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Original Research Article

Honey Bee Floras along the Agro-Ecology, Jimma Zone, Southwest Ethiopia

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Abstract: Ethiopia is home to diverse plant species that provide nectar and pollen as bees forage. In this study, honey bee forages were assessed in three different agro-ecology districts, Jimma Zone, Southwest, Ethiopia. Random sampling techniques was used to collect the data, ninety beekeepers were interviewed using structured questioner. Key informants were interviewed with in all study areas. ANOVA of GLM and Regression were done using Minitab statistical software. Accordingly 42 honey bee' forages; 28 trees, 6 shrubs and 8 herbs were mentioned by respondents which belong to 22 families, Fabaceae and Asteraceae were the first and second dominant family respectively. Natural forest trees, cultivated crops and fruits were identified as bee forage. Beekeepers experience and their knowledge on seasonal availability of bee forage and honey bee poisonous plants found in their locality were also assessed. In the study area traditional forest beekeeping system is practiced to produce honey. Different bee forages bear flower at different months and visited by honey bees for different number of days. Poisonous bee floras according to beekeepers' response there is similar knowledge in highland (93%) and midland 96.5% agro ecology, whom say 'Yes I know' while in lowland was 30%. In all agro-ecology Euphorbia cotinifolia was mentioned as bee poisonous plant which bear flower at different months of the year even if it is not toxic.

Keywords: Bee forage; Bee poisonous plants; Bee plants; forest beekeeping, Jimma.

INTRODUCTION

Honey production is a natural resource-conserving and environmentally friendly activity [1]. Among many factors, availability of potential flowering plants is the main parameter for an area to be considered as potential for honey production [2]. Like all other animal species, bees require feeds for their production & reproduction [3], which is for colony size growth or swarming. The honey bee plants provide pollen and nectar as main feed sources for honeybees, while, flowering plants depend on bees as pollen vectors for their sexual reproduction and this interaction is particularly important in tropical ecosystems [4, 5]. Bees usually forage pollen, nectar and propolies.

Ethiopia is home to diverse plant species that provide surplus nectar and pollen as bee forage [6]. Ethiopia has considerable potential in beekeeping with rich flora, good ecological conditions [3]. Beekeeping plays a significant role in conserving the natural resources and contributes to the globe through environmental protection. Abera [7], reported that assessing the potential honey source floras in a given area is very important in bee management and identification of those honey bee plants has positive impact on the development of apiculture sector.

Therefore, assessing the honey bee forages or plants found in a given agro-ecology requires the proper identification of honey bee plants which are visited by honey bees as source of nectar, pollen or propolis. Agro ecological zones of Jimma zone are suitable for the growth of different bee flora and development of apiculture. Jimma Zone has considerable potential in beekeeping with rich flora, good ecological conditions and large colonies population exist [7]. Even though there are a large number of bee colonies in Jimma Zone of different agro-ecosystems, honey production system is still largely in traditional practice. Therefor this study assesses the feed resources of honeybees is very valuable

tool for apiculture and other stakeholders to contribute towards the development of the sector. This contributes by identifying both the wild or natural and cultivated honey bee forages found in the study areas and for their conservation.

Objectives of the study were to assess bee forages found in the selected districts and to have the baseline information on their flowering months; to identify the natural forest trees, cultivated crops and fruits as bee forage in three different agro-ecology of Jimma zone and to indicate their distribution, and to assess beekeepers experience and knowledge on honey bee toxic/poisonous plant/s found in their locality.

MATERIALS AND METHODS

Description of the study areas

This study was conducted in Jimma Zone, Oromia Region of Southwest Ethiopia. Three (3) beekeeping potential districts (Shebe-Sombo/lowland, Gomma/midland and Gera/highland) were purposively selected for representing the three agro-ecologies. From each district/agro-ecology three Kebeles were selected purposively based on their beekeeping potential and accessibility. Primary data were collected from a random of 90 beekeepers from nine agro-ecological selected Kebeles. Those nine kebeles namely Genji-chala, Gera-naso and Wanja-kersa from Gera; Bulbulo, Choche-lemi and Omo-funtule from Gomma and Anja-genbo, Gasera and Keshe from Shebe-Sombo districts. Traditional forest beekeeping system is the main honey production system of the study area.

Gera district is located in the mountainous forest area; it has rugged terrain with an altitude 1500 m - 2900 m a.s.l. The average annual maximum and minimum temperatures are 26ºC and 10ºC, respectively. Average annual precipitation is 1700 mm, due to this favorable climate; Gera has 113,514 ha of forest [8]. Gomma district is located in mid-altitude sub-humid zone of the south western part of Ethiopia. Its altitude is from 1400m – 2270m a.s.l, the mean annual rainfall varies between 1400 and 1650mms with average maximum and minimum temperatures of 29.9 ^{O}C and 13.4 ^{O}C, respectively [9]. Shebe-sombo district is located at a distance of 375 km, South West of Jimma town. It is situated at an altitude ranging from 1350m - 2800 m above sea level and with an estimated area of 121.5 square km. The area receives an average annual rainfall ranging from about 900 to 1300mm. The minimum and maximum daily temperatures of the area are 20°C and 28°C, respectively.

Social Survey Data Collection

To collect the required social data for the study bee keeper individuals, key informants and experts were interviewed and focus group discussions were done using structured questioner.

Household interview: to select sample household beekeepers discussion were made with district experts and three kebeles were selected per each district randomly. Accordingly 30 beekeepers households per district were used for the structured questioner interview, 10 beekeepers per each kebele. For this study a total of 90 individual beekeepers were involved. Hence to collect information regarding bee forage plants and related parameter (like beekeeping experience in year, total number of bee colonies they have & in traditional hive, frequency of honey harvesting per year knowing of common bee flora with their flowering time, importance, seasonal forage availability, bee poisonous plants, etc). The sampled individual beekeepers were interviewed with structured questionnaire. And we take local name, picture and visual observation of the mentioned bee floras for further searching their scientific/botanical name.

Key informant interview: Key informants were experienced beekeepers selected purposively, 3-4 in number per each kebele. The qualitative information collected through interview is used to supplement and crosscheck the data obtained through the household survey.

Focus Group Discussions: For focus group discussion we used six to eight individuals from each kebele. They were purposively selected from Kebele leaders, development agents (DA), bee technician, and experienced beekeepers, which are believed to be knowledgeable about bee flora/plants of the area. According to Abera [7] report, the mean beekeeping experience of the respondent in the study area were around fourteen years, the maximum was thirty four in lowland agro-ecology and the minimum was eleven years in midland agro-ecology.

Statistical Analysis

The collected data were summarized using descriptive statistical methods (such as frequencies, percentage and pictures) using MS excel window10. ANOVA of GLM and Regression were done using Minitab 13 statistical software.

RESULTS AND DISCUSSION

Mean and standard deviation of bee forages listed by beekeepers were summarized in Figure 1 below. Those bee forages were grouped into wild and cultivated (crops and fruits) species (Figure-1A). Accordingly the largest total bee forages was listed by Shebe-sombo district beekeepers (11 bee forages), the least was at Gomma district beekeepers (8

bee forages). Wild bee forages were listed more at Gera district and cultivated bee forages were at Shebe-sombo district beekeepers. The result shows that there is significance difference for listing of bee forages among district beekeepers ($P < 0.001$, Table-1). The highest mean deviation (StdDv=3.08) was observed in Gomma district the middle agro-ecology and the lowest mean deviation (StdDv=1.95) was observed in Gera district the highland agro-ecology (Figure 1B). The regression result shows that, it is positively related with bee colonies in traditional hive and having more experience while negatively related with total number of bee colony and frequency of honey harvest per year (Table-2).

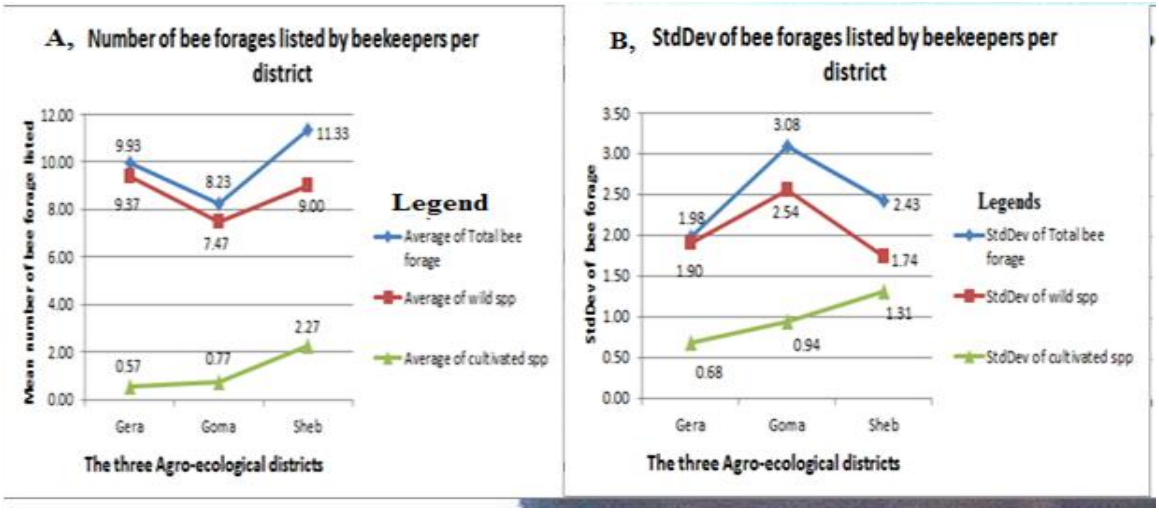

Figure 1: Mean number and standard deviation of bee forages listed by beekeepers per each district

Table 1: General Linear Model: Total bee forage versus Districts

ANOVA for Total bee forages, using Adjusted SS for Tests

Source	DF	Seq SS	Adj SS	Adj MS	F	P-value
Districts	2	144.600	144.600	72.300	11.23	0.000*
Error	87	559.900	559.900	6.436		
Total	89	704.500				

*Significance P<0.000

Table 2: Regression Analysis: Number of bee forages listed by respondents versus No of bee colony in Traditional hive, total bee colony, experience in yr & honey harvest/yr

Terms	Coefficients	SE Coef.	T	P-value
Constant	9.353	1.197	7.81	0.000
No Bee colony in Trad. Hive	0.06641	0.03856	1.72	0.089
Total No of bee colony	-0.04398	0.02959	-1.49	0.141
Experience in year	0.08412	0.02933	2.87	0.005
Honey harvest/year	-0.3420	0.5470	-0.63	0.533

S = 2.640 R-Sq = 15.9% R-Sq(adj) = 11.9%

Analysis of Variance

Source of variation	DF	SS	MS	F	P-value
Regression	4	111.881	27.970	4.01	0.005*
Residual Error	85	592.619	6.972		
Total	89	704.500			

Regression Analysis: The Regression Equation is

Number of bee forage listing = 9.35 + 0.0664 Number of bee colonies in Traditional hive -0.0440 Total number of bee colonies + 0.0841 experience in yr - 0.342 Honey harvest/yr

Regression Analysis was done for number of bee forages listed by respondents versus number of bee colony in traditional hive, total bee colony, experience in year and honey harvest per year. These contrast sums of squares completely partition the treatment sum of squares. The regression tests on such predictors are usually incorporated in the ANOVA, as shown in Table 2. We can conclude from the P-values that there is a significant difference in mean beekeeping experience of the respondents and average number of bee colony in traditional hive, total bee colony and frequency of honey harvesting per year don't differ significantly from the average of number of bee forage listed by respondents at $\alpha = 0.05$ level. The analysis of variance for the data, summarized, implies that there is a difference in mean number of bee forage estimates by beekeepers in the study areas ($P = 0.005$, Table 2).

As indicated in Table-3 below, list of honey bee forages, their flowering months in the study area have been presented with their local, scientific and their family name, while cultivated crops and fruits which are visited by honey bees were presented in Table 4. In this study 42 honey bee forages 28 tree, 6 shrubs and 8 herbs were mentioned which belongs to 22 families. Fabaceae (6) and Asteraceae (5) family were the first and second dominant family respectively. Those plant species were mentioned by respondents based on their experience in beekeeping. The result indicates that the distribution of natural vegetation, fruits and cultivated crops varies along the agro-ecology (climate, altitude, latitude, topography, and soil type). This report is supported by Tilahun, [10] is that, flowering season vary from place to place because of diversity of plant habitat and environmental conditions and distributions.

Honey bee forage species more frequently mentioned in highland agro-ecology were Schefflera abyssinica, Acokanthera schimperi, Strychnos spinosa, Prunus Africana, Olea welwitschi; in the lowland representations were Combretum molle, Erythrina abyssinica, Phoenix reclinata, Guizotia abyssinica, Sesamum indicum. Whereas Bidens spp, Guizotia scabra, Strychnos spinosa, Eucalyptus spp, Croton macrostachyus Coffee arabica, vernonia spp., Vernonia rueppellii sch., Acecia spp, Trifolium spp., Cordia afericana, and Persea Americana were found in all three agro ecologies. Those described plants bear their flower at different months of the year and stay for different days as bee forage or source of nectar and pollen (Table 3). It is also reported by Chala et al., [11] is that honeybee flora compositions of Gomma district/midland are perennial crops like Coffee, herbs, and natural trees. Honey bee plants/floras are plants that supply both nectar and pollen abundantly when in bloom [12]. Combretum molle, Vernonia Spp**,** Vernonia Spp, Coffee arabica**,** Combretum molle**,** Guizotia scabra and Biden sspp are honey source floras in Shebe-Sombo district, lowland agro-ecology, and those trees are rich in nectar to produce high-quality honey [7]. Those bee plants are also reported by Fichtl & Admasu [3], as pollen and nectar sources which honeybees collect from their flowers.

Most mentioned bee floras in all study areas were Gerawa (Vernonia Spp), Coffee arabica and Croton macrostachyus by 90(100%), 83(92.2%) and 80(88.9%) respondents respectively. Based on the result we can say Vernonia spp. is one of widely distributed plant along different agro-ecology. There are also only mentioned by a single agro-ecology respondents', Schefflera abyssinica in highland by all (100%), Combretum molle in lowland by 28(31.1%) respondents but there is no a single bee forage only mentioned by midland beekeeper respondents. This shows that midland agro-ecology is an overlapping or a transition agro-ecology for bee forage or vegetation distribution. Some honey source plants restricted to highland like Schefflera abyssinica and Combretum molle to lowland, while, some like coffee arebica and Guizotia scabra distributed along all agro-ecology [7]. Some of impertinent bee forages found in the study area during their flowering stage were presented in Figure 2 below.

Figure 2: Some of important bee forage plants: (photo by: Abera)

Table 3: List of honey bee forages, their flowering months, flowering duration and plant type in different agro ecology, Jimma zone, Ethiopia

Local (Oromo language) name of plants	Botanical name	Family	Flowering months along agro-ecology and Average flowering duration (days flower stay) and frequency						Total frequency Per 90 respond	Plant type
			Highland	Frequency	Midland	Frequency	Lowland	Frequency		
Kelo/Adey abeba	Bidens spp.	Asteraceae	Oct-Dec (30-45)	24	Sep-Oct (30-45)	24	Oct-Nov (30-45)	26	74	Herb
Ambembesa	Albizia gummifera	Fabaceae	Dec (15)	5	Feb (7)	3	-	0	8	Tree
Bedesa/Dokema	Syzygium guineense	Myrtaceae	Jan-Feb (30)	21	Jan-Mar (30)	5	Aug-Sep (15)	5	31	Tree
Baregamo/ Beharezafe/	Eucalyptus spp	Myrtaceae	March (25)	12	Sep-Oct, May-June (20)	13	Sep, March, May (15-20)	28	53	Tree
Mekenisa/ Besana/	Croton macrostachyus	Euphorbiaceae	May-June (30-45)	28	May-June (35-45)	29	May-June (30)	23	80	Tree
Beya	Olea welwitschi	Oleaceae	Jan-Feb (45)	5	-	0	-	0	5	Tree
Buna	Coffee arabica	Rubiaceae	Jan, Feb, March (5-7)	27	Jan, Feb, Mar (4-7)	27	Feb-March (3-5)	29	83	Tree
Buto/Getem*	Schefflera abyssinica	Araliaceae	March-Apr (45-60)	30	-	0	-	0	30	Tree
Lafeto /Gerare/	Acacia spp.	Fabaceae	Apr (22)	16	Feb-March (15-20)	17	March (15-20)	18	51	Tree
Ebicha/ Gerawa*	Vernonia Spp	Asteraceae	Jan-March (40-55)	30	Feb-March (30-45)	30	Jan-Feb (25-30)	30	90	Shrub
Kenchib	Euphorbia tirucalli	Euphorbiaceae	-	0	Oct, Mar (15)	5	March, Oct (15)	4	9	Shrub
Keryo	Polyscias fulva	Araliaceae	March, May-June (20-30)	7	May (15)	5	-	0	12	Tree
Korch	Erythrina abyssinica	Fabaceae	-	0	-	0	March (20)	6	6	Tree
Qerero	Aningeria altissima	Sapotaceae	Jun-Jul (30-45)	16	June (20)	1	-	0	17	Tree
Reji	Vernonia rueppellii sch.	Asteraceae	Jan (15)	2	Jan- Feb (30-45)	3	Jan-Feb (30-45)	7	12	Shrub
Mukerba/Sesa	Albizia gummifera	Fabaceae	-	0	Feb-mar (10)	4	March (15)	5	9	Tree
Sidesa	Trifolium spp.	Fabaceae	Sep-Oct (20-30)	3	Sep-Oct (20)	2	Sep. (15)	4	9	Herb
Sombo	Ekebergia capensis (E. rueppeliana	Maliaceae			March (7)					Tree
Tensa*	Combretum molle	Combretaceae	-	0	-	0	March-April (30-45)	28	28	Tree
Muka guracha/Tikure enchet	Prunus Africana	Rosaceae	June-Jul (20)	6	-	0	-	0	6	Tree
Tufo*	Guizotia scabra,	Asteraceae	Sep-Nov (45)	22	Sep-Nov (30-40)	30	Oct-Nov(30-45)	26	78	Herb
Yturumba abeba+	Brugmansia suaveolens	Solanaceae	Oct, Feb-Mar (10)	7	Sep, Feb, Mar (7)	8	March (10)	3	18	Shrub
Wedesha/Wanza	Cordia Africana	Boraginaceae	August-Sep (20-25)	3	August-Oct (20-25)	17	August-Sep (20-30)	28	48	Tree
Wendebeyo	Apodytes dimidiate	Icacinaceae	Dec-Feb (20)	6	-	0	-	0	6	Tree
Sole	Olinia rochetiana	Penaeaceae	Aug-Sep (30)	7	-	0	March (20)	6	13	Tree
Debeka	Terminalia laxiflora		-		-		Feb-Mar (30)	2	2	Tree
Seho	Allophylus abyssinicus	Sapindaceae	Aug-Sep (20)	4	-	0	-	0	4	Tree

Gravila +	Grevillea robusta	Proteaceae	-	0	Year round(7)	3	March (10-15)	6	9	Tree
Sesbania+	Sesbania sesban	Fabaceae	-	0	-	0	February (15)	5	5	Shrub
Abalo	Combretum molle R.	Combretaceae	-	0	-	0	April- Mar (15)	15	15	Shrub
Zembaba	Phoenix reclinata	Arecaceae	-	0	October to Nov(10)	10	Sep. to Oct (7)	7	17	Tree
Zido			-	0	-	0	March (7)	4	4	Tree
Sigilu			-	0	-	0	March (7)	3	3	Tree
Yezenjero-wenber	Polyscias tulva	Araliaceae	June (15)	4	July (15)	3	-	0	7	Tree

Key: +: Exotic plant; *= honey source plant

Table 4: Cultivated crops and fruits which are visited by honey bees as bee forage and their flowering months in different agro-ecology of Jimma zone, Ethiopia

Local (Oromo language) name of crop/fruit	Botanical name	Family	Flowering season along agro-ecology (days flower stay)				Plant type
			Highland	Midland	Lowland	Frequency per 90 Resp.	
Ruzi +	Oryza sativa	Poaceae	-	-	Sep (15)	3	Herb
Selite	Sesamum indicum	Pedaliaceae	-	-	June (20)	4	Herb
Nugi	Guizotia abyssinica	Asteraceae	-	-	Sep-Oct (15)	5	Herb
Boqolo +	Zea mays	Poaceae	June (15)	Jul-Aug (20)	June-Jul (20-30)	32	Herb
Mashila	Sorghum bicolor	Poaceae	-	-	Sep (15)	8	Herb
Mango +	Mangifera indica	Anacardiaceae	-	Jan-Feb, March (15-20)	March (15)	38	Tree
Avocado +	Persea Americana	Lauraceae	Sep, Jan, Mar (20-25)	Nov, March (20)	Dec, Feb, Mar (15)	38	Tree
Zeytune +	Psidium guajava	Myrtaceae	-	Jan (7)	-	4	Tree

Key: + means exotic plants

Different bee forages bear flower at different months and visited by honey bees for different number of days. For practical applicability to select as bee forage source for honey production and to conserve their blooming to shedding, months of flowering information were described (Table 3 & 4). This is important for honey production and honey bee colony swarm catching, for bee hive inspection, colony management practice during dearth period. Every ecology has its own dearth periods could be short or long duration and knowledge on bee flora helps in the effective management of bee colony during such period [13]. Bee forage diversity varies depending on the topography, climate and soil type. A good beekeeping area is one in which honey and pollen plants grow abundantly and with a relatively long blooming season [12].

Table 5: Beekeepers response to condition of shortage of bee forage across the months of the year and their reasons

Question	Response	Degree of shortage	Beekeepers response to condition of shortage of bee forage across the months of the year			
			Agro-ecology	# of response	Months	Their Reasons
Is there shortage of bee forage in your local area?	No	-	-	0		0
	yes	Critical	Highland	30	July, August	Heavy rain washes flower and bees stay inside hive for days
			Midland	30	July, August	No abundant flowering plants
			Lowland	30	Dec-Jan	Drought & few plants have flower
		Shortage	Highland	30	Dec – January,	Few tree species bear flower
			Midland	30	Sep, March	Limitation of flowers
			Lowland	30	Jan., Jul-Aug	Few flowering plants exist
		Less shortage	Highland	30	October – Nov., April	There are flowers of different plants
			Midland	30	Dec, February & March	" "
			Lowland	30	Oct-Nov, Mar & June	' "

Table 5 above shows the degree of bee forage shortage and beekeepers response in the study areas. All beekeepers in the study area response that there is shortage of bee forage at different degree level in different months of the year. Based on this we can say that presence of nectar source plants doesn't mean always there is honey in the hive, in case of heavy rain washes the nectar or if there is drought the nectar evaporates and honey bees not able to reach the nectar to make honey. That is the two extremes heavy rain and drought gets the honey bees dearth period even in the presence of flowers in the field. As mentioned by beekeepers in high land/ Gera district there is critical shortage of bee forage from July to August due to heavy rain presence even if some plants bear flowers (Table 5). Production of honey depends on availability of floral resources (bee forage) but there is flower mean doesn't mean there is honey it depends on intensity of rainfall, heavy rainfall may wash nectars which leads shortage of nectar. According to Beyene and Verschuur [14] report shortage of bee forage is directly related with deforestation of forest coverage and expansion of agricultural lands.

Honey bees before starting to store honey in their comb they start to increase their colony number through reproduction. For reproduction either colony increasing or swarming, they require pollen as protein source to feed the brood. Thus a pollen source plant flowering is very important and crucial ahead of flowering nectar source plants. Honey bees store honey in their comb when there is sufficient nectar source plants in the favorable weather conditions (rain fall and temperature). Existence of colony strength, production and productivity of the honeybee colony depends on the presence of bee forages that provide pollen and nectar. In this study minimum flower duration mentioned was 3 to 5 days for Coffee arebica and the maximum was 45 to 60 days for Schefflera abyssinica (Table 3). There for to produce coffee honey it depends on plants bearing flower ahead of coffee. Since honey bees before they start honey production they made honey comb and multiply their colony, to have this status they collect pollen on other plant flowers. Pollen plants are important in at the time of colony build-up [12]. Abera, [7] reported that honey harvesting trends in the study areas were in the range of 1 - 3 times per year per districts. Beekeepers understand that they harvest honey of different floral source at a time.

Table 6: **Beekeepers experience on existence of honey bee poisonous plants**

Agro-ecology	**Availability of poisonous plants**			**If yes list of honey bee poisonous plants**		
	Knowing poisonous plants	**No of respondents per agro-ecology (30)**	**If Yes, Local name**	**Botanical name**	**Months of Blooming/flower**	**Reason to say poisonous plant for bees**
Highland	Yes	29 (96.5%)	Abeba Dima	Euphorbia cotinifolia	Sep to Oct, & March,	Looking dead bees during flowering time of the plant
	No	1 (3.5)				
Midland	Yes	28 (93%)	Abeba Dima	Euphorbia cotinifolia /Euphorbiaceae	April – May, July – August	
	No	2 (7%)				
Lowland	Yes	9 (30%)	Abeba Dima, Nim tree	Euphorbia cotinifolia Azadirachta indica	Sep., Jan., March & April	
	No	21 (70%)				

Honey bees poisonous plants are those plants which are a cause of death or paralyses bees in contact with or swallowing plant parts. Honey bee poisonous plants are toxic plants to bees when collecting nectar or pollen and those in which the honey produced from their nectar are toxic to humans [11]. Poisonous bee floras according to beekeepers' response there is similar knowledge in highland (93%) and midland 96.5% agro ecology, whom say 'Yes I know' while in lowland was 30%. Even if beekeepers of the study areas are practice traditional forest beekeeping system which is hanging traditional beehives on trees far away from their homestead. Their reason to say there is bee poisonous plant is that looking dead bees during flowering time of the plant. There for, this cause limitation of knowing bee poisonous plants which they have less frequent contact with their hive. Euphorbia cotinifolia is mentioned as bee poisonous plant in all of three agro-ecology and in lowland agro-ecology Nim tree/ Azadirachta indica/ was also mentioned (Table 6). Euphorbia cotinifolia is shrub belongs to family Euphorbiaceae, which bear flower at different months of the year. Its vernacular name is Abeba Dima in Oromo language means Red flower because of having red color leaves; it was introduced to Ethiopia for ornamental purpose and planted as fence. Azadirachta indica has insecticide nature, it is also identified as poisons plant by Yetimwork et al., [15], while E. Contifolia suggested as non-toxic effect on bees [16]. The botanical origin of the poisonous honey bee plants can be detected and confirmed by analysis of pollen grains from the guts of forager bees [17].

CONCLUSION AND RECOMMENDATION

This study was conducted to assess bee keepers experience on bee floras visited by honey bees for different sources (nectar, pollen and propolies) in Jimma zone, Southwest Ethiopia. In this study 42 honey bee forages 28 trees, 6 shrubs and 8 herbs were mentioned which belongs to 22 families. Those are not the only bee forages found in the study area rather described by respondent beekeepers only. Beekeeping system of the study area is traditional forest system this

may cause limitation of describing all bee forages found in the study area. Because, practicing traditional forest beekeeping system, there is less frequent contact between beekeepers and their hive. Common honey bee floras mentioned by beekeepers in all of the three agro-ecologies were Bidens spp, Guizotia scabra, Strychnos spinosa, Eucalyptus spp, Croton macrostachyus Coffee arabica, vernonia spp., Vernonia rueppellii sch., Acecia spp, Trifolium spp., Cordia africana, and Persea Americana. Schefflera abyssinica is found in highland and Combretum molle in lowland but there is no a single bee forage found only in midland agro-ecology according to beekeeper response (look some of their picture figure 2). Those mentioned bee forages bear flower at different months and visited by honey bees for different number of days.

For some months there is critical shortage of bee forage, even if some plants bear flowers from July to August in high land agro-ecology it will happen due to heavy rain fall. Production of honey depends on availability of floral resources (bee forage) but there is flower mean doesn't mean there is honey it depends on intensity of rainfall. Heavy rainfall may wash nectars, drought also evaporates nectar. In all of three agro-ecology Euphorbia cotinifolia is mentioned as bee poisonous plant which bear flower at different months of the year. Further study requires on establishing bee forage calendar, pollen analysis and identification of bee toxic plants for the study area.

Declarations

Computing interest: The author declare that there is no any conflict of interest.

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