Determination of Yield and Some Characteristics of Forage Pea Genotypes (Pisum sativum ssp. arvense L.) under Erzurum Conditions

Sibel KADIOĞLU1,a Mustafa TAN2,b Banu KADIOĞLU1,c Gökhan TAŞĞIN1,d
1East Anatolian Research Institute, Erzurum, Turkey
2Trakya University, Havsa Vocational College Park and Garden Plants, Edirne, Turkey
*Corresponding author e-mail: sibel.kadioglu@tarimorman.gov.tr
doi: 10.17097/ataunizfd.628404

ABSTRACT: This research was planned to determine the performance of some forage pea (Pisum sativum ssp. arvense L.) genotypes in Erzurum conditions. The study was carried out in the Pasinler Research Station trial areas of the Eastern Anatolia Agricultural Research Institute in 2011, 2012 and 2013. Field experiments were conducted in randomized complete blocks design with 3 replications. According to the three-year averages; time for flowering was 55.0-62.8 days, time for physiological maturity was 91.6-102.0 days, plant height is 90.3-110.6 cm, green forage yield was 1587.8-2764.5 kg da⁻¹ and seed yield was 145.6-322.0 kg da⁻¹. The highest yield values were determined as 3156 kg da⁻¹ for green forage yield and 283.3 kg da⁻¹ for seed yield in the second year of the experiment and it was determined that there were significant differences between years and genotypes in terms of yield and agricultural characteristics. According to the correlation analysis between yield and yield components; a positive correlation was determined between green forage yield and the number of emergence days, plant height and number of branches, 1% pod number in the plant and 5% significance level, 1% between seed yield and thousand grain weight, 5% significance level in the number of pods. As a result, it is concluded that ecological properties affect yields and different genotypes have different yield potentials. It has been decided that H-13 and H-9 genotypes can be grown in the region without any problems in terms of green forage yield and seed yield. Among the varieties, because their seeds are easy find, Taşkent, Tore, Ürunlu and Özkaynak varieties can be recommended for hay production and Kıraızli variety for seed production.

Keywords: Forage pea, Green forage yield, Seed yield, Genotype, Correlation

Erzurum Şartlarında Yem Bezelyesi (Pisum sativum ssp. arvense L.) Genotiplerinin Verim ve Bazı Özellikleri

ÖZ: Bu araştırma bazı yem bezelyesi (Pisum sativum ssp. arvense L.) genotiplerinin Erzurum koşullarındaki performanslarının belirlenmesi amacını alınmıştır. Araştırma Doğu Anadolu Tarımsal Araştırma Enstitüsü bağlı Pasinler Araştırma İstasyonu deneme alanlarında 2011, 2012 ve 2013 yıllarında yürütülmüştür. Araştırma denemeleri tasarısı blokların deneme desenine göre 3 tekrarlı olarak kurulmuştur. Üç yıllık ortalamaları göre; çiçeklenme için geçen süre 91.6-102.0 gün, bitki boyu 90.3-110.6 cm, yeşil ot verimi 1587.8-2764.5 kg da⁻¹ ve tohum verimi 145.6-322.0 kg da⁻¹ arasında değişmiştir. En yüksek verim değerleri denemenin ikinci yılında yeşil ot verimi için 3156 kg da⁻¹ ve tohum verimi için 62.8 gün, fizyolojik olgunluk için geçen süre 55.0-62.8 gün, fazla sayısında 1% ve tohum verimi için 5% önem seviyesinde pozitif bir ilişki bulunmuştur. Verim ve verim unsurları arasında yapılan korelasyon analizi sonucunda; yeşil ot verimi ile tohum verimi, yeşil ot verimi ile bitki boyu ve son dal sayısı arasında %1 bitkide bakla sayıısı ile %5 önem seviyesinde pozitif bir ilişki bulunmuştur. Verim ve verim unsurlarının ekolojik özelliklerin verimdeki etkisini ve farklı genotiplerin farklı verim potansiyellerini olumlu etkilemesini göstermiştir. Yem bezelyesi genotiplerinin ekolojik özelliklerini ve verim potansiyellerini olumlu etkilemesi,араметrelerin ve tohum verimi için %1, %5 önem seviyesinde pozitif bir ilişki bulunmuştur. Bu araştırma sonuçlarına göre, erzurum koşullarında H-13 ve H-9 genotipleri tohum verimi ile yeşil ot veriminde verim potansiyelleri üzerinde önemli bir etkileşimi göstermiştir. Bu nedenle, bu genotipler ve genotipler ile ilgili ekolojik özelliklerin verimdeki rolü araştırılmalıdır.

Anahtar Kelimeler: Yem bezelyesi, Yeşil ot verimi, Tohum verimi, Genotip, Korelasyon

INTRODUCTION

Forage pea in Northeast Anatolia, especially in Kars, Ardahan and Bayburt is a plant that has been cultivated for many years both for its forage and for its grains in animal nutrition (Ozbek, 1980). It is known as kültür or gürül in Erzurum, is suitable for the ecology of the region due to its extremely cool and low temperature resistance. The hay, grain and straw of the forage pea are the source of food and energy for livestock. Its nutritional value is high and it is delicious. Forage pea with a very high crude...
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protein content (about 17-21%) can give about 1-4 tonnes of fresh forage per decare under favorable conditions (Ozkaynak 1980; Acikgoz 2001). Additionally forage pea enriches the soil with organic matter and nitrogen; it can also provide quality hay for animals in early spring with its winter resistance. Forage pea grains are an alternative plant that can be used instead of barley and vetch in animal feeding (Kadioglu et al., 2006). Because of the outstanding features of forage pea, in recent decades, a great deal of effort has been spent by many researches in Turkey to improve new high-yielding cultivars by using local or introduced forage pea materials (Bilgili and Acikgöz, 1999; Tekeli and Ates, 2003; Sayar and Anlarsal, 2008; Tan et al., 2012; Sayar and Han, 2016; Keskin and Temel, 2018). In order to ensure the return to forage pea farming and increase its cultivation, it is necessary to develop varieties suitable for the ecology of the region and grow superior genotypes by identifying some superior agronomic characteristics (Tan et al. 2012). In this study, the importance of forage pea is emphasized and some agricultural and phenological characteristics (days to emergence, flowering and ripening, plant height, sub-branch number and pod number per plant, grain number per pod, thousand kernel weight, green forage and seed yield) were evaluated.

**MATERIAL AND METHOD**

The research was carried out in the Eastern Anatolia Agricultural Research Institute in Pasinler experiment area through spring cultivation for 3 years (2011, 2012 and 2013). In the study, totally, 18 forage pea genotypes were used as the plant materials. 8 of the genotypes were forage pea lines, supplied from Uludag University, Bursa, Turkey. The lines were found promising as result of breeding studies. In addition, 3 local forage pea varieties, Hınıs (Erzurum), Samsun, Ardahan and 5 registered forage pea cultivars, Tore, Taskent, Urnulu, Kirazli and Ozkaynak were used.

Climatic data is submitted in the Table 1. When Table 1 examined; the temperature values of 2013 were similar to the average of long years (1954-2010), the rainfall was low. The average temperatures in 2011 and 2012 also displayed values close to the long years averages, on the other hand, the rainfall amount of the growing years were found quite low than the rainfall amount of long years average (TUMAS, 2019; Table 1).

According to the analysis results of soil samples taken from 0-20 cm soil layer from the experiment area; the soil is loamy, slightly alkaline, salt-free, calcareous, medium in phosphorus and rich in potassium, and poor in organic matter (Table 2).

**Table 1.** Some meteorological data of trial years

|       | April | May | June | July | August | September |
|-------|-------|-----|------|------|--------|-----------|
| **Temperature (°C)** |       |     |      |      |        |           |
| 1954-2010 | 5.3   | 10.6 | 14.9 | 19.3 | 19.3   | 14.5      |
| 2011    | 6.3   | 10.7 | 16.2 | 19.7 | 19.9   | 17.3      |
| 2012    | 5.9   | 10.1 | 15.0 | 19.4 | 19.0   | 13.9      |
| 2013    | 7.2   | 11.6 | 16.0 | 18.8 | 20.4   | 15.1      |

| **Rainfall (mm)** |       |     |      |      |        |           |
|-------------------|-------|-----|------|------|--------|-----------|
| 1954-2010         | 52.2  | 68.5 | 47.4 | 25.8 | 16.3   | 22.2      |
| 2011              | 15.2  | 56.7 | 24.0 | 20.0 | 7.5    | 12.0      |
| 2012              | 16.0  | 47.5 | 29.0 | 10.0 | 15.0   | 16.0      |
| 2013              | 45.0  | 32.0 | 26.5 | 7.5  | 6.0    | 72.0      |

The field experiments were designed according to the complete randomized blocks experiment design with three replications. Planting was made in 5 rows in 5 m length with 35 cm row spacing in the range of 100 plants per square meter in the last weeks of April. During sowing, 4 kg N da⁻¹ and 5 kg P₂O₅ da⁻¹ fertilizer were applied in the parcels (Kadioglu, 2015; Tan, 2018). In general, irrigations were applied before flowering, during flowering and in the bean filling period. After each irrigation, the growing weeds were removed by hoeing. Half of the plots were harvested for forage yield determining at the
blooming periods of the genotypes and the rest half was harvested for seed yield determining. 50 cm portions from the two rows at the sides and the two ends of the rows were taken as edge effects and neglected. Harvesting was performed on a total area of 4.2 square meters.

Bruchus spraying was carried out at a dose of 40 cc da⁻¹ with Deltamethrin effective drug before the formation of pods. Forage harvests were made when the grains were seen as projected in the pods, and seed harvests were carried out in the period in which the majority of the pods matured. The duration of flowering was taken as the date when there was 10% flowering in the parcels and the duration of physiological development was determined according to the date of seed harvest. The obtained data were analyzed by means of variance analysis in JUMP statistical package program and the means were compared with LSD test. Correlation analysis was conducted between the yield and the factors affecting the yield.

RESULTS AND DISCUSSION
Emergence, flowering and forage harvest days:
Observation results vary considerably over the years in the study. The emergence period changes from 15.2 to 18.4 days with an average of 16.8 days. Depending on the emergence, the number of days of flowering onset (10% flowering) varied approximately between 55.2-60.3 days and the average was determined as 58.4 days. In another study conducted in Erzurum, it was stated that the number of flowering days was between 59-77 days (Gunduz, 2013). The number of flowering days in 2011-2013 was 60.3 days and in 2012 it was 55.2 days. While forage harvesting period ranged from 65.5 to 77.5 days for the same region, Tan et al. (2013) determined the weed harvesting period as 79-91 days. Emergence and flowering were significant at 1% in years and genotypes, while genotype and year x genotype interaction were significant at 1% level in weed harvest days. Although the course of temperature during the development period is suitable for long years average, rainfall was not regular and slow and it was above the average for many years until March, and below the average until the end of September for many years, so the temperature was effective in flowering and harvest (Table 1).

Number of sub-branches and plant height:
Number of sub-branches is an important parameter especially in forage type peas. In the study, the number of sub-branches of varieties varied between 1.8-2.9. The average sub-branch development, which was 2.36 was around 2.77 in 2013. It can be stated that precipitation and temperatures have an effect on this development as well as genotype differences. The average plant height of 92.8 cm was 103.6 in 2011 which was the highest height measurement, and according to mean of years the genotype Kirazli was 110.6 cm and H-2 was 108.9 cm (Table 3). The length of the forage pea varies from dwarf types that are as short as 20 cm and do not require any support to pole forms that grow more than 200 cm (Koivisto et al., 2002). In some studies, the plant height of forage peas were determined to be vary between 34.0-169.9 cm (Bilgili, 1997; Timuragaoglu et al. 2004; Ceyhan et al. 2005; Tamkoc, 2007; Oz and Karasu, 2010 and Kadioglu, 2015).

Green forage yield: In the study, 1364.0 kg da⁻¹, 3156.0 kg da⁻¹ and 2590.2 kg da⁻¹ green forage yields were determined in 2011, 2012 and 2013, respectively. Year, genotype and year x genotype interaction were found to be significant at 1% according to the values of number of physiological development days. During the development period, forage pea, which does not like high temperature, requires humid and a cool environment. Therefore, during the development period, whereas the course of temperature goes in line with the average of long years, although the precipitation was not regular and slow, it was above the average of long years until March and below the average of long years until the end of September, thus the temperature was effective in maturation (Table 1; Table 4).

Number of physiological mature days: Seed harvest was determined as 98 days on average (Table 4). According to the genotypes, seeds were harvested between 91.6-102.0 days. Year, genotype and year x genotype interaction were found significant at 1% according to the values of number of physiological development days. During the development period, forage pea, which does not like high temperature, requires humid and a cool environment. Therefore, during the development period, whereas the course of temperature goes in line with the average of long years, although the precipitation was not regular and slow, it was above the average of long years until March and below the average of long years until the end of September, thus the temperature was effective in maturation (Table 1; Table 4).

Number of pods per plant and number of grains in pods: In the study, while the average number of pods per plant was 8.1, the values were recorded between 5.9-10.4. The highest number of pods was in Taskent (Table 4). In similar studies, the number of pods in pea varieties were determined to vary between 6-14 (Güllümsör et al., 1994), 36-60 (Qasim et al., 2001), 4.2-8.8 (Seyis, 1994), 26 (Karayel and Bozoğlu, 2008), 6.5-10 (Sayar et al., 2009), 7-25 units (Kılınç, 2017). Number of grains in pods is one of the important features that are considered as quality criteria in seed production affecting the yield and grain size. In the study, whereas the average number of pods per plant was 6.2, the values ranging between 5.4-7.5 were determined (Table 4).
**Thousand grain weight:** Values related to 1000-grain weight of genotypes, genotype, year and year x genotype interaction were found to be very important (Table 4). The average reached 202.8 g in 2011, 254.6 g in 2012 and 254.4 g in 2013. It has been recorded that whereas thousand grain weight takes value between 50-300 g in several studies (Bauder, 1999; Ceyhan et al., 2005; Sayar et al., 2009; Yılmaz, 2010; Uzun et al., 2012). These recorded values are very similar to the results of the research. Different thousand grain weight values recorded may be due to the meteorological and ecological characteristics of the study area, especially the genetic material difference.

### Table 3. Values of green forage yield and some properties of forage pea genotypes

| Genotypes | Days of emergence (number) | Days of flowering (number) | Sub-branches (number) | Plant height (cm) | Days of green forage harvest (number) | Green forage yield (kg da⁻¹) |
|-----------|--------------------------|---------------------------|----------------------|------------------|--------------------------------------|-----------------------------|
| Hınıs     | 16.0 F                   | 58.3 C                    | 2.6 A-D              | 92.2 EF          | 75.3 A                               | 2638.0 A-D                  |
| Taşkent   | 17.8 AB                  | 58.0 CD                   | 2.9 A               | 93.4 D-F         | 70.8 E                               | 2568.1 B-D                  |
| Ardahan   | 17.3 A-D                 | 57.6 C-E                 | 2.3 C-E             | 90.3 F           | 73.9 A-C                             | 1645.4 F                    |
| Töre      | 16.0 F                   | 62.1 A                    | 2.9 A               | 103.4 BC         | 74.2 AB                              | 2524.1 B-D                  |
| Samsun    | 16.3 D-F                 | 62.8 A                    | 2.0 F               | 91.5 EF          | 75.6 A                               | 2698.5 AB                   |
| H6        | 16.1 EF                  | 58.6 C                    | 2.6 A-C             | 79.7 G           | 74.8 AB                              | 2670.4 A-C                  |
| H8        | 16.6 C-F                 | 60.9 AB                   | 2.4 B-D             | 97.3 C-E         | 73.4 A-D                             | 2497.1 CD                   |
| H9        | 17.2 A-E                 | 55.0 F                    | 2.1 EF              | 76.4 G           | 64.8 G                               | 2159.4 E                    |
| H10       | 16.1 EF                  | 59.4 BC                   | 2.3 C-E             | 76.9 G           | 71.4 DE                              | 2271.7 E                    |
| H12       | 17.6 A-C                 | 55.7 EF                   | 2.5 B-D             | 108.9 AB         | 67.7 F                               | 1587.8 F                    |
| H13       | 17.6 A-C                 | 57.6 C-E                 | 1.8 F               | 81.3 G           | 72.4 B-E                             | 2764.5 A                    |
| H14       | 18.0 A                   | 56.2 D-F                 | 2.4 B-D             | 100.6 C          | 65.4 FG                              | 2237.2 E                    |
| H15       | 16.8 B-F                 | 58.3 C                    | 2.4 B-D             | 92.2 EF          | 72.6 B-E                             | 2472.0 D                    |
| Ürunlül    | 16.4 C-F                | 57.7 CD                   | 2.6 AB              | 100.0 CD         | 71.7 C-E                             | 2561.3 B-D                  |
| Özakaynak | 17.1 A-F                | 58.6 C                    | 2.4 B-D             | 90.5 EF          | 75.6 A                               | 2518.5 B-D                  |
| Kirazlı   | 17.0 A-F                | 59.1 BC                   | 2.3 DE              | 110.6 A          | 71.0 E                               | 2107.6 E                    |

**LSD (0.05)**

| Year | Genotype | CV (%) | Days of emergence (number) | Days of flowering (number) | Sub-branches (number) | Plant height (cm) | Days of green forage harvest (number) | Green forage yield (kg da⁻¹) |
|------|----------|--------|---------------------------|---------------------------|----------------------|------------------|--------------------------------------|-----------------------------|
| 2011 | 15.2 C    | 60.3 A  | 2.16 B                    | 103.6 A                   | 68.6 B               | 1364.0 C         | 130                                  |
| 2012 | 16.8 B    | 55.2 B  | 2.25 B                    | 98.4 B                    | 68.9 B               | 3156.0 A         | 10                                  |
| 2013 | 18.4 A    | 59.9 A  | 2.77 A                    | 76.3 C                    | 78.1 A               | 2590.2 B         | 10                                  |

**0.01, * 0.05, ns shows non-significant significance at the level. Means marked with different letters are statistically different from each other.**

**Seed yield:** On average, seed yield was 223.0 kg da⁻¹. The highest seed yield was gained in 2012 (283.3 kg da⁻¹). Year, genotype and year x genotype interaction were found to be significant at 1% (Table 4). Similar results were observed in similar studies. Under Samsun ecological conditions, Seys (1994) has reported a seed yield in different pea varieties as in 78.6-154 kg da⁻¹, and Gulmuşer (2004) has stated seed yield in 158.4-259.8 kg da⁻¹.

The minimum and maximum values of seed yield in the studies of Kaya (2000) was in 63.5-223.8 kg da⁻¹, of Togay et al. (2006) was in 82.5-86.3 kg da⁻¹, of Bozoglu et al. (2007) in 100.6-220.1 kg da⁻¹. Whereas a seed yield of in 113-163 kg da⁻¹ from forage pea varieties of Urünulu and Kirazlı under Erzurum conditions has been taken (Kadioğlu, 2019) Urünulu and Kirazlı, a seed yield of in 300 kg da⁻¹ from the same varieties has been taken in Bursa conditions (Uzun et al., 2012). In another study carried out in Erzurum, 259-289 kg of seed per decare from Taskent and Özakaynak in autumn sowing and 300 kg of seed yield has been recorded on H-10 and H-15 lines (Kadioğlu and Tan, 2018). Therefore, sowing time, environmental conditions and genotype cause a significant difference in seed yield. Generative opening and seed setting varies considerably depending on precipitation and temperature. In the summer period, the temperature was parallel to the long years, however the rainfall was below the average of long years (Table 1).

Although the temperature was suitable for the average of long years, precipitation was not slow. This negatively affected the plant during the full seed formation period. As it is known, climatic factors (temperature and rainfall) play a major role on seed
filling time. Low temperature, high proportional humidity and short day length delays the physiological maturity and leads to a decrease in efficiency (Bilgili, 2009). Seed yield generally depends on the number of plants per unit area, the number of pods per plant and the number of grains per pod (Table 4). Therefore, it has been reported that plants that produce more seeds per plant may have more seed yield (Elci and Orak, 1991; Oz and Karasu, 2010) and years also have significant impact on seed yield (Onder and Ceyhan, 2001; Acikgoz et al., 2007). The irregularity and instability of the distribution of temperature and precipitation during the year affected all elements, while the highest seed yield was obtained in the second year, high temperatures and inadequate rainfall caused drought and hot stress in the third year, thus shortening of the grain filling time and as a result low yield was obtained.

Table 4. Values of seed yield and some yield components of forage pea genotypes

| Genotypes   | Pods per plant (number) | Grain per pods (number) | Physiological mature days (number) | Thousand grain weight (g) | Seed yield (kg da⁻¹) |
|-------------|-------------------------|-------------------------|------------------------------------|--------------------------|---------------------|
| Hınıs       | 8.5 CD                  | 6.4 DE                  | 99.1 BC                            | 196.4 H                  | 145.6 L             |
| Taşkent     | 10.4 A                  | 6.6 B-D                 | 92.7 EF                            | 139.5 J                  | 10.23 F             |
| Ardahan     | 8.8 C                   | 6.5 C-E                 | 102.0 A                            | 185.0 I                  | 187.0 K             |
| Töre        | 8.3 C-E                 | 7.2 A                   | 99.0 BC                            | 303.4 A                  | 211.1 GH            |
| Samsun      | 8.9 BC                  | 7.5 A                   | 100.2 AB                           | 283.7 BC                 | 220.3 FG            |
| H6          | 8.3 C-E                 | 6.3 DE                  | 99.2 BC                            | 276.8 CD                 | 193.5 JK            |
| H8          | 7.1 E-G                 | 7.2 A                   | 99.0 BC                            | 303.4 A                  | 211.1 GH            |
| H9          | 9.4 A-C                 | 7.0 A-C                 | 91.6 F                             | 241.3 F                  | 322.0 A             |
| H10         | 5.9 G                   | 6.0 EF                  | 102.0 A                            | 273.9 D                  | 204.3 HI            |
| H12         | 8.4 CD                  | 6.1 D-F                 | 94.6 DE                            | 241.8 F                  | 212.0 GH            |
| H13         | 7.3 D-F                 | 7.1 AB                  | 99.1 BC                            | 287.2 B                  | 184.2 K             |
| H14         | 8.5 CD                  | 6.2 DE                  | 96.9 CD                            | 272.0 D                  | 234.3 E             |
| H15         | 7.4 D-F                 | 5.4 G                   | 99.2 BC                            | 258.7 E                  | 199.1 IJ            |
| Ürünülü     | 7.0 FG                  | 5.6 FG                  | 100.1 AB                           | 209.8 G                  | 250.4 D             |
| Öz Kaynak   | 10.1 AB                 | 7.1 AB                  | 100.3 AB                           | 199.3 H                  | 292.6 C             |
| Kirazlı     | 5.9 G                   | 6.1 D-F                 | 98.6 BC                            | 210.9 G                  | 305.1 B             |

Year ** ** ** **
Genotype ** ** ** **
Year x genotype ** ** ** **
CV (%) 11 9 2 3 8
LSD (0.05) 0.9 0.3 0.8 5.0 7.5

2011 7.2 B 6.9 A 95.6 B 202.8 B 225.6 B
2012 8.5 A 6.9 A 93.6 C 254.6 A 283.3 A
2013 8.7 A 5.7 B 104.7 B 254.4 A 160.0 C

**0.01, * 0.05, shows significance at the level. Means marked with different letters are statistically different from each other.

When the correlation table of the investigated properties was created (Table 5); there is a positive correlation between green forage yield and number of emergence days, plant length and number of sub-branches at 1% significance level, and the number of pods per plant at 5% level of significance. The sub-branches, leaves and leaflets may also increase with the plant height, forage yield also increases (Anlarsal and Gulcan, 1989). There is a positive correlation between seed yield and thousand seed weight 1% significance level, and a positive correlation between seed yield and grain number per pod at 5% significance level.

The relationship between seed yield and seed number per pod shows that the direct effect of grain number of per pod on grain yield is slightly felt, and this result is consistent with some studies (Acikgoz et al., 2007; Gurbuz et al., 2004). The presence of positive or negative relationships, which are
significant at the 1% and 5% significance levels, is important for the determination of selection criteria. The relationship between these characteristics and yields is not different from the criteria obtained in breeding studies (Erman et al., 1997; Albayrak, 2004).

Table 5. Correlation values between yield and some yield components

| Component | SY  | TGW | NDE | NDF | NPMD | NPP | NGP | PH | NGHD | NSB  |
|-----------|-----|-----|-----|-----|------|-----|-----|----|------|------|
| GFY       | 1.000 |     |     |     |      |     |     |    |      |      |
| SY        | 0.076 | 1.000 |     |     |      |     |     |    |      |      |
| TGW       | -0.144 | 0.436** | 1.000 |     |      |     |     |    |      |      |
| NDE       | 0.341** | -0.197 | 0.317** | 1.000 |     |     |     |    |      |      |
| NDF       | -0.354 | -0.422 | -0.197 | -0.170 | 1.000 |     |     |    |      |      |
| NPMD      | 0.142 | -0.381 | 0.203** | 0.209** | 0.319** | 1.000 |     |    |      |      |
| NPP       | 0.179* | 0.018 | 0.017 | 0.150 | -0.200 | -0.101 | 1.000 |    |      |      |
| NGP       | -0.028 | 0.186* | -0.073 | -0.244 | -0.100 | -0.356 | 0.190* | 1.000 |      |      |
| PH        | 0.309** | -0.205 | -0.447 | -0.388 | -0.027 | -0.473 | -0.177 | 0.146 | 1.000 |      |
| NGHD      | 0.110 | -0.430 | 0.133 | 0.230** | 0.445** | 0.641** | 0.153 | -0.196 | -0.505 | 1.000 |
| NSB       | 0.316** | -0.274 | -0.023 | 0.252** | 0.127 | 0.022 | 0.044 | -0.370 | -0.198 | 0.368** |

GFY: Green forage yield, SY: Seed yield, TGW: Thousand grain weight, NDE: Number of days of emergence, NDF: Number of days of flowering, NPMD: Number of physiological mature days, NPP: Number of pods per plants, NGP: Number of grains in pods, PH: Plant height, NGHD: Number of green grass harvest days, NSB: Number of sub-branches

CONCLUSIONS

One of the most important targets in forage crop culture is to increase the yield in the unit area. In order to develop suitable varieties that adapt to the region, it will be more accurate to determine the factors affecting the yield of hay and seed and to determine the relationships among these factors and to make the choices in breeding studies according to these elements. In this context, it can be said that forage yield is related to plant height and sub-branch number and the seed yield is related to plant height, number of ripening days and number of grains per pod and these elements will facilitate the selection.

As a result of this study, it can be stated that the H-9 and H-13 lines are suitable for both forage and seed production in the current conditions. However, due to the ease of seed supply in the short term, Taskent, Tore, Urunlu and Ozkaynak cultivars for forage production; Kirazlı variety for seed production can be recommended.

ACKNOWLEDGEMENT

This research was supported by funds of General Directorate of Agricultural Research and Policies (TAGEM) with the project number TBAD/12/A03/P01/005. We would also like to thank the TAGEM that supported the project.

Statement of Conflict of Interest

We declare that there are no conflicts of interest among the authors.

Authors’ Contributions

SK, project design, establishment of field experiments, conducting other studies, statistical analysis, evaluation and writing of the article, MT, evaluation of the study and writing the article, BK, establishment of field experiments, following field studies, taking observations, conducting and evaluating soil analysis, GT, establishment experiments, following field studies and taking observations. All authors have read and approved the last article.

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