Assessment of the effect of ant (*Dorylus fulvus*) on honeybee colony (*A. mellifera*) and their products in West & South-West Shewa Zones, Ethiopia

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Abstract

Among so many pests existing in Ethiopia, ant (*Dorylus fulvus*) is found to be the most troublesome to honeybees and beekeeping sector. Ant causes great damage to honeybees and their products and as a result many productive bee colonies have been either killed or abscond due to intolerable ant attack. However, the extent of damage inflicted on honeybee colonies and their products under local conditions was not determined. So, the main objective of this study was to assess and quantify the losses incurred due to ant attack in terms of both life of honeybee colonies and their products in West Shewa Zone. For the purpose 7 districts and 174 beekeepers possessing 1997 bee colonies were randomly selected from the Zone and interviewed on pre-tested questionnaire. From the total of honeybee colonies in the Zone, 44.2% of them were known to be attacked by ant per year, of which 24% absconded and 4.2% died. However, 16% of the bee colonies attacked remains in their hive withstanding the fight. Honey yield amounting to 29% of the production in the Zone is found to be lost per year due to ant attack. As a whole, the economic loss in the Zone every year as a result of loss of honeybee colonies and their products due to ant attack was estimated to be over 3,839,810 birr.

Key words: ant, honeybees, beeswax, abscond, Ethiopia

Introduction

Honeybee colonies existing in the wild away from man's control produce small surplus honey above their requirements signifying beekeeping is much more productive and profitable if they only managed properly (Moeller, 1982). To this reality, protecting them from diseases, pests have been recognized many centuries back and now days became a key activity of beekeepers to make the beekeeping profitable (Crane, 1990).

Among all enemies of honeybees, driver or army ant is known to cause great harms through initiating aggressiveness, absconding, and destroying the

entire colonies of honeybees (Smith, 1953, Morse and Hooper, 1985, and Crane, 1990). Although, strong bee colony resists for some time, eventually abscond if molested too much and small bee colonies be subjugated shortly (Bechtel, 1988***).*** Ant eats or carries off any comb contents honey, pollen and brood (Smith, 1953). Ant *(Dorylus fulvus)* is so long identified as one of the main honeybee enemies causing serious problem on beekeeping sector in Ethiopia (Ayalew, 1983; Amsalu *et al*., 1999, Desalegn, 2001; Desalegn *et al*., 2001, 2005; Nicola, 1988).

In many parts of the world, research is under way to develop means to combat or prevent bee pests. However, bee research in Ethiopia is at its infancy and no detail investigation made on type of honeybee pests, distributions and the actual products lost as a result of bee pest. In this regard, quantified data on the degree of damage caused is much important for intervention and further development plan. Therefore, this study was carried out to assess and quantify the magnitude of ant damage imposed on life of honeybees and their products in West Shewa Zone.

Materials and Methods

Study area

The study was conducted in West and South West Shewa Zone in 2003, representing the central highland of the country. The Zone is characterized by favorable condition for crop and livestock production having relatively better cultivated crops and natural plant coverage (Zerihun *et al*, 1991) which are mainly bee forages. Due to these, the Zone sustains large number of hived bee colonies (104383) from which about 835 tones of crude honey is produced per year (Edessa, 2004).

The Zone receives 813.2mm-1699mm of rain with average range of 22.9-29.9^{0}C temperature. The altitudes ranges from 1500-3000masl.

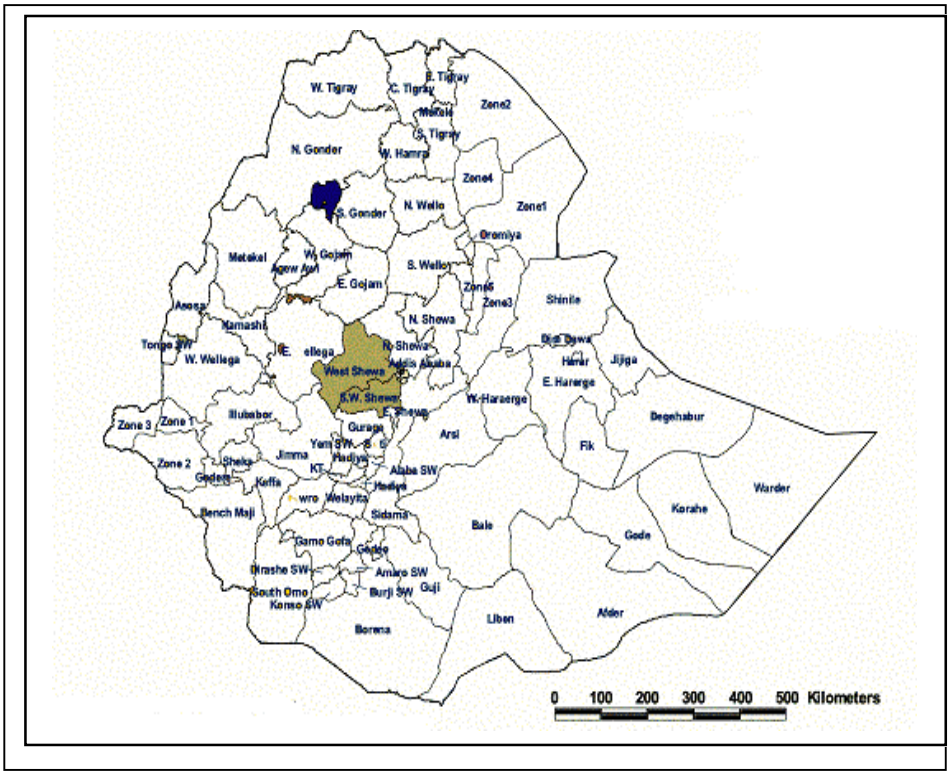

Figure -1 Study area

Methodologies

For this study 7 out of 21 districts of the Zone, were selected based on the agro ecological variability, mainly on the altitude. Based on the traditional ways of altitude classifications, the selected districts were categorized into high, mid and low altitudes. From each district 23-26 beekeepers, totaling 174 beekeepers having 1997 bee colonies were purposely selected. Selection of the beekeepers was performed in cooperation with the local agriculture & rural development office experts working either as beekeeping technician or as an expert of livestock production. Farmers' selection was based on the criterion of their beekeeping experiences & whether they are currently owning bee colonies or not. Pre-tested questionnaires were used to investigate effect of ant on the lives the honeybee colonies and their products. As they help in the effect of ant assessment, the questionnaire has mainly included records of bee colony holdings, type of hive in use, the local price of bee colonies & honey, respondents bee colony holdings, total number of bee colony in the survey

districts, total number of bee colonies in the Zone, honeybee pest types, number of honeybee colonies attacked, died, and absconded by ant per year, price of honey & honeybee colony for each district, price of beeswax at central market, the distinct time at which the ant set attack on honeybees & methods exercised to prevent ant attack. Average price of honeybee colony & honey for the colonies dead & absconded were used to compute the loss occurred due to ant attack in the survey areas.

Due to insignificant number of intermediate and frame hives in most of the surveyed districts, the effect of ant attack was analyzed based only on the data from bee colonies in the traditional beehives and the average honey and beeswax yield obtained form this bee hive type. Average beeswax production obtained from traditional bee hive was taken from the assumption that the wax production in a traditional bee hive is 10% (Moeller, 1982) of the honey yield. The wax price used (25birr) in the calculation was the average pure beeswax price of the central market in 2003. The average bee colonies attacked, absconded and died, the honey yield and beeswax losses are the average value of two years (2001 & 2002) from the surveyed districts. The degree of bee products vulnerable to ant attack was determined based on the reply got from the respondents in the study areas. Finally, loses due to ant effect at Zonal level was extrapolated from the total lose occurred in the surveyed districts.

Results

Colony holdings

From the total 174 beekeepers included in the assessment, the number of bee colony holdings varied from 1-100 with an average of 11.5 bee colonies per individual beekeeper. The majority (69%) of the beekeepers in the assessment possess 1-10 bee colonies and few of them manage more than 10 bee colonies, which in rare cases goes to 100 (Fig.2).

Type of bee hives in use

It is understood that three types of bee hives are in use in the zone. Of the total bee colonies in the survey areas, 95.1%, 0.4% and 4.5% are managed in a traditional, transitional and frame hives respectively and the number of bee colonies managed in a frame hive is relatively high in Welmera district consisting 66.7 % of the total records of frame hive (Fig 3).

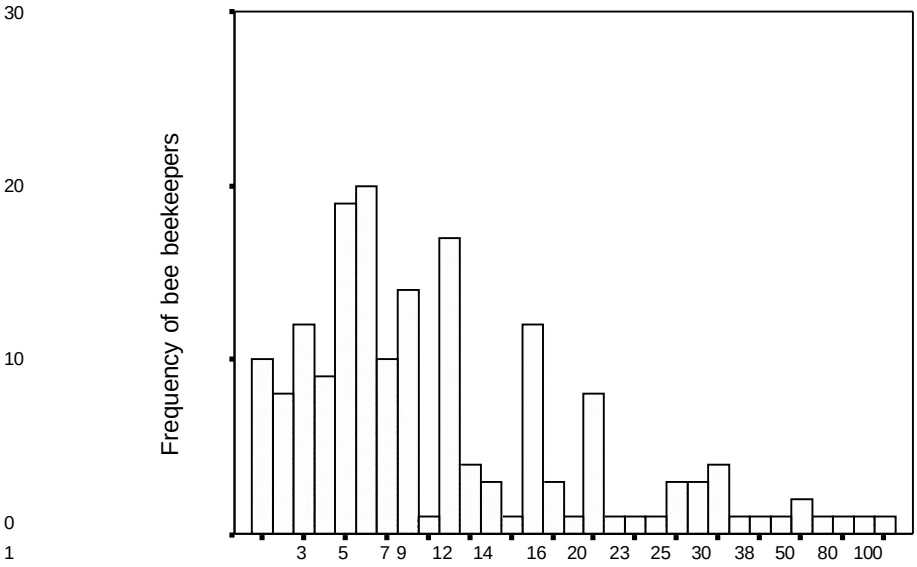

Figure 2. Bee colony holdings

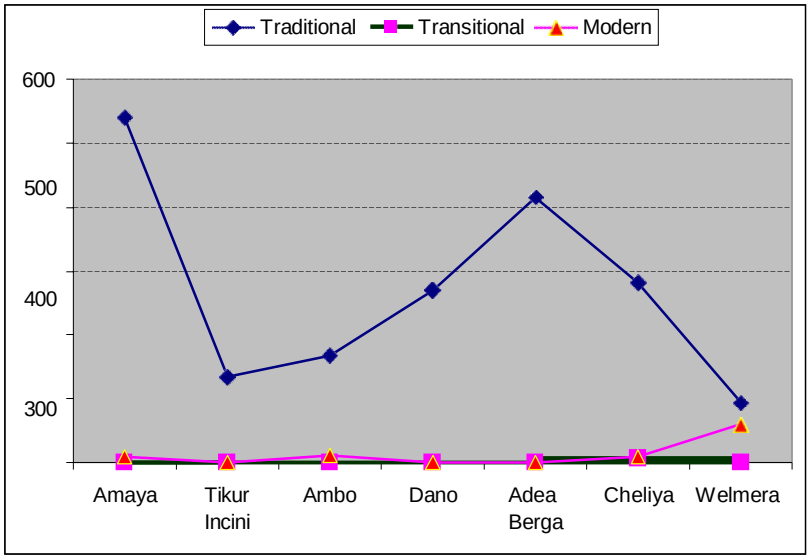

Figure 3. Status of the beekeeping with different beehives by district

Pests observed

Although the damage they create is so small and not recognized by the beekeepers, spiders, birds, and Wax moth, Honey badger (Hama), mice, toads,

snake, preymantis, lizards, bee lice, beetles, death head hawke moth and monkey were reported as bee pest in the study areas. Beekeepers reported that there is time when some of these pests are highly interacting and affecting the bees and their products. For instance, the local honey badger (Hama-local name) has ultimate effect when it attacks the colony.

Ant protection methods exercised

It has been observed that beekeepers use one or combination of methods to combat ant from attacking their bee colonies. Applying ash under the hive stands is considered as reliable and dependable method of ant protection by the beekeepers, when there is no rain. Similarly it has been observed that the beekeepers clean the underneath of the hives & keep their apiary neat as a means of ant protection. The beekeepers & the experienced local beekeeping experts also disclosed that like leaves of eucalyptus & aje (local naming) are traditionally applied as ant deterrents when it appears. Wrapping the hive stands with polytine bag, hunting and killing ant queens are also among the methods exercised by the beekeepers to protect their bee colonies from ant attack. However, it was observed that few beekeepers have developed knowledge of smearing used engine oils on the hive stands as a means of ant protection.

Causes of bee colony abscond

The beekeepers disclosed that the main reason for absconding of bee colonies in the study areas was due to ant. According to 98.3% of the respondents, ants harassed almost all, which eventually resulted into either absconding or to death (Table 1).

Regardless of the variation in altitude among the study areas, the study revealed that there was a distinct periods at which the ant set attack on honeybees. September to December was found to be common period in all the surveyed places where ants exerted attack on honeybee colonies and their products (Fig 4).

Table1. Percentage of respondents to ant attack on honeybee colonies

No	District	Total number of respondents (N)	Number responded (N)	% respondents	Total bee colonies owned by the	Number of bee colonies attacked	% colonies attacked
1	Ameya	23	21	91.3	547	157	29
2	Tikur Inchini	24	24	100	134	22	16
3	Ambo	25	25	100	179	95	53
4	Dano	25	25	100	270	208	77
5	Adeaberga	26	26	100	414	161	39
6	Cheliya	26	25	96.2	298	185	62
7	Welmera	25	25	100	155	56	36
Total		N=174	N=171	98.3	1997	884	44

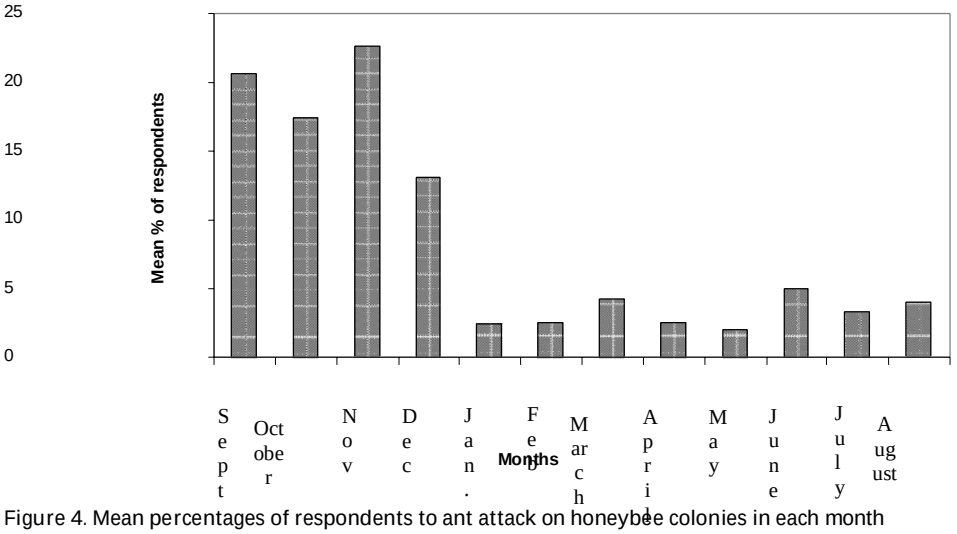

Figure 4. Mean percentages of respondents to ant attack on honeybee colonies in each month

In this study the beekeepers also revealed that other than honeybees, ants also eat different bee products. According to them, once the ant enters the bees' hive, it destroys entire colony and eats bees, honey, brood, beeswax, and pollen. Bees are the first & the most victim of the attack followed by the honey. Although pollen is observed to be taken by the ants, it could be after all the honey & the broods are depleted (Fig 5). Usually after massive attack, pile of crumbled bees & ants can be observed in and beneath the hive

entrance of the victim colony with large number of ants marching into the center of the hive.

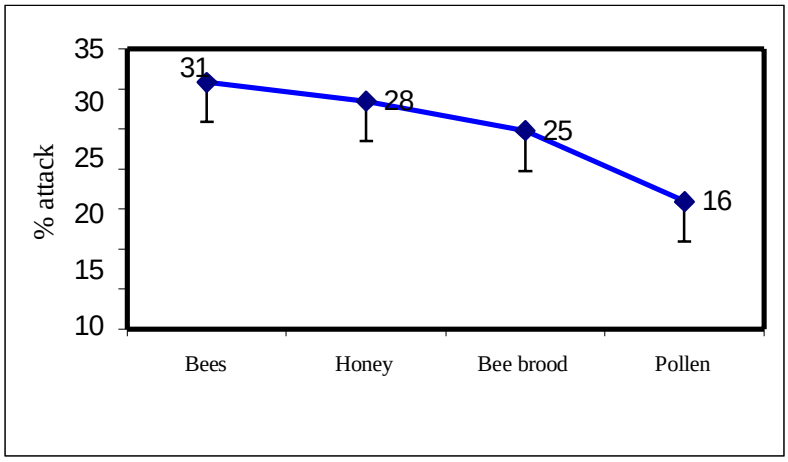

Figure 5. Percentage of bee products type attacked by ant according to the reply from the respondents

Bee colonies and their products losses

From the total 1997 bee colonies owned by the surveyed beekeepers, 884 of them were attacked of which 477 bee colonies absconded, 90 died and 317 remained in the hive after the attack. Extrapolating this result to the Zonal level, from the total of 104383 hived bee colonies in the Zone, 46137 (44.2%) of them were known to be attacked by ants every year, of which 4706 (10.2%) die and 24776 (53.7%) are forced to leave their hive. This results in 29% of the total honey yield lose in the Zone. However, of the total attacked bee colonies, 16,655 (36.1%) remained in their hives either by withstanding the fighting or assisted by the beekeepers. Irrespective of the respondent percentage to ants harassment (Table 1), the actual recorded percentage of bee colonies absconded and died, calculated from the average colony attacked is smaller for Welmera and Chelia, and higher for Tikur Inchini, Amaya and Adea Berga districts (Fig. 6 & Table 2).

Computing the economic loss encountered at rate of 50 and 10 birr (the average price obtained during the survey time) for a bee colony and a kg of honey respectively (Table 3), the total money amounting 65559.2 birr in the survey districts and 3839810 birr in the Zone is being lost annually due to ant attack on honeybee colonies.

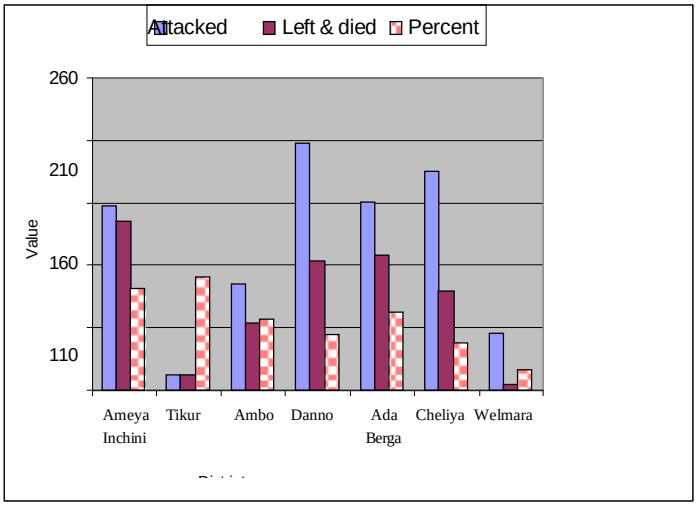

Figure 6. Number of bee colonies left and died & their percentage against the total number of bee colonies attacked.

Comparing the monetary losses in terms of different products, the losses through bee product (honey and beeswax) overweighs the losses produced through the bee colonies themselves (Fig. 7). About 51% & 13% of the losses were recorded through honey & beeswax loses, respectively, which totals to 64%. However, only 36% is lost through death of honeybee colonies.

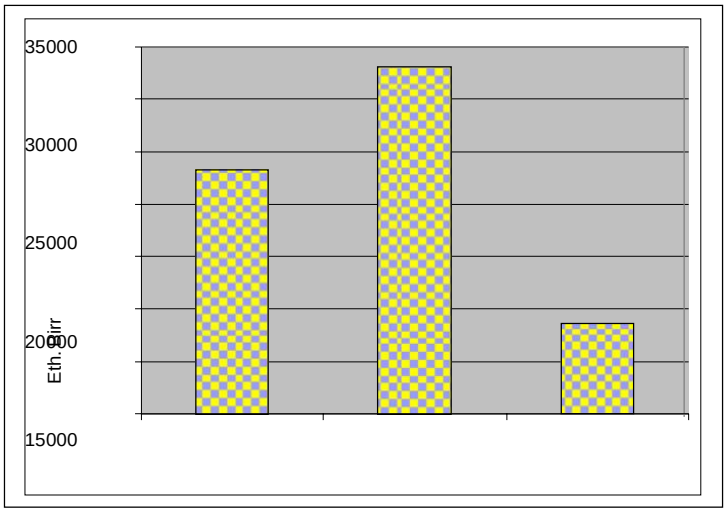

Figure 7. Magnitude of monetary losses in terms of bees & bees' products

Table 2. Status of bee colonies and percentage colonies left and died, across the districts & respondents in 2001 &2002

No	District	N	Bee colony owned by the respondents	Average honey yield per Colony (kg)	Total honey yield (kg)	Average bee colonies attacked A	Average bee colonies absconded B	Average bee colonies died C	Sum of bee colonies absconded & died D (B+C)	Percent bee colonies left & died from the total attacked E(D/A)*100
1	Ameya	23	547	3.00	1641	157	104	41	145	92
2	Tikur Inchini	24	134	8.21	1100.14	22	17	5	22	100
3	Ambo	25	179	10.52	1883.08	95	53	11	64	67
4	Danno	25	270	5.64	1522.8	208	95	19	114	55
5	Ada Berga	26	414	7.38	3055.32	161	109	9	118	73
6	Cheliya	26	298	6.73	2005.54	185	86	3	89	48
7	Welmara	25	155	3.56	551.8	56	13	2	15	27
Total/average		174	1997	45/7=6	11759.68	884	477	90	567	64

Table -3 Losses produced due to ant attack through bee colonies, honey and beeswax across each districts

	Districts	Number of bee colony left & died (A)	Average price of one bee colony (B) (Birr)	Loss due to bee colony left & died (Birr) C=AxB	Average honey yield per Colony (kg) (D)	Total honey yield lost (kg) E=AxD	Average price of one kg honey (F)	Loss through honey from bee colonies left & died (Birr) G=ExF	Loss through beeswax from bee colonies left & died (kg) H=Ex0.1	Average price 25 per kg I=Hx25	Loss through bee colonies, honey & beeswax J=C+G+I
1	Ameya	145	35	4350	3.00	435	8.5	3697.5	43.5	1087.5	9135
2	Tikur Inchini	22	37	814	8.21	181	7.5	1354.65	18.1	452.5	2621.15
3	Ambo	64	42	2688	10.52	673	10	6732.8	67.3	1682.5	11103.3
4	Danno	114	32	3648	5.64	643	8	5143.68	64.3	1607.5	10999.18
5	Ada Berga	118	47	5546	7.38	871	10	8708.4	87.1	2177.5	16431.9
6	Cheliya	89	52	4628	6.73	599	11	6588.67	59.9	1497.5	12714.17
7	Welmara	15	108	1620	3.56	53.4	15	801	5.34	133.5	2554.5
Total /average		567	353/7=50	23294	45/7=6	3455.4	70/7=10	33026.7	345.54	8638.5	65559.2

Discussion

Beekeeping in Ethiopia is very common and is one of the traditional agricultural activities. Besides its cash income & apitherapeutic role, honey and beeswax plays an important role in the cultural and religious life of the people. In addition to its contribution to the national and rural economy, beekeeping is very significant in the food production chain through pollination of fruits, vegetations and cultivated crops.

Many pests are known to affect the life and products of honeybees under local condition of which ant is the most known. Ants harbor in fertile soils beneath tree trunks, small hill soil places and, group and column perdition, periodic nomadism, and constructing soil particle along the column are also an attributes of this ant (*Dorylus fulvus*) (Gotwald (1976). The colour of this ant ranges from brown to black which is by nature high absorbent of radiant energy. Therefore, constructing soil cover along its road (column) & sheltering in hidden places are probably evolutionary adapted mechanisms of the ants to avoid direct heat from sun light.

Ant is one of the economically important pests that cause substantial losses to the beekeepers income through losses of bee colonies and their products (Smith, 1953, Morse and Hooper, 1985, Crane, 1990, and Amsalu *et al*. 1999,
Desalegn, 2001, Desalegn *et al*. 2001 & 2005, Nicola, 1988). But to what extent or degree was the question unanswered by those authors. This study additionally determined figuratively that about 29% of the total honey yield losses occurred through bee colonies abscond and death, which accounts for about 51% of the total loss due to ant attack per year in the study areas. However, loss through beeswax from bee colonies left & died & the value of the left & died bee colonies accounted to 13% & 36% of the total loss, respectively. As a result, beekeepers in the Zone losses substantial amount of money through the losses of bee colonies and their products. This is without taking in to account the bees' indirect benefit from pollination services to the cultivated crops and natural vegetation.

The percentage of bee colonies absconded and died from the actual colonies attacked varied among the surveyed districts and is small for Welmara and Cheliya while, it is very much serious for Tikur Inchini followed by Amaya and Adea Berga districts. This is probably due to provision of training and extension services by the Holota Bee Research Centre in Welmara and

Cheliya districts. In these districts Holota Bee Research Centre has demonstrated improved methods and beekeeping technologies and hence, backyard beekeeping is largely exercised to implement different ant protection methods designed at the centre.

The variation among the survey districts in terms of losses through bee colonies, honey & beeswax can be attributed to differences in total number of bee colonies absconded, died, colony productivity, price of bee colonies and price of honey among the districts. The number of colonies kept constant for all districts, the eventual loss due to ant attack on honeybee colonies and their products is so much serious in those districts having better access to road and better market. This is because in these districts, the price of bee colonies and honey is very high compared to the remote districts where the items are less priced. For instance, an impact of 15 bee colonies loss in Welmera district has produced 1620 birr loss, while absconding of 22 bee colonies in Tikur Inchini has brought about only 814 birr loss. Like wise, the loss through honey from bee colonies left & died at Ambo district having less bee colony number (N=64) with high productivity, exceeds Danno district that has high number of bee colonies (N=114) but less productive.

Despite the altitude variation and severity of attack among the study areas, the major period during which the ant attack was common to all districts is between September and December. This time is after the end of heavy rainy season (June-August), at which many grasses and vegetations are in growth and blooming by covering the land surface. This time relative moisture condition coupled with existences of different plant species flower seems to support the life & reproduction of many insect species including honeybee. This period seems an evolutionarily matched season of life to complement the prey and predators. These months are also the time at which the bees rear brood and make honey using the timely existing resources mainly pollen and nectar of different plants. It is also observed that ant appear attracted to the bee's nest through the attraction of the bee brood and the collected nectar in the hive.

Almost all beekeepers in the West Shewa Zone keep bees to generate income through honey sales and for household honey consumption. The results of the present study could well be by the majority of the areas that are from mid to high altitude.

Conclusion

It is recognized that the country has great potential in beekeeping. However, the sector is challenged by heavy loss that occur every year due to effect of ant on honeybee colonies. If the benefit from the sector is to be materialized, the beekeepers and the government should be conscious enough to protect bee colonies from various naturally existing honeybee pests like ants. Thus, improved ant protection methods designed & developed by Holota Bee Research Centre should be scaled-up to mitigate the problem & increase the production & productivity of honeybees in such a way that it benefits the beekeepers & the nation at large.

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