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Significance of *Trianthema portulacastrum* L. in sustenance of *Apis florea* colonies during dearth period

Ujjwal Layek[1], Prakash Karmakar[2*], Pankaj Kumar Pal[3]

[1&2]*Department of Botany & Forestry, Vidyasagar University, Midnapore, India*

[3]*Department of Botany, The University of Burdwan, Burdwan, India*

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Abstract

The paper reports flowering phenology, floral visitors of *Trianthema portulacastrum* and melissopalynological analyses of 8 honey samples and 374 pollen loads of *Apis florea*, collected during May to August from Bankura district, West Bengal. *T. portulacastrum* flowers during April to October. Flowers open at 6.30-7.00 am in the morning. Anther dehiscence takes place after 30 minutes from flower opening. Closing of the flower takes place at about 11.30 am – 12.15 pm. During the opening phase of the flower, a number of visitors viz. *Apis cerana*, *A. florea*, *Augochloropsis metallica*, *Halictus* sp., *Pseudoborbo bevani* and *Trigona iridipennis* visit the flower for nectar or pollen. Melissopalynological analyses revealed that all the honey samples were multifloral in origin and *T. portulacastrum* present in all the honey samples. Regarding the pollen foraging scenario of the bee species, *T. portulacastrum* also played an important role during those months. The overall result reflects the importance of *T. portulacastrum* as a major source of both nectar and pollen grains for *A. florea* colonies during dearth period.

* **Corresponding Author:** Prakash Karmakar ✉ karmakar_p@yahoo.co.in

Introduction

Trianthema portulacastrum L. (Aizoaceae) commonly known as horse purslane in English and gadabani in Bengali vernacular, is a terrestrial, annual, prostrate herb indigenous to South Africa (Jeffrey, 1960; Adamson, 1962). The plant is widely distributed in tropical and subtropical countries including India as an invasive weed of cultivated fields and wastelands (Duthie, 1960; Holm *et al*., 1997). In India, though the plant regarded as a problematic weed by virtue of its infestation in various agricultural and vegetable crops especially during the rainy seasons (Balyan and Bhan, 1986; Simmons, 1986), the plant extract possess significant pharmacological activities such as diuretic, analgestic, hepatoprotective, anticarcinogenic, antihyperglycemic, antioxidant and antibacterial properties (Kumar *et al*., 2004; Shanmugam *et al*., 2007; Shymsunder *et al*., 2009; Rattanata *et al*., 2014). In addition to the medicinal properties, the plant also serves as a source of nectar and pollen grains for many insects including *Apis florea* during late summer and monsoon.]

While investigating the foraging behavior of *A. florea* in Bankura district of West Bengal, it was found that flowering period of *T. portulacastrum* coincides with the foraging of *A. florea* during May – August. During this period, flowering plants supplying nectar and pollen grains to the bee species are less in number. Again availability of adequate sources of nectar and pollen is the most important limiting factor in the survival, abundance and distribution of honeybees (Kifle *et al*., 2014).

The present work was undertaken to work out the flowering phenology and floral visitors of *T. portulacastrum* and foraging behaviour of *A. florea* during May to August vis-à-vis to judge the efficacy of *T. portulacastrum* as a source of pollen grains and nectar for *A. florea* colonies during dearth period in Bankura district, West Bengal.

Materials and methods

Study area

The present work was conducted in different rural areas viz. Barkuri, Jenadihi, Lachhmanpur, Ranipur and Sahebdanga of Bankura district, West Bengal (Fig. 1). It is situated between 22°38′ and 23°38′ north latitude and between 86°36′ and 87°46′ east longitude. It has an area of about 6882 square km. The area is characterized by an overwhelming dominance of naturally occurring 'sal' forest (*Shorea robusta*) in association with *Eucalyptus* and *Acacia auriculiformis* plantation. *A. florea* frequently form hives and the population of *T. portulacastrum* was also high among the aforesaid localities of the district.

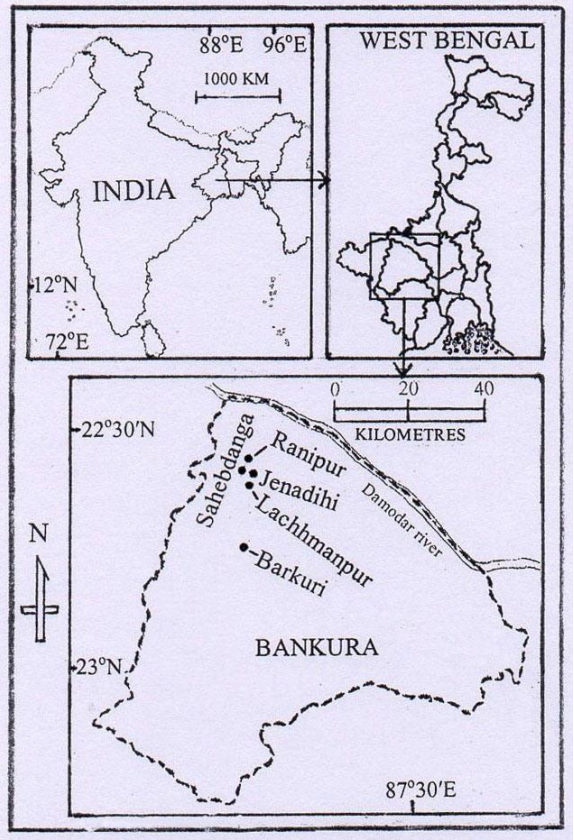

Fig. 1. Map showing sampling sites (•).

Field survey

A survey was conducted in order to collect pollen grains and honey samples from the bee hives as well as to investigate the floral biology of *T. portulacastrum* in the natural condition (*in-situ*) during its flowering period. For documentation we took photographs using Canon PowerShot SX110 IS digital camera. Collected floral visitors were preserved in 70% alcohol and identified with the help of reference literature and also taking the help of

Zoological Survey of India (ZSI).

Collection of pollen and honey samples

Pollen pellets and honey samples were collected from the wild hives of *Apis florea* during 2009-2012. A total of 374 pairs of corbicular pollen pellets and 8 honey samples were collected. Pollen pellets collected directly from the pollen baskets of worker bees by capturing them while returning to their hives after gathering pollen grains. Pairs of pellets were preserved separately in the small (5ml) glass vials containing FAA (Formalin-Aceto-Alcohol, 5:5:90) solution. Honey samples were collected from wild hives after removing the honeybees fully or partly from the hives. Pure honey samples were collected directly from honey cells with the help of a clean and sterilized fine tipped glass dropper.

Palynological analyses

The pollen pellets were prepared by acetolysis method (Erdtman, 1960). Qualitative and quantitative analyses of honey samples were done using methods recommended by Maurizio (1951) and International Commission for Bee Botany (Louveaux *et al.*, 1978). Identification was done with the help of reference slides prepared from the local flora as well as from published accounts. Photomicrographs of suitable magnifications were made with Leica MPS-60 photoautomat. Pollen pellets were categorized as unifloral, bifloral or multifloral loads on the basis of their pollen constituents. After identification and count, the pollen types of honey samples were categorized into one of the following frequency classes (according to Louveaux *et al.*, 1978): predominant pollen type (>45%), secondary pollen type (16-44%), important minor pollen type (3-15%) and minor pollen type (<3%). To established the frequency distribution of pollen types in honey samples we follow the classification of Jones and Bryant (1996): very frequent (>50%), frequent (20-50%), infrequent (10-20%) and rare (<10%).

Results

Flowering phenology of T. portulacastrum

T. portulacastrum flowers during April to October but flowering reaches its peak during May to August. The plant produces one day flowers. The flower opening starts at 6.30-7.00 am in the morning and it is completed by 7.00-7.30 am. Flower opening is synchronous and almost all the flowers open at the same time.

Table 1. Floral visitors of *Trianthema portulacastrum* in Bankura district, West Bengal.

Species	Family	Order	Visiting time	Highest incidence
Apis cerana	Apidae	Hymenoptera	8.00-10.30 hrs	9.00-10.00 hrs
Apis florea	Apidae	Hymenoptera	8.00-10.30 hrs	9.00-10.00 hrs
Augochloropsis metallica	Halictidae	Hymenoptera	8.30-11.30 hrs	10.00-11.30 hrs
Halictus sp.	Halictidae	Hymenoptera	8.30-11.30 hrs	10.00-11.30 hrs
Pseudoborbo bevani	Hesperiidae	Lepidoptera	8.30-10.30 hrs	9.00-9.30 hrs
Trigona iridipennis	Apidae	Hymenoptera	8.30-11.00 hrs	9.30-11.00 hrs

Initiation of anther dehiscence takes place after 30 minutes from the opening of flower. It starts during 7.30-8.00 am in the morning and completed by 8.20-8.45 am when all the pollen grains come out as pollen mass. Nectar secretion begins with the commencement of flower opening and continued up to the closing of the flower (11.30 am - 12.15 pm).

Floral visitors

During the opening phase of the flower, several insects belonging to the orders Hymenoptera and Lepidoptera are visited to the plant. The visiting Hymenopteran members are *A. florea*, *A. cerana*, *Augochloropsis metallica*, *Halictus* sp. and *Trigona iridipennis* and the Lepidopteran member is *Pseudoborbo bevani* commonly known as Bevan's swift (Table 1). Visitation of bees starts during 8.00-8.30 am. Among the visitors *A. florea* is the most preponderant one, forage continuously over the flower collecting both pollen grains and nectar and may act as the primary pollinator of the plant.

Analysis of pollen pellets of Apis florea

During May 108 pairs of corbicular pollen pellets were analyzed. All corbicular pollen pellets were unifloral type. Out of the 108 pairs corbicular pollen pellets, 5 pairs were of *Borassus flabellifer* (4.63%), 3 pairs of *Capparis zeylanica* (2.78%), 1 pair of *Corchorus olitorius* (0.93%), 9 pairs of *Croton bonplandianum* (8.33%), 9 pairs of *Lippia nodiflora* (8.33%), 6 pairs of *Momordica charantia* (5.56%), 10 pairs of *Sesamum indicum* (9.26%), 13 pairs of *Syzygium reticulatum* (12.04%), 31 pairs of *Terminalia arjuna* (28.70%) and 21 pairs of *Trianthema portulacastrum* (19.44%) [Fig. 2A.].

During June 101 pairs of corbicular pollen pellets were analyzed. All corbicular pollen pellets were unifloral type. Out of 101 pairs corbicular pollen pellets, 5 pairs were of *Citrus lemon* (4.95%), 10 pairs of *Cocos nucifera* (9.90%), 3 pairs of *Corchorus capsularis* (2.97%), 8 pairs of *Croton bonplandianum* (7.92%), 1 pair of *Evolvulus nummularius* (0.99%), 3 pairs of *Lippia nodiflora* (2.97%), 9 pairs of *Momordica charantia* (8.91%), 8 pairs of *Semecarpus anacardium* (7.92%), 40 pairs of *Trianthema portulacastrum* (39.60%) and 14 pairs of *Tridax procumbens* (13.86%) [Fig. 2B.].

Table 2. Quantitative analysis of honey samples of *Apis florea* as per Louveaux *et al.*, 1978 (AF= *Apis florea*; JUN= June; JUL= July; AUG= August; BAR= Barkuri; JEN= Jenadihi; LAC= Lachhmanpur; RAN= Ranipur; SAH= Sahebdanga).

Sl. No.	Sample Code	Pollen types			
		Predominant Pollen (>45%)	Secondary Pollen (16-45%)	Important Minor Pollen (3-15%)	Minor pollen (<3%)
1	MAY-BAR-AF-26	Nil	*Sesamum indicum* (20.00%) and *Terminalia arjuna* (31.71%)	*Borassus flabellifer* (9.76%), *Peltophorum pterocarpum* (7.32%), *Syzygium reticulatum* (13.17%), *Tamarindus indica* (8.78%) and *Trianthema portulacastrum* (9.27%)	Nil
2	MAY-JEN-AF-17	Nil	*Peltophorum pterocarpum* (19.82%), *Syzygium reticulatum* (22.12%) and *Terminalia arjuna* (34.10%)	*Momordica charantia* (6.91%) and *Trianthema portulacastrum* (14.75%)	*Tridax procumbens* (2.30%).
3	JUN-JEN-AF-43	Nil	*Trianthema portulacastrum* (30.88%) and *Tridax procumbens* (25.49%)	*Citrus lemon* (10.29%), *Lippia nodiflora* (9.80%), *Momordica charantia* (7.35%), *Peltophorum pterocarpum* (7.84%) and *Semecarpus anacardium* (8.33%)	Nil
4	JUN-JEN-AF-27	Nil	*Semecarpus anacardium* (18.27%) and *Trianthema portulacastrum* (34.62%)	*Citrus lemon* (10.29%), *Cocos nucifera* (12.02%), *Leucaena leucocephala* (3.85%), *Peltophorum pterocarpum* (10.58%), *Tridax procumbens* (4.33%) and *Vitis quadrangularis* (10.10%)	Nil
5	JUL-RAN-AF-08	Nil	*Acacia nilotica* (20.47%), *Semecarpus anacardium* (17.21%) and *Trianthema portulacastrum* (16.28%)	*Anthocephalus cadamba* (5.12%), *Lippia nodiflora* (11.16%), *Momordica charantia* (5.17%), *Peltophorum pterocarpum* (6.51%), *Tridax procumbens* (10.23%) and *Vitex negundo* (7.91%)	Nil
6	JUL-JEN-AF-19	Nil	*Semecarpus anacardium* (19.90%) and *Trianthema portulacastrum* (22.82%)	*Acacia nilotica* (9.71%), *Alternanthera paronychioides* (7.28%), *Anthocephalus cadamba* (8.25%), *Momordica charantia* (9.22%), *Peltophorum pterocarpum* (6.31%), *Tridax procumbens* (11.65%) and *Vitex negundo* (4.85%)	Nil
7	AUG-LAC-AF-58	Nil	*Acacia auriculiformis* (17.65%), *Peltophorum pterocarpum* (16.18%), *Tridax procumbens* (23.04%)	*Cocos nicifera* (15.20%), *Trianthema portulacastrum* (12.75%) and *Ziziphus mauritiana* (15.20%)	Nil
8	AUG-SAH-AF-59	Nil	*Acacia auriculiformis* (20.79%), *Acacia nilotica* (23.76%) and *Bridelia retusa* (28.22%)	*Coccinia grandis* (9.41%), *Cucurbita maxima* (5.94%) and *Trianthema portulacastrum* (11.88%)	Nil

During July 85 pairs of corbicular pollen pellets were analyzed. All corbicular pollen pellets were unifloral type. Out of the 85 pairs corbicular pollen pellets, 17 pairs were of *Acacia nilotica* (20.00%), 2 pairs of *Alternanthera paronychioides* (2.35%), 4 pairs of *Anthocephalus cadamba* (4.71%), 4 pairs of *Croton bonplandianum* (4.71%), 1 pair of *Leucaena leucocephala* (1.18%), 6 pairs of *Lippia nodiflora*

(7.06%), 2 pairs of *Momordica charantia* (2.35%), 8 pairs of *Semecarpus anacardium* (9.41%), 20 pairs of *Trianthema portulacastrum* (23.53%) and 19 pairs of *Tridax procumbens* (22.35%) [Fig. 2C.].

During August 80 pairs of corbicular pollen pellets were analyzed. All corbicular pollen pellets were unifloral type. Out of the 80 pairs corbicular pollen pellets, 9 pairs were of *Acacia auriculiformis* (11.25%), 11 pairs of *Acacia nilotica* (13.75%), 2 pairs of *Amaranthus spinosus* (2.50%), 9 pairs of *Bridelia retusa* (11.25%) 13 pairs of *Cocos nucifera* (16.25%), 3 pairs of *Lemaireocereus* sp. (3.75%), 7 pairs of *Luffa cylindrica* (8.75%), 12 pairs of *Trianthema portulacastrum* (15.00%), 12 pairs of *Tridax procumbens* (15.00%) and 2 pairs of *Ziziphus mauritiana* (2.50%) [Fig. 2D.].

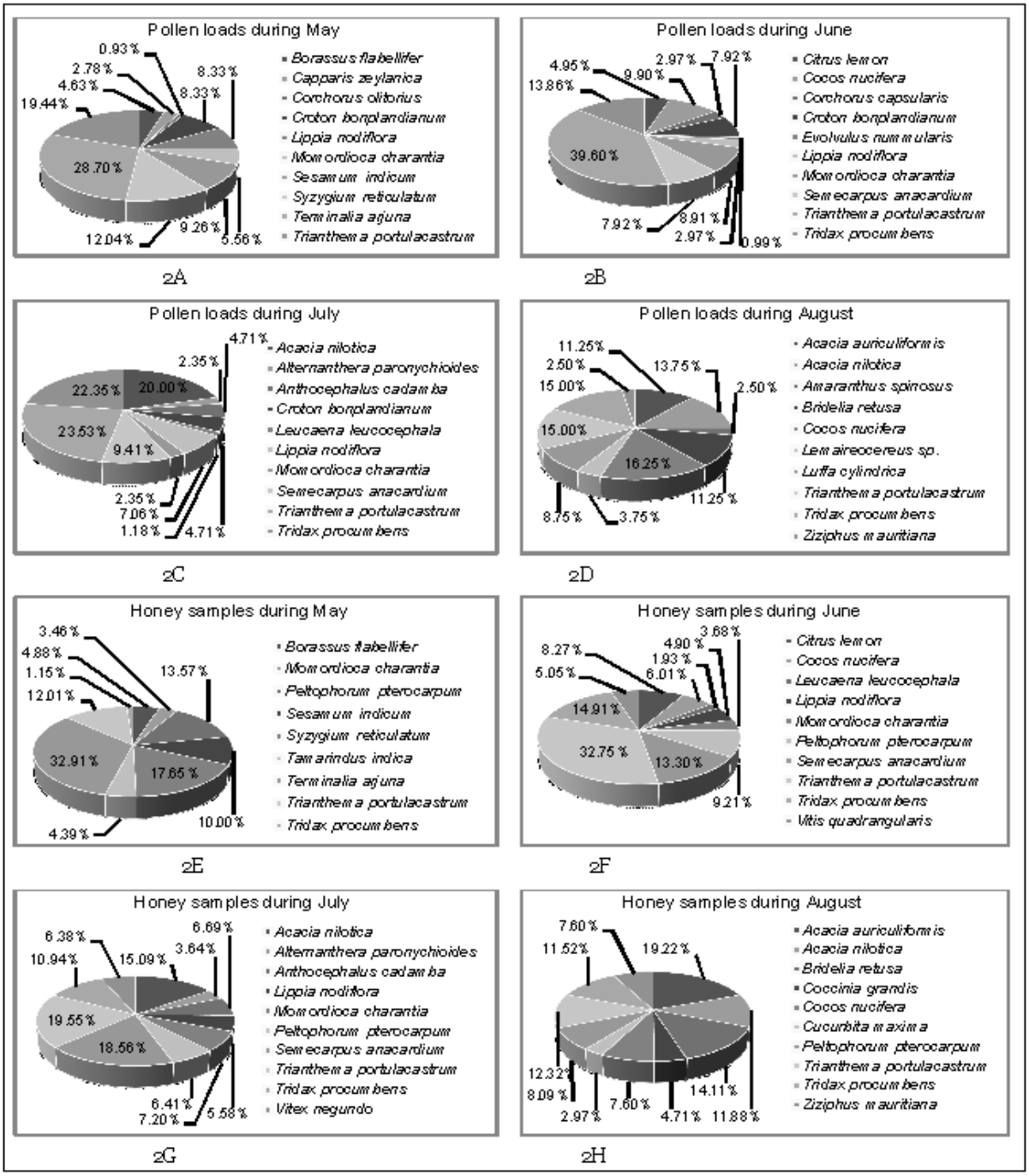

Fig. 2. A-H Pie charts showing month wise average percentage of pollen types in pollen pellets and honey samples of *Apis florea* in Bankura district, West Bengal.

Analysis of honey samples of Apis florea

Pollen content of each honey sample showed in Table 1. Obtained pollen types (month wise) and their average percentage were also given below:

During May 2 honey samples were analyzed. Both of them were multifloral in origin. The major representing plant taxa were *Peltophorum pterocarpum*, *Sesamum indicum*, *Syzygium reticulatum*, *Terminalia arjuna* and *Trianthema portulacastrum*. From the quantitative analysis of these 2 samples obtained pollen types and their month wise average percentage were of *Borassus flabellifer* (4.88%), *Momordica charantia* (3.46%), *Peltophorum pterocarpum* (13.57%), *Sesamum indicum* (10.00%), *Syzygium reticulatum* (17.65%), *Tamarindus indica* (4.39%), *Terminalia arjuna* (32.91%), *Trianthema portulacastrum* (12.01%) and *Tridax procumbens* (1.15%) [Fig. 2E.].

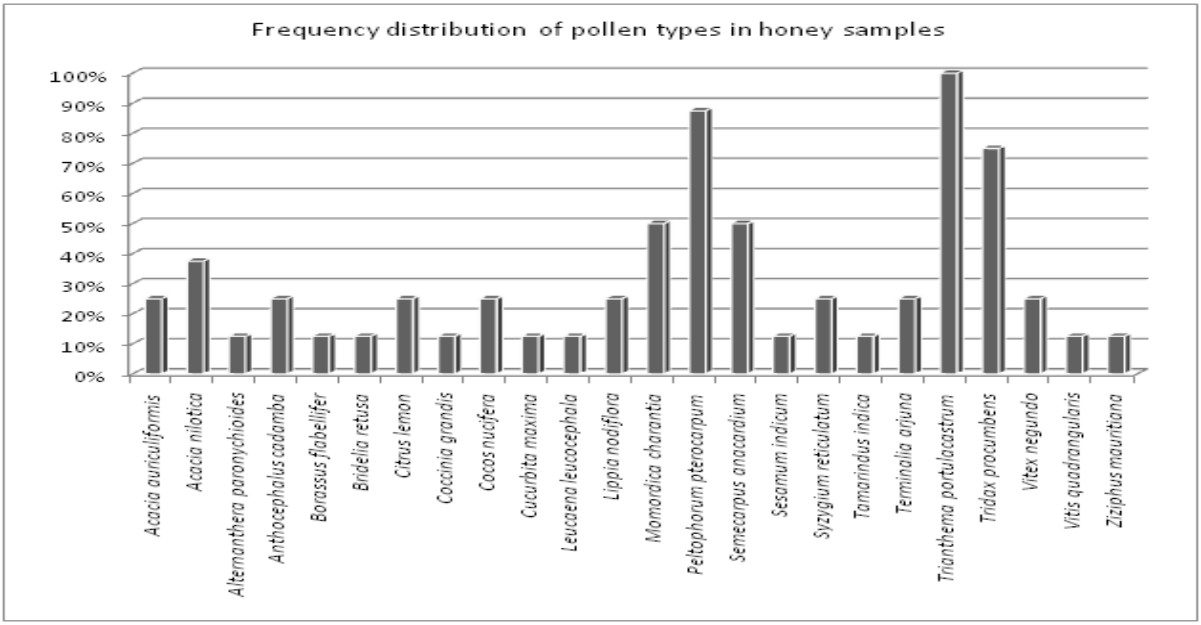

Fig. 3. Showing the frequency distribution of pollen types in honey samples of *Apis florea* in Bankura district, West Bengal.

During June 2 honey samples were analyzed. Both of them were multifloral in origin. The major representing plant taxa were *Citrus lemon*, *Cocos nucifera*, *Peltophorum pterocarpum*, *Semecarpus anacardium*, *Trianthema portulacastrum*, *Tridax procumbens* and *Vitis quadrangularis*. Quantitative analysis revealed the month wise average percentage of pollen types were of *Citrus lemon* (8.27%), *Cocos nucifera* (6.01%), *Leucaena leucocephala* (1.93%), *Lippia nodiflora* (4.90%), *Momordica charantia* (3.68%), *Peltophorum pterocarpum* (9.21%), *Semecarpus anacardium* (13.30%), *Trianthema portulacastrum* (32.75%), *Tridax procumbens* (14.91%) and *Vitis quadrangularis* (5.05%) [Fig. 2F.].

During July 2 honey samples were analyzed. Both of them were multifloral in origin. The major representing plant taxa were *Acacia nilotica*, *Lippia nodiflora*, *Semecarpus anacardium*, *Trianthema portulacastrum* and *Tridax procumbens*. Quantitative analysis revealed the month wise average percentage of pollen types were of *Acacia nilotica* (15.09%), *Alternanthera paronychioides* (3.64%), *Anthocephalus cadamba* (6.69%), *Lippia nodiflora* (5.58%), *Momordica charantia* (7.20%), *Peltophorum pterocarpum* (6.41%), *Semecarpus anacardium* (18.56%), *Trianthema portulacastrum* (19.55%), *Tridax procumbens* (10.94%) and *Vitex negundo* (6.38%) [Fig. 2G.].

During August 2 honey samples were analyzed. Both of them were multifloral in origin. The major representing plant taxa were *Acacia auriculiformis*,

Acacia nilotica, *Bridelia retusa*, *Cocos nucifera*, *Peltophorum pterocarpum*, *Trianthema portulacastrum*, *Tridax procumbens* and *Ziziphus mauritiana*. From the quantitative analysis of these 2 samples obtained pollen types and their month wise average percentage were of *Acacia auriculiformis* (19.22%), *Acacia nilotica* (11.88%), *Bridelia retusa* (14.11%), *Coccinia grandis* (4.71%), *Cocos nucifera* (7.60%), *Cucurbita maxima* (2.97%), *Peltophorum pterocarpum* (8.09%), *Trianthema portulacastrum* (12.32%), *Tridax procumbens* (11.52%) and *Ziziphus mauritiana* (7.60%) [Fig. 2H.].

According to frequency distribution the pollen types represented as 'very frequent' were *Peltophorum pterocarpum*, *Trianthema portulacastrum* and *Tridax procumbens*; 'frequent' were *Acacia auriculiformis*, *Acacia nilotica*, *Anthocephalus cadamba*, *Citrus lemon*, *Cocos nucifera*, *Lippia nodiflora*, *Momordica charantia*, *Semecarpus anacardium*, *Syzygium reticulatum*, *Terminalia arjuna* and *Vitex negundo* (Table 3, Fig. 3.).

Discussion

Pollen analyses of honey samples and pollen pellets of *A. florea* during May to August reveals that altogether 32 plant taxa have been visited by the bee species. Those are *Acacia auriculiformis*, *Acacia nilotica*, *Alternanthera paronychioides*, *Amaranthus spinosus*, *Anthocephalus cadamba*, *Borassus flabellifer*, *Bridelia retusa*, *Capparis zeylanica*, *Citrus lemon*, *Coccinia grandis*, *Cocos nucifera*, *Corchorus capsularis*, *Corchorus olitorius*, *Croton bonplandianum*, *Cucurbita maxima*, *Evolvulus nummularius*, *Lemaireocereus* sp., *Leucaena leucocephala*, *Lippia nodiflora*, *Luffa cylindrica*, *Momordica charantia*, *Peltophorum pterocarpum*, *Semecarpus anacardium*, *Sesamum indicum*, *Syzygium reticulatum*, *Tamarindus indica*, *Terminalia arjuna*, *Trianthema portulacastrum*, *Tridax procumbens*, *Vitex negundo*, *Vitis quadrangularis* and *Ziziphus mauritiana*. Some of those angiospermic pollen taxa have been depicted in Fig.4.

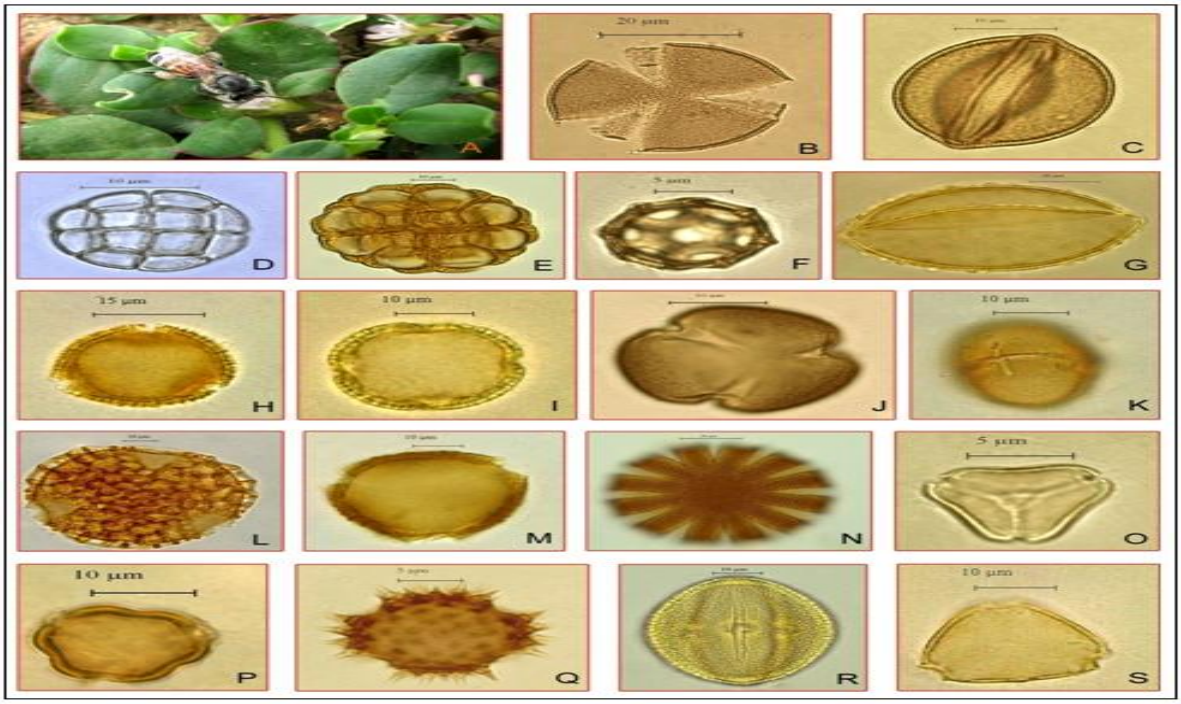

Fig. 4. (A) *Apis florea* foraging over *Trianthema portulacastrum*; Pollen grains of (B & C) *Trianthema portulacastrum*, (D) *Acacia auriculiformis*, (E) *Acacia nilotica*, (F) *Alternanthera paronychioides*, (G) *Borassus flabellifer*, (H) *Bridelia retusa*, (I) *Citrus lemon*, (J) *Leucaena leucocephala*, (K) *Lippia nodiflora*, (L) *Peltophorum pterocarpum*, (M) *Semecarpus anacardium*, (N) *Sesamum indicum*, (O) *Syzygium reticulatum*, (P) *Terminalia arjuna*, (Q) *Tridax procumbens*, (R) *Vitis quadrangularis* and (S) *Ziziphus mauritiana*.

During this time unifloral honey producing plants are unavailable. Rather a substantial number of plant taxa cumulatively supplied the rewards to the bee species for sustenance of their hives in monsoon, the so called dearth period of the honeybee species. From the pie diagrammes it has been found that *T. portulacastrum* played a vital role by supplying both nectar and pollen grains to the bee species during this period. Here the flowering period and time of the plant is very much overlapping with the forage period and time of *A. florea*. The frequency distribution of pollen types in honey samples also corroborate the observation we find. The overall result reflects the importance of *T. portulacastrum* as a major source of both nectar and pollen grains for *A. florea* colonies during floral scarcity.

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References

Adamson RS. 1962. The South African species of Aizoaceae XII. Sesuvium, Trianthema, Zaleya. Journal of South African Botany **28,** 243-253.

Balyan RS, Bham VM. 1986. Emergence, growth and reproduction of horse purslane (Trianthema portulacastrum) as influenced by Environmental Conditions. Weed Science **34,** 516-519.

Duthie JF. 1960. Flora of Upper Gangetic plain. Delhi, India. Periodical experts 500.

Erdtman G. 1960. The acetolysis method. A revised description. Svensk Botanisk Tidskrift **54,** 561-564.

Holm L, Doll J, Holm E, Pancho J, Herberger J. 1997. World Weeds: Natural Histories and Distribution. John Wiley and Sons, New York. 1129 p.

Jeffrey C. 1960. Notes on tropical African Aizoaceae, Kew Bull. **14,** 235-238.

Jones GD, Bryant VM. 1996. Melissopalynology. In: Jansonius, J; (Mc Gregor, D. C. Eds.). Palynology, principles and applications salt lake city: AASP Found, 933-938.

Kifle TB, Hora KW, Merti AA. 2014. Screening of potential herbaceous honey plants for beekeeping development. Agriculture, Forestry and Fisheries **3(5),** 386-391. http://dx.doi.org/10.11648/j.aff.20140305.19

Kumar G, Banu GS, Pappa V, Sundararajan M, Pandian MR. 2004. Hepatoprotective activity of Trianthema portulacastrum L. against paracetamol and thioacetamide intoxication in albino rats. Journal of Ethnopharmacology **92,** 37-40. http://dx.doi.org/10.1016/j.jep.2003.12.009

Louveaux J, Maurizio A, Vorwohl G. 1978. Methods of Melissopalynology. Bee World **59,** 139-157.

Maurizio A. 1951. Pollen analysis of honey. Bee World **32,** 1-5.

Rattanata N, Daduang S, Phaetchanla S, Bunyatratchata W, Promraksa B, Tavichakorntrakool R, Uthaiwat P, Boonsiri P, Daduang J. 2014. Antioxidant and antibacterial properties of selected thai weed extracts. Asian Pacific Journal of Tropical Biomedicine **4(11),** 890-895. http://dx.doi.org/10.12980/APJTB.4.2014APJTB-2014-0422

Shanmugam SK, Bama S, Kirthiga N, Kumar RS, Sivakumar T, Dhanabal P. 2007. Investigation of analgestic activity of leaves part of the Trianthema portulacastrum (L) in standard experimental animal models. International Journal of Green Pharmacy **1(1),** 39-41.

Shymsunder A, Rajyalakshmi G, Bharath A, Rajeshwar Y. 2009. Antihyperglycemic activity of Trianthema portulacastrum plant in streptozotocin induced Diabetic Rats. Pharmacologyonline **1,** 1006-11.