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Increasing Bee Forage for a Sustainable Bee Industry in Kenya

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Abstract: Planting bee forage can profitably contribute to the sustainability of the beekeeping industry in Kenya. A variety of crops and vegetables are known to be suitable forage, since they are visited by most bee pollinators. In a pollination program at the National Beekeeping Institute, Lenana, various crops were selected to boost the bee forage range, after it was noticed that the prevailing honeybee colonies were dwindling drastically due to drought and other visible causes. The kales, sunflower and strawberry, were planted for the purpose. It was observed that the kales attracted most pollinators, ranging from insects to birds. The predominant insect species was *Apis mellifera scutellata*. Butterflies, stingless bees, birds, bats, wasps, hoppers, thrips and sugar ants were observed. Sunflower and strawberry, too, attracted butterflies besides bees, birds and other pollinators, but the latter had more flower visitors than the former. There was a 54% increase in the number of domesticated honey bee colonies from five to eleven. The pollinator activity, which had ceased to revived as was physically observed from the "buzz of the bee, to the hoot of the woodpecker", signifying revamped activity. The honeybee turned out to be a more effective pollinator species adapted to the task.

Key words: Planting, bee forage, pollination, sustainability.

1. Introduction

In the wake of dwindling Bee forage resources, suitable quick flowering plants, with adequate nectar and pollen, such as: Kales, Sunflower and Strawberry, can be introduced to farmlands, to support and sustain Beekeeping industry [1-6]. Under field conditions, bees will normally have a choice of forage sources [7].

Logging, to pave way for infrastructure development, has impacted negatively on Beekeeping. The resultant micro-climate, evidenced by dry spells and change of bee routes, has led to dwindling honey bee colonies.

1.1 The Study Objective

(1) Increase bee forage by planting suitable, quick-flowering fruits and vegetables, to sustain Beekeeping for food security and sustenance of livelihoods.

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(2) Identify suitable pollinators to complement honeybees.

1.2 Study Area

National Beekeeping Institute, Lenana (Fig. 1), Coordinates: UTM 37M 0257490, 9858862, in Nairobi is situated about 6 Km from Nairobi's Central Business District. It fringes Ngong forest (528 hectares), the only indigenous forest located within the confines of a capital city, Nairobi. The forest harbours rare animal and plant species, and is characterized by indigenous trees like *Croton megalocarpus* and tree plantations. It is interspersed with patches of grass. The area used to experience long rainfall seasons from March-May and short rainy seasons from October-December. The average rainfall was 1,000 mm whereas the mean temperature was 23 °C. Common animals found within the Ngong forest include: Duiker, monkey, baboon and Bushbuck, among others. Forest resources include: honey, firewood, construction poles, medicinal herbs and shrubs.

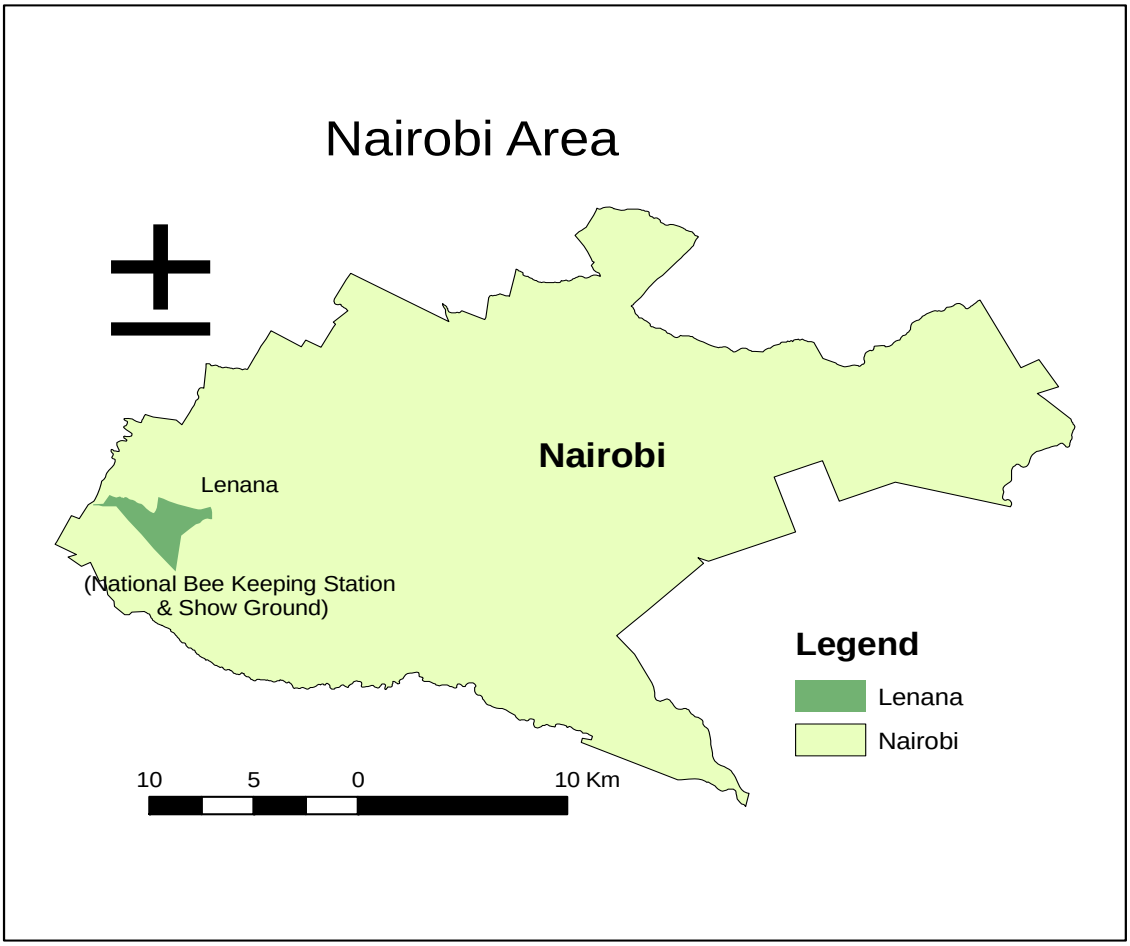


Fig. 1 Study area. National Beekeeping Station, Lenana.

Human activity, pauses threats to forest conservation efforts [8, 9].

2. Materials and Methods

2.1 Materials

8 × 24 Meter portions of land, at the demarcated Coordinates was tilled and the three targeted crops: Kales, Sunflower and Strawberry (Fig. 2), planted on each parcel, under natural conditions.

2.2. Methods

Strawberry was propagated from older cultivars and 230 young splits planted for observation. Soil samples were taken for analysis, prior to planting (Fig. 4). Direct observation of flowers was made and flower visitors counted (Table 1), irrespective of task.

3. Results and Discusion

Planting Kales, Sunflower and Strawberry, increased bee abundance, due to improved resource availability, nectar and pollen. The plants, in turn improved in fruit/seed quality. Strawberry results indicated a significant increase in fruit quality, with a record 80% of fruits categorized under super class as a result of honeybee pollination together with other mixed Pollinators (bees, butterflies, birds and baboons (Table 1)). There was reduced mal-formed industry fruit quality in the greenhouse, where the honeybee was the sole Pollinator, accounting for 84% super quality fruits ($p < 0.001$, F = 1.87, d.f = 182 on 968).

The Kales attracted the highest number of pollinators in their diversity. Strawberry was second followed by Sunflower, with the least attractive number

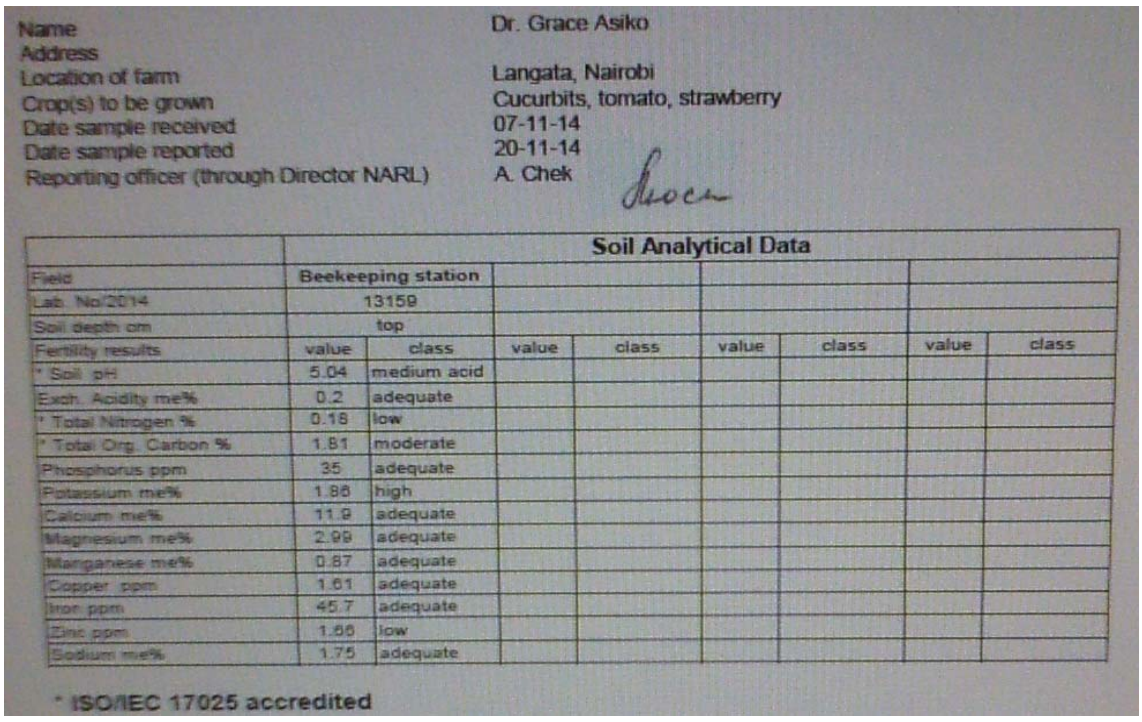
Fig. 2 Target bee forage crops, sunflower, kales, strawberry (a, b, c) and their pathogens.

Fig. 3 Honeybees, HB and Stingless bees, ST, were the most frequent & effective flower Pollinators.

Table 1 Classification of pollinators as effective or occasional (Giannini et al. 2014) [11, 12].

Pollinator	*Brassica* spp.	*Helianthus annus*	*Fragaria x Ananassa* sp.	Comment
Apis melifera scutellata	√ e	√ e	√ e	Nectar & pollen
Meliponula ferruginea	√ e		√ e	Nectar & pollen
Hypotrigona gribodoi	√ e	√e	√ e	Nectar & pollen
Hypotrigona ruspolii	√ e	√ e	√ e	Nectar & pollen
Other native bee species	√ e			Resource
Birds (sun birds)	√ o	√ o		Seed
Birds (Ibis)			√ o	Devour fruit
Bats	√o			Prey & damage
Wasps (Spechid)	√ o	√ o	√o	Prey
Wasps (Mammoth)	√ o			Prey
Wasps (Pirate)	√ o	√ o	√ o	Prey
Flies (House flies)	√ o		√ o	Lay eggs
Flies (Blue bottles)	√ o			Resource
Ants (*Componotus braunsi*)	√ o	√ o	√o	Protection
Sugar ants	√ o	√ o	√o	Nectar
Spiders	√ o	√ o	√ o	Nectar & prey
Thrips (Thysanoptera)	√ o		√	Resource
Beetles (Longhorn, Cerambycidae)	√ o			Pollen & damage
Beetles (Short horn)	√ o	√ o	√ o	Damage flower
Butterfly (Brown, Acraea)	√ e			Nectar
Butterfly (Grey, Skipper))	√ e			Nectar
Butterfly (*Belenois aurota;* white, brown-veined)	√ e		√o	Nectar
Butterfly (Greenish, Patch swallowtail)	√ e			Nectar
Hawk moths	√ e			Nectar
*Baboon			√ o	Devour fruit

Key: √ = Flower visitor; √e = Effective Pollinator; √o = Occasional.



Name Dr. Grace Asiko
Address
Location of farm Langata, Nairobi
Crop(s) to be grown Cucurbits, tomato, strawberry
Date sample received 07-11-14
Date sample reported 20-11-14
Reporting officer (through Director NARL) A. Chek

Soil Analytical Data

Field	Beekeeping station							
Lab. No/2014	13159							
Soil depth cm	top							
Fertility results	value	class	value	class	value	class	value	class
* Soil pH	5.04	medium acid						
Exch. Acidity me%	0.2	adequate						
* Total Nitrogen %	0.18	low						
* Total Org. Carbon %	1.81	moderate						
Phosphorus ppm	35	adequate						
Potassium me%	1.86	high						
Calcium me%	11.9	adequate						
Magnesium me%	2.99	adequate						
Manganese me%	0.87	adequate						
Copper ppm	1.61	adequate						
Iron ppm	45.7	adequate						
Zinc ppm	1.66	low						
Sodium me%	1.75	adequate						

* ISO/IEC 17025 accredited

Fig. 4 Soil analysis report. KALRO, 2014.

of effective flower visitors (Table 1). With increased stem-age, birds frequented Sunflower for seed (Fig. 2) and moderately visited Kales for the same, in what can best be described as "pollinator trend reversal." The honey bee continued to visit the 3 plants, Kales, Sunflower and Strawberry, even with increased stem-age, displaying her dominance and superiority over the other pollinators, due to her unique adaptation to undertake the task [10].

The honey bee carries huge volumes of nectar in her honey stomach and pollen in the pollen basket, corbicula, situated on its hind leg. Other late flower visitors include: wasps, spiders, flies and bats, some of which are predatory, providing a unique food-web. Ants provide protection whereas the smaller fauna, thrips and mosquitoes, are preyed upon [11].

4. Conclusion

Honeybees will migrate to localities with adequate forage in times of resource scarcity. The reverse is true in times of plenty. Beekeepers should be encouraged to plant bee forage for conservation of honeybee colonies (Fig. 2), increased food production and sustainability (Fig. 3).

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