

# The Possibility of Using Bee Plant of Legume Forage Crops

Yaşar ÖZYİĞİT

Mehmet BİLGİN

**Abstract**—Legume forage crops are very important for feeding of livestock. Also, legume forage crops are pollen and nectar source for bees. While the plants need bees for pollination, bees need plants for feeding. Bees gather nectar and pollen from flowers for food and they pollinate hundreds of flowers. Legume flowers is often brightly coloured to attract the bees. Anthers and stigmas are uncovered in some of plant flowers. The Clovers (*Trifolium* species) have this type of flower and they are often visited by bees. Legume plant have high honey potential. Especially, Alfalfa and Clovers produce a large amount of nectar which is highly attractive to many species of bees, and honey bees produce excellent crops of high quality honey. Nectars contain three sugar type (sucrose, glucose and fructose). Honey bees prefer a balanced nectar, consisting of equal amounts of sucrose, glucose and fructose. Nectars of legume forage crops contain balanced these sugar. Alfalfa, Clover, Sainfoin and Vetch are the most visited legume forage crops by bees. But these plants cut in early stage, otherwise forage quality decrease. So all flowers don't open and a lot of nectar and pollen loss.

**Keywords**—Legume forage crops, Bee plant, Nectar, Pollen

## 1. I. INTRODUCED

Being of alives depend on plants direct or indirect and strong joint organic link set up between alives and plants in the course of time. This joint is mutual in general. One of the best example of this joint is relation on between honey bees and plants flowers. While the plants need bees for pollination, bees need plants for feeding. Archaeologic evidences indicate that these two alives group evolution together [1].

About 250.000 species of flowering plants have been identified in world-wide and many tropical species are as yet unnamed. Many of these plants have complex relationships to bees and to other pollinators, including flies, beetles, moths, butterflies, birds and bats [2].

Honey bees gather nectar and pollen from flowers, at the same time they pollinate hundreds of flower in plants [2]. This condition is more important for cross-pollinated plants. Because, the plants which member of these group need other plants pollen for pollinate. A lot of important legume forage crops is self sterile and they need another plant pollen for

pollinate. If other plants pollen don't come to these plants flower, flowers don't pollinate and they dry. Legume seed produce depend on insect pollination. The most important pollinator of plants of in these group is honey bees [3]. Because bees are easily managed and can be transported.

Also honey bees can be managed for income from both honey production and pollination services and maintain large populations throughout the growing season [4].

Honey bees are social insects, with a marked division of labor between the various types of bees in the colony. A colony of honey bees includes a queen, drones and workers. The queen is the only sexually developed female in the hive. Drones are stout male bees which have no stingers. Drones do not collect food or pollen from flowers. Their sole purpose is to make with the queen [5]. Worker honey bees will visit any flowers that provide good amounts of nectar or pollen. These materials are processed by bees into honey. Each flower provides but a few milligrams of pollen or nectar. Bees have therefore to visit hundreds of thousands of flowers. All the available flowers do not provide food of the required quality. Because of this, the bees which gather food have to select food plants from among a host of other plants [6].

Bees use pollen and nectar for energy and protein. Pollen is essential to bees because it is their only natural source of protein. Without it, colonies would be unable to produce new bees and would eventually die. Nectar is the carbohydrate portion of the honey bee's food and is the raw material of honey. Nectars contain three sugar type (sucrose, glucose and fructose). Honey bees prefer a balanced nectar, consisting of equal amounts of sucrose, glucose and fructose [7]. Honey is derived from the nectar of numerous plant species. Different flowers produce different quantities, qualities, colors, consistencies and flavors of nectar. Basically the colour and flavour of honey depends upon the nature and type of flowers from which the nectar has been obtained. So honey ranges in colour from white to dark amber.

Also, honey bees require water in addition to pollen and nectar for their survival. Honey bee colonies are active throughout the growing season, especially in the spring [8].

Legume forage crops generally are higher in feeding value than nonlegumes. They are higher in protein, have higher-quality protein, and are superior for soil improvement [9]. Legumes extract nitrogen from the air and transfer it into the soil through their root system in a form usable by other crops. Legumes also have a high content in lysine, an essential amino acid, which is lacking in cereals, and are excellent plant sources of iron and thiamine.

Yaşar ÖZYİĞİT is research assistant in Field Crops Department of Agricultural Faculty of Akdeniz University, Antalya Türkiye (corresponding author e-mail: ozyigit@akdeniz.edu.tr)

Mehmet BİLGİN is Assistant Professor in Field Crops Department of Agricultural Faculty of Akdeniz University, Antalya Türkiye ( e-mail: bilgin@akdeniz.edu.tr)

Also legume forage crops are very important bee plants. Where produce honey, the multi-cut legumes (alfalfa, sain foin, trefoil and some clovers) should be considered. These plants can be made to bloom more than once if cutting is timed correctly and thus can provide resources for bees over large portions of the summer. If the cuttings of different parts of the planting are staggered, the nectar and pollen supply can be continuous [10]-[11].

Some legume forage crops which can utilize bee plant are be seen in below.

#### **Alfalfa (*Medicago sativa*)**

Alfalfa, or Lucerna as it is called in Europe, is one of the leading forage crops. Alfalfa is a herbaceous perennial that can produce large amounts of nutritious forage material. The energy and protein yield/acre by alfalfa rivals that of a corn crop used for silage purposes.

The purple or yellow flowers of alfalfa are attractive to honey bees. Whether Alfalfa is grown for seed or for hay makes a big difference in the size of the honey crop. Alfalfa flowers exist throughout the summer as it may be cut several times in before flowering for hay. Otherwise plants become too fibrous and forage quality decrease. So the crop may be quite useless to the beekeeper [11]. But inclement weather or other delays may cause the hay to be cut later in the season. If the hay is cut late in the season, the alfalfa plants have time to flower and become an abundant nectar source [12]-[13].

Honey bees “especially nectar gathering honey bees” have difficulty gathering nectar and pollen due to a tripping mechanism in the alfalfa blossom. Eventually honey bees learn to avoid this problem, but only about one percent of the flowers visited by a bee are pollinated resulting in the need for many colonies [2]. Pollen gathering honey bees are more efficient pollinators in alfalfa, because they must enter the flower to obtain pollen [14].

Alfalfa honey is white or extra-light amber and has low moisture content. The heavy nectar secretion of the alfalfa flowers and the fact that the honey does not granulate rapidly makes it an ideal source for produced comb honey [15].

#### **Clovers (*Trifolium* sp.)**

Clovers are the most popular honey plants in the United States. White clover, alsike clover, and the white and yellow sweet clover plants are the most important for honey production. Depending on location and source, Clover honey varies in color from water-white to extra light amber and has a mild, delicate flavor [16].

#### **White clover (*Trifolium repens*)**

White clover, also known as “dutch clover”, is native to temperate Europe and Asia. White clover used to be one of our common pasture clovers but like other clovers its use has declined as alfalfa continues to dominate other legume crops [9].

The most important pollinator of white clover is honey bees. The plant is highly attractive to bees. The bees visit the flowers for nectar present at the base of the staminal tube and during this process cause pollination.

White clover honey is considered the best quality honey. Honey is light coloured and has a clean, mild flavour. It is the standard to which other honeys are compared. The actual honey flow usually commences about ten days after the first open blossoms appear. Flowers that appear towards the end of the flowering period don’t produce much nectar [11]. In many areas it is the principle source of nectar for the production of surplus honey. The best yields come in seasons following a year of excessive rainfall. In wet years the conditions favor the rooting of thousands of new plants, which are ready to produce a crop of nectar the following summer [17].

#### **Red clover (*Trifolium pratense*)**

Red clover, a wild plant, is believed to have originated in those countries that border the Mediterranean and Red Seas and used as grazing food for cattle and other livestock. Botanically, red clover is a herbaceous perennial [9]. There are many varieties of red clover used in agriculture. They are employed in pasture seed mixtures of various kinds and may be sown as sole crop for cutting [11].

Red clover flowers are self sterile and must cross-pollinated. Most of red clover flowers are reddish purple; a few are rose, lilac, pink, or white. A good field will have more than 200 million florets to the acre. Bumble bees are its most efficient pollinators. However research indicates that honey bees actually do most of the red clover pollination and that growers in most areas must place honey bee colonies in the field in order to obtain maximum seed yield [14].

When honey has been obtained from red clover it has usually been from the second crop, i.e. the crop arising after the first crop has been cut. The reason given for this in the past has been that the flowers of the second (or third) crop are smaller and with shorter flower tubes [11]. Most studies indicate that is not good honey plant, so honey bees leave it for other attractive plants in bloom at the same time [10]. Honey which obtained from red clover has the same high quality and has the same general characteristics as that of white clover, but red clover honey may granulate more quickly [11]. Red clover honey production is uncommon. But it contains many B vitamins which are necessary for glandular health especially the thyroid [18].

#### **Crimson clover (*Trifolium incarnatum* L.)**

Crimson clover, also known as “scarlet”, “incarnate” and “German” clover, is a native of Europe [9]. Crimson clover is a versatile plant used to produce forage for livestock, for soil conservation, as a green manure crop [19]. Crimson clover also include nitrogen credit for succeeding crops and decreased weed pressure, especially in spring and fall.

Honey bees are the primary pollinators of crimson clover. The flowers are self fertile but not self pollinating [20]. Flowers open from the bottom of the flower head to the top.

Growers hope for cool, cloudy days during the bloom period, so the flowers will open more slowly, giving bees plenty of time to visit each one. If the weather is hot and sunny, all the blooms open at once. Then not every flower gets pollinated, and the seed yield is lower [21].

Crimson clover is a source of pollen and nectar for bees. It is a valuable honey plant and often fills the gap in the nectar flow between the fruit and tree blossoms and white clover [11]. A good field may have about two million flower heads per acre with nearly 100 florets per head [14]. Many beekeepers move colonies to these areas to gather the early honey crop which occurs in early April.

#### **Alsike clover (*Trifolium hybridum* L.)**

Alsike clover is so named from locality in Sweden from which the plant came to England. The plant is perennial and the smooth leaf systems arise from a crown [9]. It is a good hay, pasture, and green manure crop, and like other legumes, it improves the soil and contributes to reduced soil erosion.

The florets of alsike clover are largely self-incompatible and they must receive pollen from another plant to produce seed [22]. The most important pollinator is bees in the alsike clover. Honey bees usually predominate in alsike fields and few bumble bees are attracted [14].

Alsike clover is good nectar and pollen source for bees [3]. The mechanism of the flower in Alsike is the same as that in white clover and it is of about the same value as honey plant. In some areas in fact it is considered to yield nectar more freely than white clover [11]. Alsike and White clover flowering period is equally long. So much of the clover honey is a mixture of the two. Alsike clover honey color is change usually from water white to amber. The flavor is mild and very distinctive [15].

#### **Persian clover (*Trifolium resupinatum*)**

Persian clover is a native of southern Asia Minor and the Mediterranean countries. It is an annual legume adapted to the heavy low-lying soils and primarily a pasture and hay crop. It supplies good grazing from late winter to late spring [9]. Persian clover is most often sown as a one year hay crop.

Persian clover is self pollination unlike other much of legume forage crops, but it is visited by bees [23]. Bees are beneficial in persian clover-pollination. Their caged plots that included bees yielded about nine times as much seed as plots caged without bees [24].

Persian clover is extremely appropriate for bee pasture, when it came full blooming [23]. But its not good bee plants as much as other clovers.

#### **Sweet clover (*Melilotus* sp.)**

There are three species of sweetclover of agricultural importance; white sweetclover (*Melilotus alba*), yellow sweetclover (*Melilotus officinalis*) and sourclover (*Melilotus indica*). The white and yellow sweetclover are mostly biennial, but some are annual. Sourclover is a winter annual [14].

Sweet clover may be used for hay or pasture or as a plow-down crop. By far, its greatest use and adaptation is as a

pasture- and soil-improving crop. Sweet clovers have high coumarin content. So they don't as palatable as most other legumes [3].

White sweet clover is self pollination, but insects are increase pollination rate. Yellow sweet clover is cross pollination, so role of insects is big in sweet clover seed produce. Sweet clover flowers are visited by a lot of insect species [3].

Sweet clovers are always attractive to bees and an important honey- producing plant in many parts of the world, and has been renowned as a bee plant from classical times. The name of the plant derives from the words Mel (honey) and lotus (flower). The quality of sweet clover honey is good, being light in color although often greenish. It is of medium density, with a pleasant mild flavour, slightly vanilla-like. Granulation takes place more readily than with ordinary white clover (*Trifolium repens*) [11].

#### **Vetches (*Vicia* sp.)**

All of vetches are annuals except hairy vetch, which is either annual or biennial depending on its utilization [9]. Vetches or tares are an important forage crop throughout the country and are extensively grown, being either spring or autumn sown [11].

Much of vetches are self pollination. So they don't require to bees for pollination [3].

Vetches don't rank as good bee plants, although bees visit the flowers on occasions and seem to get a certain amount of nectar. It would seem that the plant may be useful for nectar in some seasons, but not in others and that some localities are more favourable than others. Like its close relative the field bean (*Vicia faba*) the vetch has well-developed extra-floral nectaries [11]. Good crops of vetch honey have been reported but the beekeeper is not likely to obtain a large honey crop while renting bees for vetch pollination [14].

#### **Trefoil (*Lotus* sp.)**

Birdsfoot trefoil is a long-lived perennial with a branching taplike root with a few or many stems growing from each crown. It is more drought-resistant than many other legumes. It is unusual among legumes in that it does not cause bloat in cattle. Both as pasture and as hay it is highly palatable and nutritious. They make high-quality hay and silage [9].

Trefoil is largely cross pollinated and, for seed production, cross pollination must be done by bees and other insects. The most important pollinator of trefoils are bees. The flower is so constructed that pollen is released before the flower opens and self-pollination appears feasible [25]. Leafcutter bees are also effective pollinators. Some growers allow the first growth to set seed. Others get better results by clipping the stand in early to mid-June. This delays flowering and gives time for bee populations to build up. The growing season on the prairies is too short to permit clipping [26].

Bees prefer trefoil to many other flowering plants to nectar and pollen and tend to congregate in flowering trefoil fields. Flowers are bright orange-yellow to lemon-yellow and are attractive to honey bees. Honey bees often are supplied to seed fields and excellent quality honey can be obtained. Trefoil produces a superb honey although on a national scale

the amount produced annually is not great [25]. Some beekeepers prefer trefoil to most other legumes as a source of nectar for honey.

### Sainfoin (*Onobrychis viciifolia*)

Sainfoin is a perennial plant and a non bloating forage legume with an upright habit of growth suitable for cutting and aftermath grazing. It is primarily used as a source of very high quality hay. Sainfoin is higher in carbohydrates than alfalfa, but has less crude protein, crude fiber and ash. Sainfoin hay is equal to alfalfa in feed efficiency and digestibility for beef cattle [3].

Sainfoin is self pollination and flowers are pollinated almost entirely by honey bees. Bee colony must put near of sainfoin fields, when seed is produce [3].

Sainfoin flowers are very attractive to bees for nectar and pollen. They are a rosy pink color and field in full bloom is a pleasing sight [11]. Flower heads grow at the apex of erect stems and florets do not need to be tripped so bees have ready access to nectar and pollen [14]. Sainfoin honey is of excellent quality. It is a very distinctive type of honey, being deep yellow in color, bright, and with a characteristic flavour and aroma [11].

## II. CONCLUSION

Legume forage crops are very important for bees. Because these plants are provide nectar and pollen which essential for bee feed. But these plants cut in early stage, otherwise forage quality decrease. So all flowers don't open and honey product decrease.

## REFERENCES

- [1] H. Baydar ve F. Gürel, "Antalya doğal florasında bal arısı (*Apis mellifera*)'nın polen toplama aktivitesi, polen tercihi ve farklı polen tiplerinin morfolojik ve kalite özellikleri." *Turkish Journal of Agriculture and Forestry*. 22: 475-482, 1998
- [2] R. A. Hoopengartner and G.D. Waller Crop Polination. The hive and the honey bee. Extensively resieved 1992 (Third printing 1997). Chapter 24. Dadant&Sons . pp. 1044-1080. Hamilton. Illinois. 1997
- [3] E. Açıkgöz, Yembitkileri . 3. Baskı. Uludağ Üniversitesi Güçlendirme Vakfı Yayın No: 182. VİPAŞ A.Ş. Yayın No: 58.,584 ss. Bursa, 2001.
- [4] Maintain bee forage areas.  
<http://entomology.unl.edu/beekeeping/tidings/btid1998/btdmay98.htm> 2005
- [5] Beekeeping's Benefit to Agriculture.  
[http://www.fourh.umn.edu/Programs/camping/bug\\_camp/beekeeping.html](http://www.fourh.umn.edu/Programs/camping/bug_camp/beekeeping.html) 2005
- [6] Flowering Plants useful to Honey Bees.  
<http://mandafamily.com/indhonindresources.htm> 2005
- [7] J.R., Hagler. "Honey bee (*Apis mellifera* L.) response to simulated onion nectars containing variable sugar and potassium concentrations." *Apidologie* 21: 115-121, 1990
- [8] J. E. Tew, Nectar and pollen producing plants of alabama (A Guide for Beekeepers). <http://www.aces.edu/pubs/docs/A/ANR-0351/> 1998.
- [9] M. S. Kipss, Production of Field Crops. A Textbook of Agronomy(VI. Edition). Tata mcgraw-hill publishing company ltd. New Delhi. 790 p. 1981.
- [10] G. S. Ayers, and, J. R. Harman, Bee forage of North America and the potential for planting for bees. The hive and honey bee. Extensively resieved 1992(Third printing 1997). Chapter: 11, Dadant&Sons Hamilton. Illinois., pp. 437-535, 1997

- [11] N. F. Howes. Plants and Beekeeping. p.p.: 236 Faber and Faber. London&Boston, 1979.
- [12] <http://www.honey.com/votm/Alfalfa.html> 2005
- [13] F. Mulder,. Nectar and Pollen Plants of Oklahoma.  
<http://www.osuextra.com> 2005
- [14] E. C. MARTIN, The use of bees for crop pollination . The Hive and Honey Bee. Extensively resieved 1975 (Second printing 1975). Dadant&Sons . Publishers of the American Bee Journal. pp. 600-605. Hamilton. Illinois, 1975.
- [15] F. A. Robinson and E. Oertel, Sources of nectar and polen. The Hive and Honey Bee . Extensively resieved 1975 (Second printing 1975). Dadant&Sons . Publishers of the American Bee Journal. pp. 283-279. Hamilton. Illinois, 1975.
- [16] <http://www.honey.com/info/floral.html#part4> 2005
- [17] Pellet, F. C. 1976. American honey plants. 5th ed. Dadant & Sons, Hamilton, IL.
- [18] Nutrients of Space Syrup Ingredients.  
<http://fp1.centurytel.net/diadeluz/spacesyrup.htm> 2005
- [19] D.M. Ball, and G.D. Lacefield, Crimson Clover. Circular 00-1.Oregon Clover Commission, Salem, Oregon 2000.
- [20] W.E. Knight, Crimson clover.. In N.L. Taylor (ed.) Clover science and technology. Agron. Monogr. 25. p. 491-502. ASA, CSSA, and SSSA, Madison, WI., 1985.
- [21] S. A. Markham, Clover Seed Production In Oregon  
<http://www.oregonclover.org/pdf/seedproduction.pdf> 2005.
- [22] A. J. Pieters and, E. A. Hollowell, Clover Improvement. U.S. Dept. Agr. Yearbook 1937: 1190-1214, 1937.
- [23] S. Gençkan. Yembitkileri Tarımı. Ege Üniversitesi Ziraat Fakültesi Yayınları No: 467 519 ss. İzmir 1983
- [24] N. Weaver and R. M. Weihing, "Pollination of Several Clovers By Honey Bees." *Agron. Jour.* 52: 183-185, 1960.
- [25] R. R. Seaney and P. R. Henson, "Birdsfoot Trefoil". *Adv. in Agron.* 22: 119-157, 1970.
- [26] Birdsfoot Trefoil Seed.  
<http://www.forageseed.mb.ca/BirdsfootTrefoilSeedInfo.html> 2005

Yaşar ÖZYİĞİT was born in Gazipaşa/Antalya in 1979. He graduated from Akdeniz University, Faculty of Agriculture, Department of Field Crops in 1999 in Antalya, Turkey. He received his Master of Science Degree from Akdeniz University Institute of Science and Technology, Department of Field Crops in 2003 in Antalya. He is educating his doctorate program at the same Institute. He is a research assistant in the Faculty of Agriculture, Department of Field Crops of Akdeniz University. His research area is forage crops and rangeland.

Mehmet BİLGEN was born in Aydın in 1966. He graduated from Çukurova University, Faculty of Agriculture, Department of Field Crops in 1987. He received his Master of Science Degree in 1991 and Doctor's Degree in 1996 from Akdeniz University Institute of Science and Technology, Department of Field Crops in Antalya. He received Assist. Prof degree in 1999. He is now officiate as Assist. Prof. in the Faculty of Agriculture, Department of Field Crops of Akdeniz University. His research area is forage crops and rangeland.