BEE-PLANTS AROUND AN APIARY IN GAZIPUR DISTRICT OF BANGLADESH

Begum, H. A. and M. S. Hossain[1]

Department of Botany, Govt. Haraganga College, Munshigonj, Bangladesh; [1]*Department of Entomology, Sher-e-Bangla Agricultural University, Dhaka-1207, Bangladesh*

Abstract

Study of bee-plants through pollen analysis from pollen-loads and pollens from bee legs was made to identify a number of bee-plants around the apiary at Bhadun in Gazipur, Bangladesh. It was also identified the dearth period of the year from November to February. Suggestions were made for plantation of some plants that bloom in these critical months. The study revealed that pollen-load was maximum in May and minimum in December and January.

***Key Words*:** Bee-plants, apiary, dearth period, bee-plant relation.

INTRODUCTION

In Bangladesh there are mainly three monofloral honeys. They are produced from the plans litchi (*Litchi chinensis*), kulshi (*Aegiceras majus*) and mustard (*Brassica napus*). Besides honey, litchi and mustard give increased yield when pollinated by honey bee (Munawar *et al.* 2009). A large number of bee pollination is required to increase yield of different crops. After monsoon bee colonies become weak due to unfavorable weather, attacks by different pests and diseases, and scarcity of food in the nature. Thus, before a honey-flow season only medicine and food supplement cannot maintain the bee population at its usual level. The natural source of food (plant source) enhances the egg laying of queen bee. Natural foods are also always fresh and less costly. Identification of bee flora from the bee-collected pollens round the year provides the information of dearth period in a year. At the same time the bee plants (which bloom at these critical periods is very few in number in Bangladesh) can be compensated to solve the food crisis of honey bees. Thus, the present study has been envisaged to identify the bee plants around Bhadun apiary at Gazipur. Pick pointing the duration of dearth period has been themed as one of the objectives. The natural food supply can increase the number of pollinators which enhance the cause of yield of crops. And at the same time the pollinated plants can help in enhancing the production of natural honey.

MATERIAL AND METHODS

Bee plants are identified by studying pollens carried by the honey bees (*Apis mellifera*) and comparing with those of known plants around the apiary. The location of the apiary is at the North latitude 23˚56′48′′ and at the East longitude 90˚27′3′′. Sixty bee boxes in the apiary are placed in several rows. Five bee boxes were selected for the study. Each single colony of *A. mellifera* was reared in a wooden box with eight frames (or combs) and each box had a single east facing entrance. For pollen-load collection the entrance was fitted with a pollen-trap. It had holes which permitted bees to pass through. The holes were made in such a way that, not the heavy loads of the pollens in the hind legs of the bees were allowed to pass

through them. The platform of the trap was also porous and the pollen-loads pass through onto the basket at the bottom. After one hour the pollen-loads were collected and air-dried on a white paper in room temperature. The pollen-loads with different colour were separated and kept in separate small vials. The vials of a single-day treatment were kept within a plastic pot and preserved in refrigerator at 4°C. Afterwards when the pollens were seen 'infected' by microbes and mites, they were kept at 0°C overnight to kill the infesting organism. A second sort of pollen- collection was made by keeping celotape (adhesive side upward) on slide at the entrance-floor. Almost each and every honey bee left her foot-print on the adhesive side of celotape. The stickiness of celotape was such that no leg stick on but the pollens on the legs left on it. After 30-60 minutes the slides were removed and stick the tape on the other side of the slide. The date and time was marked on slide. All the slides collected in a day were kept within a plastic pot and preserved in refrigerator in deep freezing. To identity the pollen-plants, slides were prepared with the pollens from pollen-loads. A pinch of pollens from the load was spread on the drop of saturated glucose solution on a slide and covered by a cover glass. Maximum pollen grains showed clear structure but some showed hazy ornamentation. In such cases pollens were pressed under cover glass to tear the exine showing clear ornamentation. Sometimes the granules in the cytoplasm caused disturbances. Too much sticky pollen-loads (high concentration of nectar gluing pollens together) were washed with water. Acetic acid and 100% alcohol were tried also for exine with some coloured substances. For examining shape and germ pore, excess glucose solution was added on pollen grains under cover glass. It was made to understand the examination of overall structure. The dried pollen grains showed their characteristics well under the processes. The details of the pollen-structures were recorded with free hand drawing and compared with those of the pollens on plants in the nature. The use of pollens from mature and immature buds was added to the study in another technique. The pollens on celotape were also compared with those of plant-pollens. The slides were used as semi permanent preparation. Some slides were made for future use by dusting pollens from plants and from pollen-buds on celotape. To determine the period of food-scarcity, the amount of pollens collected per hour measured month-wise. The percentage of major pollen-type was estimated from the total pollens collected in an hour.

RESULTS AND DISCUSSION

A number of bee-plants were identified throughout the year by taking them around the apiary. The pollens were identified by examining their morphological features. Table 1 shows the plants and their time of blooming in different months of the year in the experimental areas.

Table 1. The levels of flower density during the blooming period of bee plants around the Bhadun Apiary.

Source -plants	Density of flowers; + = Low, ++ = Moderate, +++ = High											
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Lagenaria siceraria	+++	++							+	+	+	++
Cucurbita moschata	+++	++	+								+	+++
Momordica charantia	++					+++						+
Phoenix sylvestris	+	+++										
Dulbergia sisso		+++										
Moringa oleifera		+++										

Loranthus longiflorus		+++						+++			++	
Pithecellobium dulce		++	+									
Toona ciliala		+++	++									
Nephelium litche				++								
N. longana			+	+++								
Syzygium cumini			+++									
S. fruticosa				+	+++							
Albizia procera			+	++	++	+++	+++	++	+			
A. labbek								+	+++	++		
Mangifera indica			+++									
Lannea coronsbondelica		+++	+									
Emblica officinale		+	++									
Melia azadarachta		++	+++									
Shorea robusta		++	+++	+								
Spondius pinata			+++	++	+							
Citrus gandis		+	+++	++								
Citrus aurantifolia	+		+++	+++	++	++	+	+	+			
Psidium guagiava				+++								
Syzygium samaaugense				+++								
Vitex peduncularis					+++							
Samanea saman			+	+	+	++	+++	+++	+++			
Borringtonia acutangula				+	+++							
Lixsea glntinosa					++	+++	++					
Borassus flabellifera			+	+++	+++	+++	+++	++	+	+	+	
Xanthoxylum rhesta				+++	+							
Mimosa pudica					+	++	++	++	++	+	+	
Averrhoa corombola			+	+	++	++	++	++	++	++	+	
Grewia nervosa			+	+++	++			+	+++	++	+	
Lagerstroemia speciosa				++	++	++	++	++				
Eucalyptus alba				+	+		++	++	++	+++		
Tamarindus indica					+	++	+++	++	+	+		
Dillenia indica						+	++					
Elaeocarpus floribumndus						+++	+					
Nymphoides. sp					+	++	+++	+++	+++	+++		
Nymphaea rubra					+	++	++	++	++	+++	+	
N. pubescens							+++	+++	+++	++		
N. stellata/nouchali								+	++	+++	+	
Polygonum. sp				+	++	+++	+++	++	++	+		
Acacia auriculiformis							+	+++	+++	+++	+	
Type-1												
Acacia auriculiformis								+	+++	+++	++	
Type-2												
Sesbania cannabina						+	+++	++				
Zizyphus mauritiana									+++	+		
Urena lobata								+	+++	++	++	
Phyllathus acidus										+++	+	
Brassica nigra	++										+	+++
Glycosmis arborea							+	+	++	+++	++	+
Evalvulos numularis				+	++	++	++	+				
Luffa cylindrica					+	+++	++	++	+++	++	+	
Luffa acutangula								+	+++	+		
Momordica charantia	++						+++					+
Erica vulgaris	+		+		+		+		+		+	
Antigonon leptopus							+++					
Cucumis sativus						++	+++	+				
Leucas linifolia												
Cocos nucifera	+			+								
Musa paradisica	+			+								
Aspergillus sp.												

The density of flowers per plant on some experimental plants was low or pollen grains per flower were not sufficient. The amount of collected pollen grains (g) was expressed month-wise in Figure 1. Practically there was a very short but extreme dearth period from mid- February to March due to insufficient plants for the large apiary. Besides, blooming in mustard field ceased 15 days earlier in the year 2012. Secondly, due to heavy rainfall, another dearth period appeared in between the months of August and September. On that time food for bees was supposed to be available in the nature; but by unusual climatic change, all the nectar and pollens washed away by rain water. But as the pollen-collections were made on sunny days the data reflects no dearth period. Supplements (sugar syrup and flour of soya bean) were given for those days. Lastly as mustard cultivation was made in Bhadun areas as leafy vegetables, then maximum bee boxes were transported to the mustard field of Dhamrai, Dhaka on that time. From the onset of litchi blooming on early March, the bee colonies were with rich food-supply. Figure 1 shows the highest amount of pollens collected in May and the lowest in December and January. Again the routine checkup of the honey comb and field observations on flowering, flower structure and availability of food revealed that there were plenty of flowers in nature. But honey bees could not collect food from them. It was because of: i) plants were far away beyond their capacity to fly; ii) flowers with long narrow corolla tube; iii) flowers in hypanthodium; iv) flowers with anthers opening through pores; v) small flowers not in clusters; and vi) choice of honey bees was not adjusted.

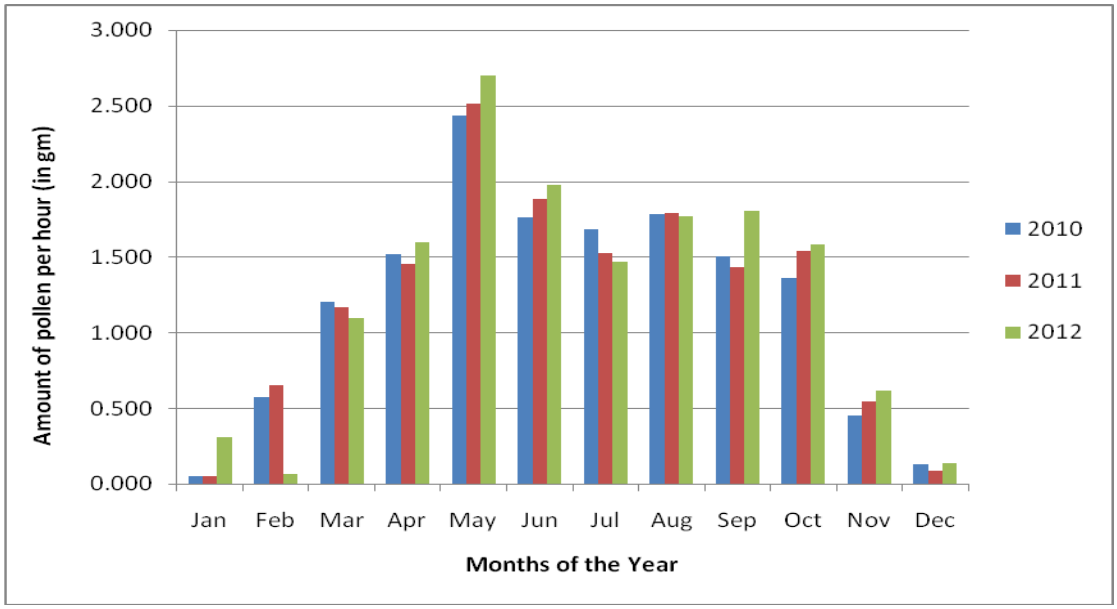

Fig. 1. Amount of pollen grains (g) collected by honey bees as pollen loads in the different months of the year 2010-2012.

From the percentage of different pollen-loads, some major pollen-plants were identified around the year 2010-2012 (Table 2). The table 2 shows the absence of major pollens in December and January. In these months there were very few plants in blooming condition in Bhadun areas. To solve the dearth (want of food) problem, blooming plants were searched in different districts (mainly Narayanganj, Munshiganj, Gazipur and Dhaka) throughout the year 2011 and 2012.

Table 2. Sources of major pollens round the year 2010-2012.

Month	Source of major pollens	% of pollens		
		2010	2011	2012
January	No major pollens	--	--	--
February	*Phoenix sylvestris*	70	80.2	60
	Cucurbita moscheata	30	50.0	90
March	*Borassus flabellifer*	68	60.5	62
April	*Borassus flabellifer*	90	90.7	90
May	*Borassus flabellifer*	40	50.6	60
	Lixsea glutinosa	50	40.8	--
June	*Lixsea glutinosa*	70	80.0	70
July	*Nymphaea sp*	50	50.5	40
	Luffa cylindrica	60	40.1	60
August	*Nymphaea sp*	60	50.9	30
September	*Nymphaea sp.*	25	30.7	--
	Acacia moniliformis	48	50.8	58
October	*Acacia moniliformis*	60	50.0	90
November	*Acacia moniliformis*	50	50.3	40
December	No major pollen	--	--	--

As a result some bee plants were identified as 'absent or rare' in Bhadun areas. A list of such plants was made for plantation in the apiary area to meet up the crisis of natural food availability for honey bees (Table 3).

Table 3. Plant suggested to be introduced near to the apiary site.

Plant Name (Scientific)	Blooming Period	Nature of Food
Toona ciliata	Jan-Feb	N
Streculia villosa	Feb	N
Zea mays	Feb	P
Bombax insigne	Feb	N/P
Averhoa bilimbi	Feb	N/P
Cajanus cajan	Jan-Feb	N/P
Lannea coromandelica	Jan-Feb	P
Foeniculum vulgare	Feb	N/P
Moringa oleifera	Year round	N/P
Nigella sativa	Year round	N/P
Guizotica abyssinica	Jan-Feb	N
Helianthus annus	Jan-Feb	N/P
Tridax procumbens	Year round	N/P
Cosmos sp	Dec-Feb	P
Erica vulgaris	Jan-Feb	N/P
Antigonon leptopus	July-Aug	N
Lotus corniculata	Sep	N
Asclepioas currassavica	July-Aug	N
Vitex peduncularis	May	N
Tecoma stans	Year round	N
Brassica nigra	Dec-Jan	N/P

Note: P-Pollen, N-Nectar, N/P-Nectar and Pollen

The study of pollens from pollen-loads and on celotape made possible to identify bee plants for Bhadun apiary. Faegri and Piji (1979) observed that bee collected pollens (from pollen loads) did not express the bee plants totally, hence pollens and nectar both were also

studied. Here in the present investigation the additional pollens on celotape besides those in the pollen-loads compensated as nectar plants. Hence the pollens altogether from loads and on celotape were compensated as bee-plants. The density of palm, olive, date palm, hizal, blackberry, plum, litchi, water lily, dhundal, kamranga etc. plants were sufficient in the area of experimentation. There is a possibility for the production of mono-floral honey from lotus by cultivating them in Bhadun areas. Before starting an apiary in a new area, small number of bee boxes should be pioneered for the identification of bee plants. In many countries assessment of bee plants was made through pollens-study (Mbah and Amao 2009). Study of vegetation was made as per methods adopted Pasha and Hossain (2009) may be taken as example. No previous record was seen to use celotape for pollen collection before so far the literature is revealed. Hence, this technique was unique in the present investigation of the study of pollens. Attachment on adhesive tape reveals that the number of plants identified from pollen-loads were fewer than those from pollens on tape. Many bees were observed entering the box without any pollen loads. Some bees with very small loads passed trap-hole placing the hind legs crosswise under its abdomen. Hence only the bee collected pollen loads cannot give the clear information about bee plants. In the present investigation pollens from the legs of honey bee on the celotape fill up the absence of some loads. Pollen-loads collection was lowest in February in the present investigation. Blooming plants were very few at that time. It was highest in the month of April, May and June. But Bhuyan *et al.* (2002) found it lowest in June, July and August and maximum in December. This variation was due to the differentiation in vegetation culture. Hourly examination of pollen-loads could give a clear idea about blooming time in the day or night. Again the percentage at pollen-kinds in a load with mixed pollens also confirms the idea. Night bloomers gave pollens to the bees very early in the morning. The depletion of food in the first source enhances the bees to the second bloomers (at 6 to 7 am). Then to the third source 9 to 10 am. The scorching sun light and high temperature was avoided by them. Some flowers open at noon. Bees collected those pollens at afternoon or even at next morning. The dried condition of pollens expressed earlier dehiscence. Bees were seen to collect pollen fallen on the petal base. Levin (1983) saw bees cutting anther for pollens. Immature pollens collection was observed in the present investigation also. Pollens-study and field observation focused on important aspects on that the honey bees have choice for some flowers. It happened only when there were different kinds of blooming plants available in the same area. They choose flowers nearby the apiary; large or medium sized flowers with dense and numerous stamens; flowers compactly or closely situated in the inflorescences; smaller pollens; numerous pollens with fully exposed another; another with longitudinal slit; flowers having no bad taste; both nectar and pollens availability in the same flower. Rogel (2002) also recorded such performance of the bees. However, in crisis of pollens, loads with large pollens were collected from the flowers of sweet gourd and rain trees. Cook *et al.* (2003) observed performance of pollen having higher amino acid content. Stanley and Linskens (1974) observed performance of polliniferous plants. Duration of blooming period when focused on the pollens-study. Then it stands possible to identify eurypalynous and stenopalynous taxa. Pollens-collection in successive years may not static due to some reasons as: i) some large trees were cut down; ii) progressive number of picnic and shooting spot in that area; iii) clearing of ponds and low lands for fishing practices; iv) change of crops in the field; v) impacts of environmental

factors on blooming periods; vi) internal factors of less flower production in *Lixsea* sp.; vii) cutting the male inflorescence of *Borassus flabeliffer* for molasses (*Gur*) production; and viii) new plantation as avenue tree or trees of domestic use tends. After monsoon, bee population decreased mainly by the attack of diseases and pests. The environment acted as a hazardous factor also. Vigorous growth of flowering plants ceases in many plants population and that incoming food in the hive became less. Because of the prevailed conditions the queen also lessens her egg laying. Planting appropriate bee plants to meet up the dearth period naturally can enhance the egg laying capacity of the queen. To increase the bee population in a colony is a prerequisite before a honey season. At the end of November or early December, the mono-floral mustard honey season starts. The harvesting honey is a cash crop of a bee-keeper. The crop of a bee-keeper is the honey. But the aim of a farmer is to increase the yield of his cash crop grains (mustard grains). It is obvious that more honey bees make more pollination which results higher yield both for mustard grains and honey production. Winston and Scott (1984) and Robinson *et al.* (1989) recorded higher yield by honey bee pollination.

To save the bees, to increase the crop yield, the bee-keeping, agriculture and horticulture should run side by side. Modern bee-keeping has the aim of honey production and its marketing. In some areas of Bangladesh bee-boxes are transported to the orchard (litchi) and field (mustard, niger, sesame) to get better honey harvest. Nowadays farmers or orchard owners should make themselves conscious about pollination, fruit and seed set, which can arrange bee-boxes from different sources for attaining higher yields and upgrade the national economy.

ACKNOWLEDGEMENTS

The authors are grateful to Dr. Mamataj Begum, Professor, Department of Botany, University of Dhaka for her kind suggestions during the study. Indebtedness is offered to the BSCIC Chairman for giving permission for carrying out the research. The Authors acknowledge Mr. Mizanur Rahman, Extension Officer of the Apiary, BSCIC, Gazipur for his fruitful suggestion. Thanks to Md. Amanat Ullah, the ecologist of Centre for Environmental and Geographic Information for his cordial cooperations. Authors are also indebted to the authority of the BNH, especially to Sarder Nasir Uddin, Senior scientific officer for the identification of the plants.

REFERENCES

Bhuyan, P. M., M. L. Khan and R. S. Tripathi. 2002. Regenaration status and population structure of Rudraksh (*Elaeocarpus ganitrus* Roxb.) in Arunachal Pradesh. *Current Science*. **83**: 1391-1394.

Cook, S. M., C. S. Awmack., D. A. Murray and I. H. Williams. 2003. Are honey bees foraging preferences affected by pollen amino acid composition? *Ecol. Entomol.* **28**(2): 622-627.

Faegri, K. and L. Van der Pijl. 1979. *The principles of Pollination Ecology*. 3rd ed. Pergamon Press, New York. 20 pp.

Levin, M. D. 1983. Value of bee pollination to US Agriculture. *Bull. Entomol. Soc. of Amer.* **29**: 50-51.

Mbah, C. E. and A. O. Amao. 2009. Natural foods and feeding habits of the African Honeybee *Apis mellifera andersoni* Latrielle (1804) in Zaria, Northern Nigeria. *Sci. world J.* **4**(1): 11-14.

Munawar, M. S., S. Raza, M. Siddique, S. Niaz and M. Amjad. 2009. The Pollination by Honeybee (*Apis mellifera* L.) Increases Yield of Canola (*Brassica napus* L.). *Pak. Entomol*. **31**(2): 103-106.

Pasha, M. K. and M. S. Hossain. 2009. Airborne Pollen grains at Chittagong University Campus, Bangladesh. *J. Bot*. **38**(1): 39-46.

Robinson, W. S., R. Nowogrodski and R. A. Morse. 1989. The value of honeybees as pollinators of US Crops. *Am. Bee J.* **129**: 411-487.

Rogel, V. G. 2002. Polliniferous plants and foraging strategies of *Apis mellifera* (Hymenoptera: Apidae) in the Yucatan Peninsula. Mexico. *Rev. Biol. Trop*. **50**(3-4): 1035-1044.

Stanley, R. G. and H. F. Linskens. 1974. Carbohydrates and cell walls in Pollen Biology, Biochemistry and Management. *Springer-Verlag*, Berlin., pp. 129-144.

Winston, M. L. and C. D. Scott. 1984. The Value of Bee Pollination to Canadian Agriculture. *Canadian Beekeeping*. **11**: 134.