Advances in Biological Research 2 (1-2): 13-16, 2008
ISSN 1992-0067

Comparative Study of the Efficacy of Six Different Baiting Materials on Bee Colony Performance in Traditional and Modern Hives

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Abstract: The efficacy of five local baiting materials, i.e. Hayaki (Hy), Locust beans (Lb), Fresh cow dung (Cd), Lavender (Lv) and Pineapple fruit juice (Pj) were compared with that of molten beeswax in terms of colony establishment rate, initiation time, record of abscondment and quality of pests encountered. About 72.22% beeswax baited hives established bee colonies at various times with an overall mean of 113.75 days in all the hives types except the Bucket (BKT) hives. Beeswax was most efficient in the KTB hive where an average of about 70 days was recorded. The performance of Hayaki (Hy) where 66.68% of its hives established bee colonies with a mean initiation time of 99.75 days was comparable and not significantly different from the Bw value ($P>0.05$). It, however, showed significantly better ($P<0.05$) efficiency than the beeswax in grass woven (GWH) clay pot (PTH) and Langstroth (LAN) hives. Pineaple juice (Pj) and Lavender (Lv) were weak as baiting materials with only 20% colony establishment rate. Cow dung (Cd) and Locust bean (Lb) did not establish bee colonies in any of the hive type. The order of efficacy of the baits therefore was Bw = Hy > Lv = Pj > Cd =Lb. A generally low level of pest infestation incidence on the occurrence of the greater wax moth (*G. mellonella)*, spider (*L. mactans)* and the ants, *C. pennsylvanicus* was recorded. The possibility of the greater wax moth (*G. mellonella),* being responsible for frequent bee abscondment was also highlighted.

Key words: Bee · Bait type · Colony establishment · Abscondment and bee pest

INTRODUCTION

Apiculture, as an agricultural practice has been identified as one of the several ways of achieving Millennium Development goals (MDGs). It has the potential to improve the living standards in developing countries through improved food supply, intake and generation of productive employment [1], It entails the management and maintenance of colonies of honey bees [2] for highly desirable products such as honey, comb/wax, pollen, propolis, bee venom and royal jelly [3].

The success of beekeeping rests on the possibility of establishing a bee colony, a factor that is largely dependent on natural swarming. It is usually initiated by a prospective queen or by procurement of nucleus colony from a queen rearing program [4].

Bee hive construction and installation does not guarantee bee colony establishment. Hence most bee farmers often resort to the use of baits to facilitate bee colony establishment. Various types of baiting materials have been documented over the years. These include, beeswax [5, 6], a product sourced directly from bee itself and unlike other materials are not easily accessible to bee farmers. Easily accessible and cheap ones include granulated sugar, lavender spray [6], dried cow dung [4], sweet fruit juices and syrup [4, 6], fermented locust beans [4], the scent of grass which resembles the nasanov pheromone of *Apis mellifera* [7]. The increasing awareness about the usefulness of bee products globally and the dire need to avail of the use of the product has called for a concerted effort aimed at boosting beekeeping practice in the world [6]. This brings to bare the challenge of prompt initiation of bee colonies and their management. This study therefore attempts to compare the efficacy of various baiting materials and other management challenges that may be associated with the use of typical bait.

MATERIALS AND METHODS

Study site: The experiment was conducted at the University of Ilorin Apiary site. The University of Ilorin

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bee farm is located about 3 km off the major road linking the University campus to the town. The experimental hives were shaded by the dense vegetation of cashew and neem trees present at the location. Ilorin is located in the Guinea savanna vegetation zone with a rainfall range of between 1000mm and 1500mm annually for 8 to 9 months and a maximum temperature range of 30 to 35°C.

Hive types: Five beehive types (3 traditional and 2 modern), namely: Bucket (BKT), Grass woven (GWH), Clay Pot (PTH) hives and the Kenyan Top bar (KTB) and Langstroth (LAN) hives were engaged in the study. The description of each of the hive type is as follows:

BKT: Ten litre light blue rhomboid plastic bucket with tight fit lid were procured from Oja Oba market, washed and dried. Three even spaced 10mm diameter holes were bored into the lid. The lid was fastened to the base with a rope.

GWH: Conical shaped grass woven hive made from grass and ropes supported by sticks were ordered from a local farmer in Niger state. The 45cm to 50cm opening at the wide tip was covered by a separately woven lid that is held in place by two pointed tipped pegs.

PTH: Oval heat treated 10 to 15 litre capacity clay pots and hence with minimal permeability to liquids, with an access circular rim of about 30 cm diameter and a lid with three even spaced 1mm diameter holes were ordered from Idiape market, Ilorin. The lid was held tightly in place with a rope.

KTB: Ready made wooden (97cm x 20cm x 30.5cm) hives with (1cm x 5cm) bee entrance sourced from University of Ilorin apiary.

LAN: Ready made wooden (50cm x 40cm x 50cm*)* hives composed of a bottom board, brood chamber, queen excluder, honey super, inner and outer covers with (1cm x5cm*)* bee entrance were sourced from University of Ilorin apiary.

Bait types: Five locally sourced baiting materials, namely: Hayaki (Hy), Locust beans (Lb), Fresh cow dung (Cd), Lavender (Lv) and Pineapple fruit juice (Pj) were compared with Beeswax (Bw) as baits on each of the hive type.

Bw: About 300g of beeswax was sourced from the University of Ilorin Apiculture Unit. 4g each was melted at 55°C and smeared around the inner walls and the bee entrance point of each hive types with the aid of a brush. This was allowed to dry after which the hive was mounted.

Hy: Fresh twigs of lemon grass (*Cybopogon citrates*), pignut (*Hyptis suavelens*), yellow oleander (*Thevetia peruviana*) and basil (*Ocimum grattissimum*) were collected; sun dried, pulverized and mixed in the ratio of 1:1:1:1. It was applied as incense after igniting on a burning charcoal in a dug hole of 15cm diameter and 20cm below soil surface. Each hive was inverted against the smoke for 10 minutes after which it was shut and mounted.

Lb: About 500g of freshly fermented locust beans purchased from a local market in Ilorin, Nigeria was kept in an airtight container for 2 days to improve its fermentation level and thereby enhance the odour emanating from it. 4g of this was subsequently smeared on the inner walls around the bee entrance point on each hive using a brush. Hives were mounted after the bait had dried up.

Cd: About 500g of fresh cow dung was collected from the cow staple of the University of Ilorin Teaching and Research Farm and utilized immediately. 4g each was smeared on the inner walls around the bee entrance point of the hive using a brush. This was allowed time to dry, after which the hives were mounted.

Lv: 60mls of Bintel Sudan was procured from a local market in Ilorin, Nigeria. Six drops each were administered around the inner lining of the bee entry point on each hive. The baited hive was mounted immediately.

Pj: Ripe pineapple fruit bought from a local market in Ilorin, Nigeria was peeled and cut into 15g pieces. The cut piece was stored in an air tight plastic container for three days to allow fermentation and enhance the emanating aroma. A 15g piece was rubbed against the inner wall around the entry point of each hive and the remnants, if any, was left in the hive. Hives were mounted after drying of the bait.

Installation: The three traditional hives, i.e. BKT, GWH and PTH were either placed on the sturdy branch or on the fork of the cashew or neem tree at irregular height. However, the height of the hive base to the ground was noted for each hive as the installation height in meters.

The two modern, i.e. KTB and LAN were installed on their conventional stands, which was about 0.6m and 0.7m high from the ground respectively.

Surveillance: Three replicate hives of each bait type were mounted per hive and these were put under daily surveillance for bee colony establishment for 180 days between January and June, 2007. Colony establishment was monitored by the occurrence of dancing scout bees around the hive entrances and humming sound within the hive. The total number of days between installation and colony establishment was recorded per hive and bait as the colony initiation time (t). Each of the established colonies was subsequently monitored for possible abscondment. Incidence, types and number of pests and diseases were also monitored. The average colony initiation time (days) per bait was calculated and the mean colony establishment rate was calculated per bait in percentage. The abscondment rate per bait, i.e. the proportion of established colonies that absconded subsequently per bait were subsequently determined in percentage. The frequency of occurrence of each pest type per bait in the established colonies were also noted in percentage

Statistical analysis: Parametric student't' test was employed in the test for significance difference between the test bait types and beeswax at P=0.05.

RESULTS

Bee colony establishment in the course of the experiment was generally delayed and discouraging with a mean of 155.23 days in the twenty-seven hives out a total of the ninety set up in the experiment

Table 1 shows the mean bee colony initiation time per bait in the various hive types tested. As expected all beeswax baited hives except the BKT established bee colonies at various times with an overall mean of 113.75 days. The beeswax was particularly very efficient in the KTB hive where an average of about 70 days was recorded. Other beeswax baited hives established their colonies six to seven weeks later. Hy baited hives seemingly attracted bees better with a mean initiation time of 99.75 days, this was, however, not significantly different from the Bw value (P>0.05). The performance of Hy baited KTB hives was at variance with that of Bw, as it showed poorer efficiency with KTB, but significantly better (P<0.05) with GWH,PTH and LAN hives. Lv and pj established colonies in the three replicates of one hive each, i.e. PTH and KTB with mean initiation times of 119±24 and 84±15 days, respectively, both of which were comparable and not significantly different from the beeswax timings.

A very low bee colony establishment rate of 30% was recorded in the experiment. Table 2 shows the bee colony establishment and abscondment rates with various baits

Table 1: Mean bee colony initiation time (Days) per bait in various hive types

	Mean colony initiation time (Days)					
Bait type	BKT	GWH	PTH	KTB	LAN	Overall
Bw	NC	133±21	119±12	70±6	134±24	113.75
Hy	NC	112±13*	77±9**	112±10*	98±12*	49.75
Lb	NC	NC	NC	NC	NC	NC
Cd	NC	NC	NC	NC	NC	NC
Lv	NC	NC	119±24	NC	NC	119
Pj	NC	NC	NC	84±15	NC	84

NC: Not colonized, *: Significantly better than Bw (P< 0.05), **: Significantly poorer than Bw (P< 0.05)

Table 2: Bee colony establishment rate of various hives under the influence different baits

	Colony establishment (Abscondment) rate (%)					
Bait yype	BKT	GWH	PTH	KTB	LAN	Overall
Bw	0.00	66.70 (50.00)	100.00 (0.00)	100.00 (0.00)	100.00 (66.67)	72.22
Hy	0.00	66.70 (50.00)	100.00 (33.33)	100.00 (0.00)	100.00 (66.70)	66.68
Lb	0.00	0.00	0.00	0.00	0.00	0.00
Cd	0.00	0.00	0.00	0.00	0.00	0.00
Lv	0.00	0.00	100.00 (33.33)	0.00	0.00	20.00
Pj	0.00	0.00	0.00	100.00 (66.67)	0.00	20.00

Table 3: Frequency of occurrence of pests encountered in established hives with different baits

	Frequency of occurrence (%)					
Pest type	Bw (11)	Hy (10)	Cd (0)	Lb (0)	Lv (3)	Pj (3)
Ants *(Campanotus pennsylvanicus)*	18.18 (2)	00.00 (0)	-	-	0.00	66.67 (2)
Greater Wax moth (*Gelloria mellonella)*	36.36 (4)	60.00 (6)	-	-	0.00	0.00
Spider *(Lactrodectus mactans)*	45.45 (5)	60.00 (6)	-	-	0.00	0.00

-No bee colony was established, Values in parenthesis represent number of bee colonized hives

and in different hives. Cd and Lv baited hives did not establish bee colonies in any of the hive type. Lv and Pj established in all replicates set ups of PTH and KTB hives, respectively. This represented an overall establishment rate of 20% each. Hy bait overall performance of 66.68% was comparable with beeswax rate of 72.22%. Both were equally efficient in KTB, PTH and GWH hives, But Bw was slightly more efficient in LAN hive. Abscondment featured sporadically in all the different baited hives. These were, however, more frequent in Hy baited hives than in Bw baited hives.

Bw and Hy baited hives encouraged the occurrence of greater wax moth (*Gelloria mellonella)* and spiders. The frequencies of occurrence of these were higher with the Hy bait. The ants, *Campanotus pennsylvanicus,* featured in two of the Bw and Pj baited hives (Table 3).

DISCUSSION

The molten beeswax (Bw) proved its superiority as a bee baiting material, as it established the highest number of hives, i.e. 72.22%; thus, corroborating Adjare's (1990) position that beeswax is the best bait. This positing was, however, challenged by the incense from the concoction made from various herbs locally referred to as 'Hayaki' (Hy), which gave a comparable bee colony initiation time as the beeswax and a better initiation times than beeswax as bait in PTH, LAN and GWH hives. It also did not encourage hive infestation by ants, but had more record of infestation by the greater wax moth and abscondment. Pineapple juice (Pj) and Lovender (Lv) baited hives were weak baiting materials with only 20% colony establishment rate despite the notice able bee probing activities around the hive during their application. This therefore belong to the group of baiting materials that loose their bee attracting properties and efficacy over time [6]. The inability of cow dung (Cd) and fermented locust bean seeds (Lb) to attract bee and initiate colony establishment may not be due to lack of attractiveness but inability to compete favourably with the baits named earlier. More so that bee swarming within the vicinity of the University of Ilorin apiary is low ebbed [8]. The same reason may have informed the tardiness and rather low bee colony establishment rate of 30% recorded in the course of the study. The order of efficacy of the baits therefore was Bw = Hy > Lv = Pj > Cd =Lb.

Pest infestation levels with the use of various baiting materials were generally low. The greater wax moth (*G. mellonella)* and spider (*L. mactans)*, were most frequently encountered, while the ants, *C. pennsylvanicus,* occurred in few hives. Whereas the spider infested hives maintained their respective colonies throughout the period of the surveillance, same was not the case with the greater wax moth; as most of the greater wax moth infested hives absconded. Thus, confirming Olsson and Friedroki [9] assertion that pest infestation informs abscondment of bees.

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