg/lt, phosphorus: 20-40 mg/lt, potassium: 30-90 mg/lt) and soil (50%) (clay, strongly alkaline, low organic material) mixture were used as plant growth media and this material was filled to seedling viols.

Table 1: Seed size groups, line number and 1000 seed weight of lines

Seed size	Line Number	1000 seed weight (g)
Small	126	48.22
	76	44.44
	2	31.33
	114	30.33
Medium	89	60.33
	61	53.66
	93	53.44
	13	53.22
Large	56	81.33
	54	77.11
	115	74.11
	41	64.77

Five seeds were sown for each replicate and sown depth were adjusted as 3 cm. After sown, viols were placed to climate growth chamber and they controlled in same time every day to determine first emergence day. Proportions of emergence were determined at the end of 18 days. Firstly, seedlings were extracted carefully from growth media, peat and soil particles adhering to the roots were carefully removed with water. Later, in each fresh seedling, the following variables were measured: root weight (g) root length (cm), shoot weight (g) and shoot length (cm). The root/shoot ratios calculated using weight and length values of root and shoot.

Data were analyzed by an analysis of variance using SAS statistic software to test the significance of the main effects. Means were compared using Duncan multiple range tests. Also correlation analysis was performed to determine relationships among traits.

Results and Discussion

Results of study are shown in Table 2 and Table 3 for seed size groups (small, medium, large) and lines, respectively. According to Table 2, while emergence proportion and number of emergence days were effected by seed size, the highest emergence percentages were recorded in medium size seeds with 90% and large size seeds with 80%. Similar results were obtained in number of emergence days and earliest emergences were determined in medium and large size seeds with 5 and 6 days, respectively.

Table 2: Effect of different seed size on emergence traits (Group)

Seed size	Emergence proportion (%)**	Number of emergence days (Day)**
Small	63 b	8 b
Medium	90 a	5 a
Large	80 a	6 a
LSD	14.505	0.4263

**Any means in the same column followed by the different letter are significantly ($p<0.01$) different by Duncan's multiple range test.

As can be seen in Table 3, the effects of seed size were found significant for emergence traits in lines. While the highest emergence proportion was determined in line-115 (large seed) and line-93 (medium seed) with 100%, lowest emergence was observed in line-114 (small seed) with 50%. Generally, large seeds have strong embryo and large endosperm, so they have high emergence potential [4]. Seedling vigour, emergence of seed and stress tolerance are associated with seed size [21]. Qui et al. [22] were determining that larger seeds have greater energy potential than small seeds in cotyledones, so emergence and seedling growth better in larger seeds in common vetch. Farahani et al. [23] were determined that seed size had a significant effect on germination percentage in sunflower (*Helianthus annuus*). Many other studies show that, seed size has important effect on germination and emergence traits [24-28].

Table 3: Effect of different seed size on emergence traits (Lines)

Line number	Group	Emergence proportion (%)**	Number of emergence days(Day)**
126	Small	75 abcd	8 c
76		58 cd	8 c
2		67 bcd	8 c
114		50 d	8 c
89	Medium	84 abc	6 b
61		84 abc	6 b
93		100 a	5 a
13		92 ab	5 a
56	Large	59 cd	6 bc
54		78 abc	6 b
115		100 a	5 a
41		84 abc	6 b
LSD		27,24	0,7927

**Any means in the same column followed by the different letter are significantly ($p<0.01$) different by Duncan's multiple range test.

The effects of seed size on the root length, shoot length, root/shoot ratio (for length), root weight, shoot weight and root/shoot ratio (for weight) are shown in Table 4. According to results, while the effect of seed size was significant on root length, shoot length, root:shoot ratio (for length), shoot weight and root:shoot ratio (for weight), root weight didn't effected by seed size. Highest root length were determined in medium seeds with

14.81 cm. Similar result was recorded for shoot length and highest values were detected in large seed and medium seeds with 19.42 and 17.03 cm, respectively. Also biggest root:shoot ratios(for length) were recorded in medium seeds (0.88 cm) and small seeds (0.81 cm). However, the differences among seed size group for root weight was not significant. Shoot weight increased with increasing seed size and highest shoot weight was determined in large seed with 0.18 g. Root:shoot ratio (for weight) varied between 1.20-1.58 and highest ratio was determined in small size seeds.

Table 4: Effect of different seed sizes on seedling traits (Groups)

Seed size	Root length (cm)**	Shoot length (cm)**	Root:shoot ratio (for length)**	Root weight (g)	Shoot weight (g)**	Root:shoot ratio (for weight) **
Small	11.51 b	13.76 b	0.81 a	0.18 a	0.12 c	1.58 a
Medium	14.81 a	17.03 a	0.88 a	0.21 a	0.15 b	1.40 ab
Large	13.06 ab	19.42 a	0.68 b	0.22 a	0.18 a	1.20 b
LSD	2.7687	2.4046	0.1258	0.0411	0.0267	0.2384

**Any means in the same column followed by the different letter are significantly ($p<0.01$) different by Duncan's multiple range test.

The experiment data of root and shoot traits for lines are presented in the Table 5. As seen in table, there are not found significant difference among lines for root length and root:shoot ratio (for length) in variance analysis, but according to Duncan test, highest root length and root:shoot ratio (for length) were determined in line-13 (medium seed) with 17.09 cm and 1.02, respectively. Also, significant statistic difference were determined among lines for shoot length, root weight, shoot weight and root:shoot ratio (for weight). Highest values were observed in line-115 (large seed) with 22.50 cm for shoot length, in line-61 (medium seed) with 0.27 g for root weight, in line-115 (large seed), line-54 (large seed) and line-61 (medium seed) with 0.20 g, 0.20 g and 0.19 g, respectively, for shoot weight and line-114 (small seed) with 2.17 for root:shoot ratio (for weight).

Table 5: Effect of different seed size on seedling traits (Lines)

Group	Line number	Root length (cm)	Shoot length (cm)**	Root:shoot ratio (for length)	Root weight (g)**	Shoot weight (g)**	Root:shoot ratio (for weight) **
Small	126	12.43 abcd	15.97 bc	0.78 abc	0,16 cd	0,14 bc	1,20 de
	76	10.39 cd	10.79 d	0.89 ab	0,13 d	0,10 c	1,28 cde
	2	14.29 abc	15.77 bc	0.91 ab	0,25 ab	0,14 bc	1,69 b
	114	8.94 d	12.50 cd	0.68 bc	0,20 bc	0,10 c	2,17 a
Medium	89	11.59 bcd	15.64 bc	0.77 bc	0,13 d	0,11 c	1,20 de
	61	14.75 abc	17.95 b	0.82 abc	0,27 a	0,19 a	1,41 bcd
	93	15.83 ab	17.93 b	0.90 ab	0,22 abc	0,16 ab	1,39 bcd
	13	17.09 a	16.58 bc	1.02 a	0,21 abc	0,14 bc	1,59 bc
Large	56	11.55 bcd	16.65 bc	0.70 bc	0,22 abc	0,16 ab	1,36 bcd
	54	12.24 abc	19.82 ab	0.62 c	0,24 ab	0,20 a	1,18 de
	115	16.20 ab	22.50 a	0.72 bc	0,20 bc	0,20 a	0,99 e
	41	12.25 abcd	18.72 ab	0.67 bc	0,21 abc	0,16 ab	1,26 cde
LSD		5,3143	4.4678	0.2515	0.0641	0.046	0.3441

**Any means in the same column followed by the different letter are significantly ($p<0.01$) different by Duncan's multiple range test.

Seed size is the most predictable and consistently measurable plant functional trait [29-31] and it is correlated with habitat, phylogeny and rooting depth [32-33]. Growth of root and shoot is very important for plant production. Because roots are in direct contact with the soil and absorb water and nutrient elements from soil and shoot supply it to the rest of the plant [34]. Especially in first development stage, genotypes which have well root system are more resistance to stress conditions and high yield can be obtained from these plants [35-36].

Generally, large seeds constitute larger root than small seeds and large roots have advantage in low humid areas [5]. So, seed size is an important parameter for plant growth and yield.

Roots provide essential functions including the uptake of water and nutrients for plant growth, serve a role as storage organs [37]. Also root systems of plants play an important role to resistance to cold, temperature and drought [4]. Westoby *et al*. [38] reported that seedlings from large seed were better able to survive drought.Many study explained that root traits associated with maintaining plant productivity under drought conditions [7, 39-41]. Qui et al. [22] reported that larger seeds have greater cotyledon reserves than small seed and therefore can provide energy to young seedlings at faster rate in common vetch. Seed size was related to plant height, but this association was weaker than that between seed size and root depth. Root depth explained a significant proportion of the variation in seed weight, independently from life form or dispersal mode and, in some cases, more than either of them [33]. Shanmuganathan and Benjamin [42] reported that seed size had little effect on seedling emergence time, but plants derived from large seeds were larger than those from small seeds.

Correlations among traits were evaluated as shown in Table 6. As seen in table, there was strong negative relationship between emergence proportion and number of emergence days. These result indicate that seeds which have high emergence proportion are early emergency. Also emergence proportion was positively correlated with root length, shoot length, root weight and shoot weight and was negative correlation with root:shoot ratio (for weight). While there was negative correlations between number of emergence days and root length, shoot length and shoot weight, positive correlation was determined between number of emergence days and root:shoot ratio (for weight). Root length was positively correlated with shoot length, root weight, shoot weight and root:shoot ratio (for length). Also there were positive and strong relationships between shoot length and root weight and shoot weight, but negative relationship was determined between shoot length and root:shoot ratio (for weight). However, root weight was positively correlated with shoot weight, and shoot weight was negatively correlated with root:shoot ratio (for weight).

Table 6: Correlation coefficients between the factors among all emergence and seedling traits

	EP	**NED**	**RL**	**SL**	**RW**	**SW**	**RSL**	**RSW**
EP	-							
NED	-0.785**	-						
RL	0.601**	-0.433**	-					
SL	0.563**	-0.563**	0.625**	-				
RW	0.305*	-0.237	0.585**	0.614**	-			
SW	0.510**	-0.506**	0.587**	0.902**	0.766**	-		
RSL	0.270	-0.041	0.693**	-0.101	0.170	-0.079	-	
RSW	-0.341*	0.381**	-0.175	-0.526**	0.132	-0.440**	0.191	-

*: p<0,05, **: p<0,01 (EP: emergence proportion, NED:number of emergence day, RL: Root length, SL: Shoot length, RW: Root weight, SW: Shoot weight, RSL: Root/shoot (for length), RSW: root/shoot (for weight))

Conclusion

In this study, the effect of different seed size on emergence traits and seedling growth in common vetch lines was evaluated. Results of the study demonstrated that emergence proportion and number of number of emergence days were positively affected by seed size. So larger seeds should be used especially in field areas which growing period is not sufficient. Also root and shoot traits of seedlings which obtained from large and medium seeds were better than small seeds. For this reason large and medium seeds had an advantage of seedling growth and these type seeds should be preferred to obtain good seedlings in common vetch farming.

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