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Evaluation of Transitional and Modern Hives for Honey Productivity in Buffer Zone of Chebera-Churchura Park, Konta Special District of Ethiopia

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Abstract
The study was designed to evaluate transitional and modern beehive on productivity of honey yield under smallholder beekeeper. A total of 16 honeybee colonies which had similar strength were used. Honey yield data from each hive per harvesting season was measured immediately after harvesting. The collected data were analyzed by using GLM analysis of variance procedure. There was investigated significant effect among modern and transitional beehive for productivity of honey yield. The potential honey yield productivity of the modern hive (19.78kg/ hive) was higher than transitional hive (10.42 kg/hive). In addition, the result of variance analysis indicated that year of harvesting and season of harvesting had significant effect ($p > 0.05$) on honey yield per hive. But, all main effects investigated had no significant interaction effect ($p > 0.05$) on honey yield per hive. . It is therefore the effort should be made to use modern beehive as an alternative technology in the areas and promoting the adoption of modern bee hives to improve the livelihood of beekeepers
Keywords: honeybee colonies, evaluation, modern beehives, transitional beehives, honey yield

Introduction

Ethiopia is known diversified of agro climatic conditions and biodiversity which suitable the existence of diversified honeybee colonies and high number of bee colonies. It has the huge honey bee colonies in Africa with over 10 million colonies, from these 5 to 7.5 million are estimated to be hived while the remaining found in the wild (Haftu 2015). Yearly honey production of Ethiopia is approximated to be 45,300 metric tons which makes the country to rank 1st honey producer country in Africa and 10th in the world (FAO, 2010). Although Ethiopia is recognized as top 10 producers of honey in the world, and the nation's productivity is still lower 10% of its production ability and this involves the existence of clear constraints strangling the sector (Haftu 2015).

Ethiopian honey production is distinguished by the widely use of traditional technology resulting in low honey quantity and poor honey quality harvested when measured up to the potential honey quantity and quality gains of transitional and modern beehives (Haftu 2015). The mean honey yield obtained from modern hive is higher when compared to transitional and traditional hives in Adami Tulu and Arsi Negelle districts *(Taye 2015)*. The potential productivity of the modern hive is 22.8 kg/hive and transitional hive is 17.8 kg/hive in Tigray Region, Northern Ethiopia (Haftom and Awet 2013). The yield from transitional and modern beehives is considerably higher and these improved hives gives better- quality honey as well designated on average 33 and 16 kg of honey yield per hive was harvested from modern and traditional beehives in the northern Ethiopian highlands, respectively (Teferi 2011).

Konta special district has high potential of honey bee colonies, and the district also has high potential of bee flora. But, majority of beekeepers used traditional bee hives and productivity is low. In the district limited numbers of transitional and modern hives are available. However, the productivity these two hives are not studied in the district and it is important to distinguish the productivity of these hives. Therefore, current study focuses to evaluate transitional and modern hives for honey yield productivity in buffer zone of Chebera-Churchura Park, Konta special district of Ethiopia.

Material and method

Description of study area

The study was conducted in buffer zone of Chebera-Churchura Park Konta special districts from 2015 to 2016 to assess the productivity performance of transitional and modern beehives. The district is located at 464 km to the south of Addis Ababa. It is situated at an altitude ranging from 870 to 2850 meter above sea level and latitude $7^0$42 N and $36^0$50'E. The area receives mean annual rain fall ranging from 500mm-2200mm. The rainfall is bimodal, the long rain happen beginning from June to end September and the short rainfall is beginning from March to end April with more rainfall measures from July to August, respectively. Mixed crop-livestock production system is common in the districts (Konta special district livestock and fishery office, unpublished data).

Study design

The study design to evaluate the productivity on honey yield of transitional and modern beehive under smallholder beekeeper condition, and a total of 16 bee colonies which had identical colony strength were used.

For the transitional and modern beehives, honey bee colonies were shifted from traditional beehives. During transferring, supplemental feeds, honey and bee broods were transferred from the traditional beehive to the transitional and modern beehives. All managements were done after transferring to transitional and modern beehives to maintain similar strength of the colony. 20 farmers were selected for demonstration purpose. From selected farmers 10 randomly selected and grouped in to one group and eight modern and eight transitional hives were given, at the same time the rest 10 farmers' grouped in to one group and eight modern and eight transitional hives were given to see the effect of transitional and modern hives on productivity of honey yield. Modern and transitional beehive was taken as an experiment, and the bee colonies were allocated randomly to current study was conducted for two successive years in 2015 and 2016.

Training

Since the transitional and modern beehive was new to smallholder beekeepers of both groups, training was provided before starting the study. Training was provided to the two randomly selected groups about the significance of transitional and modern beehives, honey bee colony management, harvesting of honey, internal and external colony inspection. This was carried out before bee colony transferring to the transitional and modern beehives.

Honey harvesting and measurement

Ripe honey showed combs sealed with thin wax layer. After harvesting of honey, the amount was measured immediately by using sensitive balance weigh.

Data collection

Check list and data collection notebook were prepared by the researcher during the study. Data related to honey yield from each hive during harvesting season was directly documented after harvest from each hive. The amount of honey yield was soon measured and recorded on honey collection notebook.

Data analysis of

The data was analysed using the GLM procedure of SPSS 20th. Multiple comparisons of means for honey yield as a function of hive type, year of harvesting and season of harvesting was statistically analyzed using least square significant difference (LSD) with a significance level of alpha = 0.05 to identify a significant effect between the treatments.

Result and discussion

The result of variance analysis showed that hive type had significant effect ($p > 0.05$) on honey yield per hive (Table 2). The study result showed that the mean honey yield per hive/year from transitional hive was 10.42kg/hive and modern hive was 19.78kg/hive (Table 1). The mean honey yield from modern hive in this study is lower than 23.1 kg/hive in Adami Tulu Research Center (Taye *et al* 2015). It also lowers than the result indicated by Haftom and Awet (2013), which is 22.8 kg/hive. But it is higher than the result mentioned by Taye *et al* (2015) in the district of Ashoka lepis, which is18.61 kg/hive.

The mean yield obtained from transitional hive in this study is similar to the report mentioned by Haftu (2015), which is 8–15kg per hive per year. It also similar to the mean honey yield 10.45 kg hive/year in Ashoka Lepis district (Taye *et al* 2015), but it is lower than the average yield of traditional hive by Taye *et al* (2015), which is 13.88 kg hive/year in Asebo districts. Similarly, the mean honey yield obtained from transitional hive in this study is lower than 14.07 kg per hive/year in districts of Gamo Gofa zone reported by Nebiyu and Messele (2013). Furthermore, it is lower than the mean yield of traditional hive indicated by Haftom and Awet (2013), which is 17.8 kg/hive. The difference in honey yield among transitional and modern beehive is due to the fact

that the difference in the time of honey bees spent more time to build comb in the transitional hive, while in the modern hive the foundation sheet provided and given by the beekeepers. This might assist in honey bees to spend more time for collecting nectar and pollen in modern hive.

Table: 1. Effect of hive type, year and season of harvesting on productivity of honey.

Hive type	Year	Season	Mean	95% Confidence Interval	
				Lower Bound	Upper Bound
Modern hive	2015	September -November	22.34	20.85	23.82
		April - June	18.03	16.54	19.51
	2016	September -November	21.39	19.90	22.87
		April - June	17.36	15.88	18.85
		Total mean of honey yield	**19.78**		
Transitional hive	2015	September -November	13.34	11.85	14.82
		April - June	9.51	8.026	10.99
	2016	September -November	11.46	9.98	12.95
		April - June	7.38	5.89	8.86
		Total mean of honey yield	**10.42**		

Year of harvesting had significant effect ($p > 0.05$) on honey yield per hive at the study area (Table 2). The study result mentioned that the mean honey yield per hive/year from modern hive in 2015 was 20.19 kg/hive and 2016 was 19.38 kg/hive. Similarly, the mean honey yield per hive/year from transitional hive in 2015 was 11.43 kg/hive and 2016 was 9.42 kg/hive (Table 1). This might be the amount of rainfall vary between two years and the availability of bee forage different in 2015 and 2016.

In addition, season of harvesting had also significant effect ($p > 0.05$) on honey yield per hive (Table 2). September to November resulted better honey yield than April to May (Table 1). The current result is agree with Taye eta al (2015) indicated that large honey harvesting season is September to early November, while small amount of honey harvesting season is May in Mid rift valley of Ethiopia. This may be due to the fact that the availability of bee forage difference between two season and amount of flower produced.

All main effects investigated had no significant interaction effect ($p > 0.05$). This may be one main effect has no impact on the others.

Table: 2: Tests of between-subjects effects.

Source	Sum of Squares	Df	Mean Square	F	P-value
Corrected Model	1702.58[a]	7	243.26	55.19	.000
Intercept	14592.64	1	14592.64	3311.37	.000
Hive type	1400.63	1	1400.63	317.83	.000
Year	31.64	1	31.64	7.18	.010
Season	264.06	1	264.06	59.92	.000
Hive type * Year	5.76	1	5.76	1.31	.258
Hive type * Season	.18	1	.18	.041	.840
Year * Season	.001	1	.001	.00	.991
Hive type * Year * Season	.303	1	.303	.07	.794
Error	246.78	56	4.41		
Total	16542.00	64			
Corrected Total	1949.36	63			

a. R Squared = .873 (Adjusted R Squared = .858), Df degree of freedom

Conclusions

It was concluded from the finding of this study that modern beehive had better productivity in terms of honey yield compared to the transitional beehive. There was a significant difference between the transitional and modern beehive in relation to honey yield per hive. In addition, year and season of harvesting had significant effect on honey yield per hive. On the other hand, the interaction of all main effects had no significant effect on honey yield per hive. It is therefore the effort should be made to use modern beehive as an alternative technology in the areas and promoting the adoption of modern bee hives to improve the livelihood of beekeepers.

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