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RESEARCH PAPER

Determination of Some Yield Characteristics of Hungarian Vetch Varieties and their Evaluation as Bee Pasture

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Abstract

This study was carried out to determine some yield characteristics of Hungarian vetch varieties and to evaluate them as bee pastures based on bee-plant relationship. Eight Hungarian vetch varieties were used in the study. In Bingöl province, where the research was carried out, flowering of Hungarian vetch started on April 18. Counts started on April 23 and ended on May 11. Hungarian vetch remained blooming for about three weeks in Bingöl province. An average of 14.9 bees per m2 visited the Hungarian vetch and the bees remained on the flower for an average of 9.0 seconds. It has been determined that Hungarian vetch has an average of 377 flowers per m2, the natural plant height is 38.7 cm, the fruit per plant is 21.3, the seed per fruit is 4.0, the seed yield is 22.5 kg/da, and the thousand-seed weight is 33.0 g. Also, it was observed that the Hungarian vetch reached the highest natural plant height by April 30, the number of bees visiting the plant was high on May 04-07, the bees stayed on flower for a long time when the plant bloomed the most. It was seen that Kansur and Efes varieties are distinguishable for the features such as the number of bees per m2, the duration of the bee staying on flower, and the number of flowers, while the features such as natural plant height, seed yield and thousand-seed weight, are distinguished in Akçalar, Efes and Tarm Beyazı varieties.

Introduction

Vetch, an annual legume forage crop, is used as a source of roughage and concentrated feed in animal nutrition, and is also known as plants grown in different agricultural systems to increase the fertility of the soil. Vetch are known as important fodder crops because of their high grass yield and high nutritional value. There are about 150 species of vetch (*Vicia*) growing all over the world (Serin & Tan, 2008). In Turkey, natural vegetation is very rich in terms of vetch species. Hungarian vetch is an annual, whitish yellow flowered vetch species whose cultivation has become widespread in our country in recent years. Hungarian vetch is an native plant of Central Europe, the Balkans, the Danube countries and the Eastern Mediterranean Region. It is cultivated in a wide area from Spain to Asia Minor to the Caucasus and from the Lower Balkans to Central Europe (Balabanlı et al., 2009; Hashalıcı et al., 2017). Hungarian vetch takes the first place among the vetch varieties in terms of winter resistance. In addition, Hungarian vetch is resistant to drought and is cultivated even in arid conditions. For this reason, it can be planted in arid conditions in winter and can benefit greatly from early spring precipitation (Serin & Tan, 2008). Hungarian vetch, which can produce 350-450 kg/da of hay under arid conditions, contains 15-17% crude protein (Balabanlı et al., 2009). When Hungarian vetch is used in

crop rotation systems, it increases soil fertility, prevents the formation of foot stones, uses water economically, and does not tire the field. Therefore, it can be used successfully in fallow areas. There is a good forage production opportunity with Hungarian vetch planting in regions with an annual precipitation of more than 400 mm and in the bottom areas (Serin & Tan, 1999). Many plant species continue their generation by pollination. Pollination is the pollination of flowering plants and can also be defined as the name of the transfer "from the stamen to the pistil". While it was thought that pollination was provided by wind only before, as a result of scientific studies, it was determined that insects are effective and mostly bees (*Apoidea*) and the importance of studies on bee plant pollination has increased (Benedek, 1996). Honey bees are important insects that contribute to the fertilization of plants and increase the product while collecting pollen and nectar from plants in order to meet their nutritional needs (Çankaya & Korkmaz, 2008). Pollen collected by honey bees ensures the development of the glands that secrete royal jelly in worker bees and is used as the sole protein source of baby bees (Kutlu et al., 2005).

Pollen, which is a source of protein in the nutrition of honey bees, is obtained only from natural flora. With this study, it is desired to investigate whether Hungarian vetch flowers, which are thought to be a good food source for honey bees, will be preferred by honey bees as a source of nectar and pollen in areas where flora is insufficient. Therefore, in this study the relationship between Hungarian vetch and bee was discussed and it is aimed to plant Hungarian vetch to support the plant population in Bingöl ecological conditions, to evaluate Hungarian vetch varieties as bee pasture, and to determine some yield and yield elements of Hungarian vetch varieties.

Materials and Methods

Material

Hungarian vetch varieties named Akçalar, Aygün, Budak, Doğu Beyazı, Efes, Kansur, Sarıefe, and Tarm Beyazı were used as plant material in the research. The research was carried out at Bingöl University, Agricultural Application and Research Center. This area is 15 km away from the city center of Bingöl, located at the coordinates of 38º 32' 41.85" N and 40º 32' 25.58" E and its height above sea level is 1080 m.

Climatic Characteristics of the Research Area

The annual average temperature in Bingöl is 12.1ºC. In January and February, the average temperature is below zero, and July and August are the hottest months. The annual total precipitation of Bingöl province is 948.4 mm. The most precipitation is received during the winter months. July and August are the months with the least rainfall.

Soil Characteristics of the Research Area

According to the soil analysis, the soil structure is clayey-loamy, slightly acidic (pH: 6.26), salt-free (0.014%), organic matter content is low (1.09%), slightly calcareous (0.41%), potassium content is low (18.27 kg/da) and phosphorus ratio was found to be medium (7.60 kg/da).

Method

In the study, some yield characteristics of Hungarian vetch varieties were examined and the possible chance of using Hungarian vetch as a bee pasture was evaluated. The trial was established on October 02, 2020, with each application plot in 6 rows, the distance between rows 40 cm and the length of each row 20 m. The results were made on an area of 1 m^2 determined in the parcels in three replications. The first bloom was seen on April 18, 2021. With the increase in the flowering rate of the plot, observations began to be taken as of April 23. On six different days, 23 April, 27 April, 30 April, 04 May, 07 May and 11 May, at 9:00 in the morning, 12:00 in the afternoon and 15:00 in the afternoon (Tansı & Kumova, 1999; Bakoglu & Kutlu, 2006; Kutlu et al., 2018) the number of bees per m^2 was determined as the average of these three different times for five minutes at three different times. The duration of stay of the bees in the flower was determined by keeping the time in seconds with the help of the chronometer. The natural plant height was measured in cm on six different days, with 10 plants in each replication. Again, data were obtained by counting the number of flowers per m^2 and taking the average at six different times. After the flowering phase was over, the number of fruits per plant, the number of seeds in the fruit were obtained, and 1 m^2 of land was harvested from each plot, the seed yield obtained from this area, the seed yield by hand threshing and the thousand-seed weight data were obtained.

Analysis of variance was applied to the obtained data with the help of JMP statistical package program. The differences of the means were compared with the LSD test at the 0.05 level.

Results and Discussion

In the study, characteristics such as the number of bees visiting Hungarian vetch cultivars per m^2, the duration of the bees in flower, the number of flowers per m^2, plant height, fruit per plant, seeds per fruit, seed yield and thousand grain weight were investigated.

1- The Number of Bees Per m^2 Determined at Different Counting Times of Hungarian Vetch Varieties

In this study, the number of bees that visited Hungarian vetch varieties per m^2 at different times is given in Table 1. In the table, it is observed that the

difference between Hungarian vetch varieties and the number of bees visiting per m^2 at different times is statistically significant. According to the table, the highest number of bees per m^2 on average was determined on 07 May. On April 23, the lowest number of bees per m^2 was determined. In terms of variety, the highest number of bees was determined in Efes and Kansur varieties, and the lowest number of bees in Sarıefe, Aygün, and Akçalar varieties. The number of visiting bees per m^2 was determined as 14.9 as the average of the varieties and different times. The flowering date of Hungarian vetch varieties, the air temperature and the number of rainy days in April and May affect the number of visiting bees per m^2.

Table 1. The number of bees per m^2 determined at different counting times of Hungarian vetch varieties (units)

Varieties	Time of Count						
	23 April	**27 April**	**30 April**	**04 May**	**07 May**	**11 May**	**Average**
Akçalar	8.5	6.0	9.3	17.2	20.0	8.5	11.6 c**
Aygün	4.2	4.7	13.5	21.2	16.0	5.0	10.8 c
Budak	3.2	8.5	13.3	19.0	31.7	5.3	13.5 bc
Doğu Beyazı	6.5	11.7	19.0	17.5	34.8	3.3	15.5 b
Efes	4.7	7.0	5.5	23.2	43.0	42.0	**20.9 a**
Kansur	6.3	12.8	22.2	30.8	38.7	15.2	**21.0 a**
Sarıefe	5.7	8.0	15.8	17.2	14.8	1.3	10.5 c
Tarm Beyazı	5.7	10.2	11.7	28.3	34.8	4.8	15.9 b
Average	5.6 e**	8.6 de	13.8 c	21.8 b	**29.2 a**	10.7 cd	**14.9**

**: $P \leq 0.01$

2- The Duration of the Bees in Flower at Different Counting Times of Hungarian Vetch Varieties

In the study, the duration of the bees in flower in Hungarian vetch varieties and at different times is given in Table 2. In the table, it is seen that the difference between Hungarian vetch varieties and the duration of the bees in flower at different times is statistically significant. According to the table, the maximum duration of inflorescence was determined on May 04. In terms of variety, the maximum duration of inflorescence was determined in Akçalar and Kansur varieties, and the lowest duration in flowering was determined in Sarıefe variety. As the average of the varieties and different times, the duration of the bees in flower was determined as 9.0 seconds. Air temperature, cloudy or rainy weather on the dates of the observations were effective on the duration of the bees' staying on flower.

Table 2. The duration of bees in flower of Hungarian vetch varieties at different counting times (seconds)

Varieties	Time of Count						
	23 April	**27 April**	**30 April**	**04 May**	**07 May**	**11 May**	**Average**
Akçalar	6.7	7.1	9.3	16.4	10.6	11.7	**10.3 a***
Aygün	7.3	6.3	10.3	11.2	10.7	8.9	9.1 abc
Budak	10.0	6.5	11.8	10.0	5.8	7.8	8.7 abc
Doğu Beyazı	6.8	8.5	11.8	13.5	8.5	3.0	8.7 abc
Efes	10.2	6.4	5.5	8.5	6.3	10.8	8.0 bc
Kansur	7.9	5.9	15.7	11.2	8.5	11.1	**10.1 a**
Sarıefe	7.8	5.7	9.8	12.4	8.0	2.1	7.6 c
Tarm Beyazı	7.9	7.5	9.6	14.9	7.2	10.7	9.6 ab
Average	8.1 c**	6.7 c	10.5 b	**12.3 a**	8.2 c	8.3 c	**9.0**

*: $P \leq 0.05$, **: $P \leq 0.01$

3- The Number of Flowers Detected Per m^2 of Hungarian Vetch Varieties at Different Counting Times

The number of flowers determined per m^2 in Hungarian vetch varieties and at different times in the study are given in Table 3. In the table, it was observed that the difference between the Hungarian vetch varieties and the number of flowers per m^2 at different times was statistically significant. According to the table, the highest number of flowers per m^2 was determined on May 04. April 23 was the date when the lowest number of flowers per m^2 was seen. In terms of variety, it was determined that the highest number of flowers per m^2 was in Kansur cultivar and the lowest number of flowers per m^2 was in Akçalar cultivar. The average number of flowers per m^2 at different counting times of the cultivars was determined as 377.

Table 3. Number of flowers per m^2 of Hungarian vetch varieties at different counting times (pieces)

Varieties	Time of Count						
	23 April	**27 April**	**30 April**	**04 May**	**07 May**	**11 May**	**Average**
Akçalar	26	164	313	558	429	185	279 d**
Aygün	41	164	395	710	405	138	309 cd
Budak	48	188	250	773	425	151	306 cd
Doğu Beyazı	56	313	421	1013	656	105	427 ab
Efes	18	43	110	710	720	1105	451 ab
Kansur	49	170	359	1024	670	690	**494 a**
Sarıefe	48	273	455	843	395	291	384 bc
Tarm Beyazı	55	350	455	656	520	188	371 bcd
Average	43 e**	208 d	345 c	**786 a**	528 b	357 c	**377**

**: $P \leq 0.01$

4- Natural Plant Height in Hungarian Vetch Varieties

In the study, the data about the natural plant heights in Hungarian vetch varieties and at different times are given in Table 4. It was observed in the table that the difference between Hungarian vetch varieties and natural plant heights determined at different times was statistically significant. According to the table, the highest natural plant height was determined on 30 April, 04 May, 07 May and 11 May. In terms of variety, it was determined that the highest natural plant height was determined in Akçalar variety. The average natural plant height of the cultivars at different times was determined as 38.7 cm.

Table 4. Natural plant heights of Hungarian vetch varieties according to different counting times (cm)

Varieties	Time of Count						
	23 April	**27 April**	**30 April**	**04 May**	**07 May**	**11 May**	**Average**
Akçalar	32.7	39.2	63.2	39.1	38.9	42.2	**42.6 a****
Aygün	32.6	37.8	38.1	46.0	39.0	41.0	39.1 bcd
Budak	26.1	33.0	41.1	38.2	39.3	39.9	36.3 d
Doğu Beyazı	32.0	40.2	42.5	41.5	41.2	40.5	39.7 abc
Efes	24.9	35.3	34.4	39.2	37.9	45.6	36.2 d
Kansur	27.9	32.3	37.5	40.7	39.1	40.5	36.3 d
Sarıefe	36.1	35.3	39.4	46.7	46.3	46.2	41.7 ab
Tarm Beyazı	29.0	41.9	35.8	38.8	39.4	43.1	38.0 cd
Average	30.2 c**	36.9 b	**41.5 a**	**41.3 a**	**40.1 a**	**42.4 a**	**38.7**

**: $P \leq 0.01$

5- Number of Fruits Per Plant, Number of Seeds Per Fruit, Seed Yield And Thousand-Seed Weight in Hungarian Vetch Varieties

In the study, the number of fruits per plant, number of seeds per fruit, seed yield and thousand-seed weights of Hungarian vetch cultivars are given in Table 5. Among these characteristics, the difference between the cultivars in terms of seed yield and thousand grain weight was found to be statistically significant. According to the data obtained, the highest seed yield was determined in Efes variety (76.9 kg/da), and the highest thousand kernel weight was determined in Tarm Beyazı variety with 38.6 g. In the study, it is seen that there is no statistical difference between the cultivars in terms of the number of fruit per plant and the number of seeds per fruit. The number of fruits per plant was determined as 18.0-25.8 with an average of 21.3, while the number of seeds per fruit was determined as 3.7-4.6 with an average of 4.0.

Table 5. Number of fruits per plant, number of seeds per fruit, seed yield and thousand seed weights in Hungarian vetch varieties

Varieties	Fruits per plant (unit)	Number of seeds per fruit (unit)	Seed yield (kg/da)	Thousand seed weights (g)
Akçalar	25.8	3.7	23.0 bc**	38.3 ab*
Aygün	22.4	4.6	4.9 e	26.3 d
Budak	21.9	4.3	8.0 e	29.1 d
Doğu Beyazı	20.2	3.7	18.2 cd	31.5 bcd
Efes	22.9	4.0	76.9 a	37.0 abc
Kansur	20.9	4.3	26.9 b	32.4 abcd
Sarıefe	18.4	3.8	6.3 e	30.9 cd
Tarm Beyazı	18.0	3.8	15.9 d	38.6 a
Average	**21.3**	**4.0**	**22.5**	**33.0**

*: $P \leq 0.05$, **: $P \leq 0.01$

The number of flowers in plants is very important in terms of both seed yield and nutrition of bees. It is generally known that plants with more flowers, are visited more frequently by bees according to the nectar status in the flowers of the plant (Özyiğit & Bilgen, 2003). Since pollination will increase during these visits by bees, more seeds are obtained from plants.

A study was conducted by Tansı and Kumova (1999) on the possibilities of using some forage crops (Broad bean, rapeseed and phacelia) as a bee pasture and on the determination of seed yields. They reported that the average flowering period of 3 years during the flowering periods of the plants in the parcel consisting of all three plants was 54 days, the number of flowers varied between 16.6-746 pieces/m² and the bee density varied between 1-64 bees/m². They also determined that the seed yield increased significantly in rapeseed and phacelia plants that were visited by honey bees.

Kumova et al. (2001), in their study to determine the preference of honey bees in phacelia cultivars, reported that they made flower and honey bee counts in the plant once a week at three different points of each cultivar determined in the plot during the flowering period. In the censuses made in the research, the average number of flowers in Turan 82, T-98/1 and T-98/2 cultivars was 1077.60 ± 231.43, 971.10 ± 283.06 and 1021.10 ± 403.57 units/m^2, and the average number of honey bees was 68.10 ± 17.30, 62.36 ± 14.93 and they determined that they were 62.23 ± 21.57 pieces/m^2 and the difference between varieties was insignificant.

In the study conducted by Özyiğit and Bilgen (2003) to determine the effect of different cutting times on yield and agricultural characteristics of some legume forage crops in Antalya lowland conditions, it was reported that the first flowering plant was the forage pea and was initially visited by bees, but almost no bees came to this plant after the grass pea bloomed. The researchers determined the number of flowers per plant and the number of bees per m^2, 41.33 and 13.67 in common vetch, 86.33 and 20.00 in Anatolian clover, 81.62 and 5.00 in melilot, 12.33 and 10.33 in sainfoin, 42.33 and 10.67 in hairy vetch, 16.33 and 12.33 in grass pea, 13.33 and 2.33 in field pea. In addition, researchers reported that they observed a dense bee population in Anatolian clover despite the flowering of plants in the natural environment.

Kızılşimşek and Ateş (2004), in their study to examine the flowering course of phacelia at different sowing times in Kahramanmaraş conditions and to determine the possibilities of using it as a bee pasture, the number of flowers during the flowering period was between 61-1662 pieces/m^2, and the number of flowers in 5 minutes visited the flowers in m^2. They reported that the number of bees varies depending on the number of flowers and they found an average of 7 per square meter when the flowers were very few, and 119 pieces/m^2 when the flowers were plentiful.

In the study conducted by Bakoğlu and Kutlu (2006) to determine the effects of different row spacing on some agricultural characteristics in phacelia in Bingöl irrigated conditions, the number of flowers was determined as 8982.23 pieces/m^2, the number of bees as 116 pieces/m^2, and the highest values were observed in 50 cm row spacing.

Kuvancı and Deveci (2010), in their study to evaluate facelia, sainfoin and clover plants according to honey bee preference, found that the most visited plant by honey bees in terms of plant preference was phacelia with 71.8 units/m^2 that followed by sainfoin with 55.9 units/m^2 and reported that the alfalfa plant, with 1.5 units/m^2, is much less preferred next to phacelia and sainfoin.

In the study conducted by Tuncer (2014) to determine the vegetative properties of phacelia at different nitrogen doses (2.5, 5.0, 7.5 and 10.0 kg/da); it has been reported that N doses have a significant effect on bee visitation, the highest bee visitation occurs at the N4 dose during the 50% flowering period, and the lowest bee visitation occurs at the N1 dose. Researchers have determined that the number of bees visiting the flowers in the plant varies between 18.17-24.33 pcs/m^2, including the control.

Kuvanci et al. (2016) in the study conducted to determine the importance of Alexandria clover and phacelia in plant preference of honey bees, it was declared that the average number of flowers in plants was 33600 per Alexandria clover and 9500 per m^2 in phacelia. In addition, it was reported that the bee visits to the flowers in the plants within 5 minutes were 72.74 units/m^2 in the phacelia plant, 53.90 units/m^2 in the Alexandria clover, and the visits made during the day were at noon in both plants.

Hashalıcı et al. (2017) obtained the highest main stem length of 75.5 and 76.3 cm from Aegean Beyaz-79 and Budak varieties in the first year of Hungarian vetch planting. In addition, they determined the highest main stem length of 53.0, 55.3, 56.7 and 56.9 cm in the second year in Tarm Beyazı-98, Anadolu Pink-2002, Aegean Beyazı-79 and Budak varieties. Tenikecier et al. (2020) determined the main stem length of Hungarian vetch genotypes as 51.60 cm in the 50% flowering period in the first year and 55.52 cm in the 50% flowering period in the second year in the study they carried out for two years. Bakoglu et al. (2004) reported that they achieved an average plant height of 46.20 cm in their study on the adaptation of some Hungarian vetch lines and varieties to Bingöl dry conditions. Sayar et al. (2012) reported the plant height as 52.3-63.1 cm in the study they conducted with 12 Hungarian vetch genotypes in Kızıltepe conditions of Mardin province. In the study of Çaçan et al. (2021) the highest plant height (93.3 cm) at the first planting time was reported in their study in which they examined the yield, quality and nutrient content of Hungarian vetch according to different sowing times. It is seen that the natural plant heights obtained in these studies are similar to the natural plant heights obtained in other studies, but are lower than the findings measured as the main stem length.

Erdoğdu et al. (2016) reported that the seed yield was between 53.7-76.5 kg/da in their study on the forage and seed yields of Hungarian vetch lines and varieties in Eskişehir conditions. Albayrak et al. (2011) investigated the effects of 2 row spacing (17.5 and 35.0 cm) and 4 sowing norms (4, 6, 8 and 10 kg/da) applications on the forage yield and quality of Hungarian vetch in Isparta conditions, and according to the data obtained in their two years study, They declared that the seed yield is between 53-98 kg/da in average.

Bakoğlu et al. (2004), in their study on the adaptation of some Hungarian vetch lines and varieties to Bingol dry conditions, reported that the highest number of pods per plant in the Ege Beyazı variety was 9.37 and the average of the varieties was 7.65. In addition, they reported that they found the highest number of seeds in the pod (3.50 units) from line 16, and the Ege Beyazı variety with the highest number of seeds per plant (26.76 units).

Uzun et al. (2004) investigated the effects of four different sowing rates on seed yield and yield components in four Hungarian vetch lines planted in winter. Statistically significant differences were observed between the Hungarian vetch lines, which were examined according to the two-year data they obtained, in terms of all measured characteristics except 1000 grain weight. In the study, the number of pods per plant was 27.7-43.9, the number of seeds per plant was 94.1-171.2, the weight of 1000 seeds was 36.2-37.3 g, and the seed yield was 50.5-140.3 kg/da.

Conclusion

This study was carried out to determine some yield characteristics of Hungarian vetch varieties and to evaluate them as bee pastures; the highest number of bees per m^2 visited Hungarian vetch varieties was on 07 May. The maximum duration of stay of the bees and the number of flowers per m^2 were observed on May 4, the highest natural plant height was observed on May 11, and the differences between the groups were found to be statistically significant. In addition, in terms of seed yield, Efes cultivar and Tarm Beyazı cultivar showed the highest yield according to thousand seed weight characteristics and statistically differences were observed between cultivars. In this study, there was no difference between cultivars in terms of the number of fruits per plant and the number of seeds per fruit.

As of April 18, the first flowers have started to appear in Hungarian vetch in Bingöl conditions. Counts started on April 23 and flowering ended on May 15. Hungarian vetch stayed on flower for about 3 weeks in Bingöl conditions. The highest number of bees visiting the plant was on 07 May. It has been determined that bees stay on flower longer between 30 April and 04 May. The date of May 11 was when the plant reached its highest plant height.

As a result, when Hungarian vetch was evaluated as bee pasture, it was concluded that Kansur and Efes in terms of bee-plant relationship, Akçalar, Efes and Tarm Beyazı varieties are ideal for Bingöl conditions in terms of natural plant height, seed yield and thousand-seed weight. Considering the time in the flowering period of Hungarian vetch, it was concluded that bees can benefit from this plant significantly after the winter season and therefore it can be used as a bee pasture until the first

half of May in Bingöl conditions.

Ethical Statement

Not applicable.

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Author Contributions

The authors contributed on an equal footing and there was no conflict between the authors.

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References

Albayrak, S., Türk, M., & Yüksel, O. (2011). Effect of row spacing and seeding rate on Hungarian vetch yield and quality. *Turkish Journal of Field Crops*, *16*(1), 54-58.

Bakoğlu, A., Kökten, K. & Karadavut, U. (2004). A study on the adaptation of some Hungarian vetch hats and people to Bingol currency. *III. Bingol Symposium*, 93-99.

Bakoğlu, A. & Kutlu, M. A. (2006). A research on the effect of different row space on some agricultural traits and use of bee foraging in phacelia (Phacelia tanecetifolia Benntham) grown under irrigated conditions of Bingöl. *Uludag Bee Journal, 6*(1), 33-38.

Balabanlı, C., Avcıoğlu, R., Hatipoğlu, R. & Karadağ, Y. (2009). Forage crops, leguminous forage crops, Cilt II. İzmir: *TC. Publications of the Ministry of Agriculture, General Directorate of Agricultural Production and Development*, 417-418.

Benedek, (1996). In: Nyeki, J. & Soltesz, M. (eds.) Floral Biology of Temperate Zone and Small Fruits. Akademia Kaido, Budapest, Hungary. *Insect Pollination of Fruit Crops* (pp. 287-342).

Çaçan, E., Nursoy, H. & Şahin, E. (2021). Changes in yield, quality and nutrient content of Hungarian vetch (Vicia pannonica Crantz) in different sowing times. *Yuzuncu Yil University Journal of Agricultural Sciences*, *31* (3), 733-741.

Çankaya, N. & Korkmaz, A. (2008). *Samsun Provincial Directorate of Agriculture Farmer Education and Extension Branch Publication.*

Erdoğdu, İ., Sever, A. L. & Atalay, A. K. (2016). Forage and seed yields of Hungarian vetch lines and varieties under Eskişehir ecological conditions. *Journal of Field Crops Central Research Institute*, *25* (2), 230-234.

Hashalıcı, S., Uzun, S., Özaktan, H. & Kaplan, M. (2017). Determination of forage yield and quality of some Hungarian vetch cultivars at Kayseri arid conditions. *Journal of Faculty of Veterinary Medicine, Erciyes University*, *14*(2), 113-123.

Kızılşimşek, M. & Ateş, F. (2004). The flowering course of bee grass (*Phacelia tanacetifolia* Benth.) in Kahramanmaraş conditions at different planting times and its evaluation as a bee pasture. *K.S.Ü. Journal of Science and Engineering, 7*(11), 96-103.

Kumova, U., Sağlamtimur, T. & Korkmaz, A. (2001). Research on honeybee (*Apis mellifera* L.) foraging preferences among varieties of phacelia (*Phacelia Tanacetifolia* Bentham). *Mellifera*, *1*(1), 27-32.

Kutlu, M. A., Bakoğlu, A. & Batmaz, B. (2005). Colony performances of queenbee that are different aged are growed in beekeeping of Bingol college of Firat University. *Eastern Anatolia Region Researches*, 19-22.

Kutlu, M. A., Kiliç, Ö., Özdemir, F. A. & Bakır, Y. M. (2018). An investigation about *Phacelia tanacetifolia* Benth. from Olur District (Erzurum). *International Journal of Scientific and Technological Research, 4*(3), 61-69.

Kuvancı, A. & Deveci, M. (2010, October, 05-08). The plant of phacelia (*Phacelia tanacetifolia* Bentham), sainfoin (*Onobrychis sativa* L.) and alfalfa (*Medicago sativa* L.) evaluation with respect to honey bee preference. *2nd International Mugla Beekeeping & Pine Honey Congress*, *Mugla-Turkey.*

Kuvancı, A., Deveci, M., Alay, F., Çankaya, N. & Avcı, M. (2016). Importance of berseem clover (*Trifolium Alexandrinum* L.) and phacelia (*Phacelia Tanacetifolia* B.) plants in honey bees (*Apis mellifera* L.) preference. *Journal of Field Crops Central Research Institute*, *25* (Special issue-2), 188-194.

Özyiğit, Y. & Bilgen, M. (2003, October, 13-17). The effect of different cutting stages on the yield, quality and agricultural characteristics of some forage legume - bee plants [Poster Notice]. *Turkey 5th Field Crops Congress*, *Diyarbakır.*

Sayar, M. S., Karahan, H., Han, Y., Tekdal, S. & Başbağ, M. (2012). Determination of forage yield, its affecting components and relationships among traits of some Hungarian vetch (*Vicia pannonica* CRANTZ.) genotypes in Kızıltepe ecological conditions. *Journal of Agricultural Sciences Research* , *5*(2), 126-130.

Serin, Y. & Tan, M., (1999). Forage crop cultivation in fallow fields. Serin Y. eds. In: Meadow-Passage Management and Improvement. *Publications of the Ministry of Agriculture, General Directorate of Agricultural Production and Development* (pp. 69-81).

Serin, Y. & Tan, M., (2008). Forage crops and pasture based livestock training. *Kayseri: Erciyes University Publication No.:160.* S.S *Yerköy Village Agricultural Development Cooperative , 2*, 107-117.

Tansı, V. & Kumova, U. (1999). A research on the possibilities of using some forage plants as bee pastures and the determination of seed yield quality. *Ç.Ü. Journal of the Faculty of Agriculture, 14,* 81-90.

Tenikecier, H., Orak, S., Tekeli, A., & Gültekin Birol, A. S. (2020). The effects of different harvest stages on herbage yield and some quality characteristics of some Hungarian vetch (*Vicia pannonica* Crantz.) genotypes. *Turkish Journal of Agriculture and Natural Sciences*, *7*(4), 833-847.

Tuncer, K. (2014). Influence of different nitrogen doses on plant properties and forage quality of phacelia (*Phacelia Tanacetifolia* Bentham). *Bozok University Institute of Science and Technology Department of Field Crops,* Master Thesis, Yozgat.

Uzun, A., Bilgili, U., Sincik, M. & Açıkgöz, E. (2004). Effects of seeding rates on yield and yield components of Hungarian vetch (*Vicia pannonica* Crantz.). *Turk Journal of Agriculture and Foresty*, 28, 179-182.