Comparative study of kacha (Aloe sp.) and bamboo (Arundinaria alpine) for making top-bar of transitional bee hive

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ABSTRACT

The study was conducted at Adami Tulu Agricultural Research Center to compare the performance of kacha (Aloe sp.) and bamboo (Arundinaria alpine) top-bar. For this study a total of six bee colonies were kept in kacha (Aloe sp.) top-bar hive and bamboo (Arundinaria alpine) top-bar hive with three replications. The collected data were analyzed using T-test. Mean comparisons was done using the least significant difference (LSD) for parameters significant difference at ($p<0.05$).The mean amount of honey produced per kacha top-bar hive and bamboo top-bar hive were 14.5 kg and 12.2 kg respectively. The mean amount of honey produced of kacha and bamboo top-bar were 1.32 kg and 0.91 kg respectively. The study result showed significant different in average of honey yield per hive per year, honey yield per top-bar, number of combs developed, top-bar with brood ($p<0.05$).However, the study result showed none significant in comb with pollen and tendency of colony absconded ($p>0.05$).The strength honeybee colonies in the present study found to be higher in kacha top-bar hive compared to bamboo top-bar hive. Considering honey yield per hive, honey yield per top-bar, number of combs developed, frames with brood and colony strength, kacha tree (aloe spp.) is suitable for making top-bar for transitional hive.

Keywords: Bamboo top-bar, honeybee colony, honey yield, kach top-bar, transitional hive

1. INTRODUCTION

Beekeeping is one of the best practices that have been recognized to improve livelihood of poor farming communities without much investment cost. The income from beekeeping can used to purchase grains, agricultural inputs, others house hold needs and for meeting obligatory land taxes. Apart from being consumed as food, bee products especially honey, propolis and bee pollens have long been used in traditional medicine.

Ethiopia is the leading honey producer in Africa and one of the ten largest honey producing countries in the world (Ayalew, 1990). Presence of large and diverse botanical resources combined with suitable climatic condition make the country favorable for beekeeping (Girma Deffar, 1998). Ethiopia has potential to produce about 500,000 metric tons of honey and 50,000 metric tons of beeswax annually, but currently production is limited to 53.68 thousand tons of honey and 4700 tons of beeswax annually (Central Statistics Authority (CSA), 2010/11). Despite the favorable agro-ecology for honey production and number of honeybee colonies the country is endowed with, the level of honey production and productivity is still low. One of the factors for this low honey production is traditional beekeeping practice. About 98% beekeepers' in mid rift valley of Ethiopia engaged more on traditional honey production system (Tesfaye and Tesfaye, 2007). Therefore, in order to improve the level of honey production both in quantity and quality, generating new technologies, adapting, evaluating and demonstration of locally available technologies is very important

Transitional hives made of timber is one of the improved hive types being promoted in the country since 1978 and types of hives used is widely known and commonly used in many parts of the country (HBRC, 1997).It is considered as better hives over traditional ones because they are relatively cheaper, give high yield of honey, simple to design, can be constructed from local materials, easy to inspect the status of bee colonies and enable to harvest quality honey (FAO, 1990; Beyene *et al*., 2015).Besides since it can be placed at backyard, it can be practiced by women beekeepers. But as timber top-bar hive is machine made it cost is increasing from time to time. To solve this problem chefeka hive, which can be made from locally available materials by farmer was developed and widely used by farmers beekeepers (HBRC,1997).This hive is three times cheaper than timber top bar hive and while maintaining all the advantages of timber top hive mentioned above. Though chefeka hive can be made from any locally available materials, it is difficult to find local materials that fulfill required standard (straight and 3.2cm width) for making top bars. The present study is therefore to see the possibility of using kacha, which is dominantly found in mid rift valley of Ethiopia and compared with bamboo top-bar which is recommended by HBRC.

2. MATERIALS AND METHODS

2.1. Description of the study area

The study was conducted at Adami Tulu Agricultural Research Center 167 km away from Addis Ababa the capital city of Ethiopia. The center is located at an elevation of 1500 to 2000 m.a.s.l, at 7° 19' N to 7° 40' N latitude and '35 38° 30' E to 38° 53 'E longitudes (ATARC, 1998). The agro- ecological zone of the

area is semi-arid and sub-humid in which 90% of the area is low land while the remaining 10% is mid land. Mean annual rainfall is 760.9 mm. The mean annual temperature ranges from 12° C to 28°C. The soil is fine sandy loam with sand silt clay in the proportion of 34:48:18%, respectively.

2.2. Preparation of top-bars

Mature and straight kacha trees (Aloe sp.) were cut and splited with the required dimensions (3.2cm wide and 48cm long) using hand tools. Bamboo (Arundinaria alpine) splits top-bars were prepared by machine at Holeta Bee Research Center's wood work with similar dimension.

2.3. Experimental design

Two types of top-bar namely: manually made from kacha tree (Aloe sp.) and bamboo (Arundinaria alpine) splits top-bars were used in the transitional bee hives with three replications. For this trial, a total of six bee colonies (*Apis mellifera*) were purchased from the local farmers of Asebo kebele and randomly allocated to treatment hives to avoid bias in colony strengths. During colony transferring, all materials including honey, pollen and bee brood were attached on top-bars and put for the newly transferred bee colonies to help establish transferred colonies. Equal bee management practices such as colony feeding, inspection, keeping the apiary site clean, protecting from pests and predator were under taken for each treatment.

Figure1: Kacha tree (Aloesp.)

2.4. Data collection

Data collection sheet were prepared at team level. Data related to honey yield per hive per year, honey yield per frame, number of combs developed, top-bar with brood, combs with pollen, tendency of colony absconded and bended character of top-bar were collected and recorded on data collection sheet throughout of the study period. The weight of honey yield was measured using a digital balance. Colony

strength was rated as excellent, very good, good and weak by looking at a number of worker bees covering three randomly inspected combs. Bee colonies were rated as excellent if all inspected top-bar covered by bees. If less than 25, 25-50 and 50-75 of the randomly inspected top-bar were covered by bees it was rated as weak, good and very good respectively. The numbers of combs developed were also counted to test the suitability of each top-bar. Brood and pollen areas were measured by using frame divided unit areas. A unit area is (5cmx5cm).

2.5. Statistical analysis

The collected data were coded and tabulated for analysis. The collected data were analyzed using T-test. Mean comparisons was done using the least significant difference (LSD) for parameters significant difference at ($p<0.05$).

3. RESULTS AND DISCUSSION

3.1. Colony strength

The strength honeybee colonies in the current study found to be higher in kacha top-bar compared to bamboo top-bar (table1).In the present study, the reason kacha top-bar to be preferred by honeybee colonies could be due to the protecting/insulating nature of kacha top-bars. Kacha tree (Aloe sp.) contains fibers in nature which could absorb hot temperature and maintain required temperature whereas the reason for relatively less performance of honeybee colonies in bamboo (Arundinaria alpine) splits top-bars hive might be due to susceptible to absorb both high temperature and cold weather conditions. Awraris *et al*., (2015) also reported that colony strength varied in different hive types due to its insulating nature of the hive to maintain optimum hive temperature during hot and cold season.

Table 1: Colony strengths in kacha and bamboo top-bar hives

Traits (%)	**Type of top-bar**		
	Kacha top-bar hive	**Bamboo top-bar hive**	**Over all mean**
Colony strength			
Excellent	42(45.2)	38(40.4)	80(42.8)
Very good	30(33.1)	22(24.12)	52(29.6)
Good	11(13.2)	21(23.6)	32(19.4)
Weak	5(7.2)	7(9.3)	12(8.25)

*Values in parenthesis are percentages

3.2. Honey production performance of kacha (Aloe sp.) and bamboo (Arundinaria alpine) top-bar

The study result revealed that the mean of annual honey yield per kacha top bar hive and kacha top-bar were significantly higher than that of bamboo top-bar hive and bamboo top-bar respectively (table 2).These results are in line with the findings of Workneh *et al.*, (2008) who reported that the average of honey yield per top-bar hive in a year was 10-15 kg. The average of honey yield per top-bar of the current study was similar with the average of honey yield per top-bar reported by Gebreagziabher *et al*., (2014). The reason for more honey yield from kacha top-bar hive due to the larger comb size, thickness of combs, large number of combs developed and uniformity of honey ripened. The current studies are also supported by Gebreagziabher *et al*., (2015) who reported the performance of bee colony at different hive types. Kacha top-bar hive absorb hot temperature and maintain required temperature. This is encouraging population growth to produce more honey and reduce honey consumption during dearth period.

Table 2: Average of honey yield per hive (AHYPH), Average of honey yield per top-bar (AHYPTB)

	Parameters (Mean+SE)	
Type of top-bar	**AHYPH (kg)**	**AHYPTB (kg)**
Kacha	14.5±1.6[a]	1.32±0.175[a]
Bamboo	12.2±1.52[b]	0.91±0.18[b]
LSD (5%)	4.2	0.36
CV (%)	9.7	5.5
Over all mean	13.35	0.592

*Means in column with different superscript letters show significant difference at (P<0.05)

Figure 2 (a): Honey produced from kacha top-bar

Figure (b): Honey produced from bamboo top-bar

3.3. Development of combs, combs with brood and pollen in kacha and bamboo top-bar hives

Large number of developed combs and frame with brood was recorded from kacha top-bar hive. The study result showed significant difference in number of combs developed and top-bar with brood

($p<0.05$).However, the study result showed none significance in comb with pollen and tendency of colony absconded ($p>0.05$).These results are in line with report of Gebreagziabher *et al*., (2014). Kacha top-bar hive absorb hot temperature and maintain required temperature. This is encouraging colony growth to produce more brood and combs.

Table 3: Development of combs (DC), Top-bar with brood (TBWB), Top-bar with pollen (TBWP) in kacha and bamboo top-bar hives

	Parameters (Mean+SE)		
Type of top-bar	**DC**	**TBWB**	**TBWP**
Kacha	10.7 ± 0.94^{a}	6.36 ± 0.67^{a}	1.4 ± 0.54^{a}
Bamboo	8.45 ± 0.87^{b}	4.85 ± 0.58^{b}	1.29 ± 0.42^{a}
LSD (5%)	1.4	1.02	2.12
CV (%)	7.2	12.7	9.5
Over all mean	9.6	5.6	1.35

*Means in column with different superscript letters show significant difference at ($P<0.05$)

3.4. Bended character of top-bars and tendency of colony absconded

The total numbers of bee colonies absconded from each top-bar hive, bended of top-bar and empty top-bar were recorded over the entire of experimental period. The study result showed significant difference in bended top-bar and empty top-bar ($p<0.05$). However, the study result showed none significance in tendency of colony absconded ($p>0.05$).

Table 4: Bended top-bar (BTB), Empty top-bar (ETB) and Tendency of colony absconded (TCA) in kacha and bamboo top-bar hives

	Parameters (Mean+SE)		
Type of top-bars	**BTB**	**ETB**	**TCA**
Kacha	1 ± 0.47^{a}	2 ± 0.78^{a}	0.7 ± 0.24^{a}
Bamboo	0.3 ± 0.36^{b}	6.7 ± 0.94^{b}	0.3 ± 0.12^{a}
LSD (5%)	0.4	4.7	0.6
CV (%)	10.4	6.8	5.6
Over all mean	0.65	4.4	0.5

4. CONCLUSIONS AND RECOMMENDATIONS

The study revealed that kacha (Aloe sp.) top-bar had superiority in honey yield per hive, honey yield per top-bar, number of combs developed, top-bar with brood, number of empty top-bar and colony strength

compared to bamboo (Arundinaria alpine) top-bar. However, there was no significant difference in comb with pollen and tendency of colony absconded ($p>0.05$). Therefore, kach tree (Aloe sp.) can be used to make top-bar for transitional hive to improve honey production and productivity

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