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Identifying and Evaluating the Effect of Poisonous Plants on Honeybee Colonies in East Amhara, Ethiopia

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Abstract*— The study was conducted to identify and evaluate the effect of poisonous plants on honeybee colonies in Eastern Amhara. Two beekeeping potential zones, South Wollo and Waghimra, were selected purposively. Using a multistage sampling technique, a total of six districts and 18 local kebeles were addressed in this survey. A total of 225 sample beekeepers were selected purposively based on their experience in beekeeping, and data was collected through interviews. The result indicated that about 15.6% of the respondents had awareness about the existence of honeybee poisonous plants in their locality. According to the present finding, a total of 11 plant species were identified as poisonous plants. These include Helianthus anus, Agave spps, Aloea spps, Parthenium hysterophorus, Euphorbia tirucalli, Ranunculus mustifidus, Euphorbia spps, Guizotia scarab, Acacia saligna, Lanthana camara, and Nicotiana glauca. The effect of the poisonous plants might be either direct physical damage to honeybees or causing internal abnormality, which can lead to death. Some plants were repellent and honeybee killers, while others weakened and were responsible for the dwindling of colonies during their flowering period. The other plant species were reported to cause (vomiting, allergic reactions, headaches, diarrhea, and bad taste) to the consumers by irritating consumers' throats. The identified poisonous plant species were located abundantly in the (home garden, fence, and watershed) areas of the study area where apiaries existed. Though these plants had no value to the honeybee, beekeepers did not try to remove the plants from the area where honeybee colonies are available. Moreover, by this survey, the identified poisonous plants may or may not be poisonous plants unless checked by critical investigation of chemical analysis or by feeding of honeybees. Hence, it could be recommended that a detailed chemical analysis of these identified plants should be conducted to devise and implement appropriate control and prevention measures.

Keywords*— Beekeepers, Eastern Amhara, Honeybees, Poisonous plant

I. INTRODUCTION

Honeybees are well known for their commercial products, playing increasing roles in income generation, healthy food, and medicinal values [1]. However, the recent reduction of the bee population arises from different angles and has become a great concern for global food security and environmental stability. It is multistage factors that lead to the decline of the bee population worldwide. An outbreak of pathogens and pests, exposure to pesticides, shortage of forage, and global climate change are the known factors commonly responsible for the loss and death of honeybee colonies [2; 3; 4; 5]. Exposure to poisoning substances from natural and chemical sources is considered a prime cause of honeybee deaths and colony reduction. It is difficult to differentiate between plant and pesticide poisoning; some reports describe that honeybee death follows visits to some plant species [6]. This can be supposed to be the biochemical effects of some active ingredients in their pollens and nectars that may be toxic to bees and other humans and animals.

Accordingly, recommended plant species such as Aesculus californica, Clematis hirsuta, Clematis simensis, Croton macrostachyus, Datura stramonium, Euphorbia abyssinica, and Justicia schimperiana were reported as poisonous plants [1; 5; 7; 8]. Honeybees occasionally encounter sources of such toxic nectar, but the predominating nectar sources provide great dilution of any toxic nectar collected. These specific stress conditions seem to occur repeatedly in most cases of poisoning, and they affect the dose of poison the bees receive. When good nectar source plants are scarce to honey bees in the surrounding area, especially soil moisture, reducing good nectar source plants becomes necessary; the bee is forced to forage from the poisonous plants because it is the only food available. Most of those poisonous plants' symptoms are limited to the blooming period. If the poison is in the pollen, the symptoms may stay longer as long as the pollen remains in the combs. There is no clear-cut method for differentiating between plant poisoning and pesticide poisoning. The effects

of plant poisoning are usually more gradual and last longer than the effects of pesticide poisoning. Plant poisoning usually occurs in the same geographical areas at the same time each year, whereas pesticide poisoning is indiscriminate [6].

In different countries, plants that are poisonous to honeybees and man are identified, and important cautions are exercised. In our country, there are many oral reports about plants that are poisonous to honeybees and also honey that is poisonous to man. Therefore, poisonous plants those have economic importance to honeybees in the Wag-himra and south Wollo zones of the Amhara Region should be investigated and studied to take the right cautions. With these backgrounds, the objectives of this study were to identify and prioritize important honeybee poisonous plants, determine the distribution, and generate baseline information in minimizing these poisonous plants.

II. Materials And Methods

A survey questionnaire was prepared to comprise mainly of the types of poisonous plants. In the present survey, two beekeeping potential zones of Eastern Amhara (South Wollo and Waghimra) were selected and addressed in data collection. From each zone, three districts, and from each district, three rural kebeles were selected through a multistage sampling approach. Thus, a single household respondent is used as a sampling unit, and the total households included in this study were determined according to the formula given by [9].With a 95% confidence level. The respondents were selected based on their experience in beekeeping, knowledge of locally available honeybee forages, and honeybee colony ownership. Hence, a total of 225 respondent beekeepers were selected from the total beekeepers.

$$n = {}^{N}/_{1} + N(e)2 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots.. (1)$$

Note: n = sample size; N = population size; e = the desired level of precision.

A. Data Analysis

The social data was analyzed using descriptive statistics (percentage, frequency, mean, and standard deviation) with SPSS Version-23. The result was presented in table form.

III. Results And Discussion

In the present study, the concept of poisonous plants for honeybees from the beekeepers minds and experience is mentioned accordingly. Hence, 15.6% of respondents reported the presence of poisonous plants, and 84.4% of the interviewed beekeepers said there were no poisonous plants in their locality. According to the interviewed beekeepers, the existence of poison for honeybees and/or honey resulted from the nectar and pollen of the source plant. In other ways, some plants reported as poisoned may cause damage to honeybees. Moreover, in the study area, as beekeepers argue, some plant species can cause honeybee colonies to lose their colonies due to their poisonous nature in their pollen and nectar.

TABLE I. Plants Known For Their Poisoning Effect, Their Flowering Month, Effects And Symptoms To Bees And Humans

No	**Local Name**	**Scientific Name**	**Family Name**	**Flowering Season**	**Plant type**	**Effects on**	**Symptoms and causes**
1.	Bahir suf	HelianthusHelianthus anus	Asteraceae	Oct-Nov	Cultivated crop	Bees	Produce a tar which bees get stuck
2.	Chiret	Agave spps	Agavaceae	Dec-Apr	Shrub	Bees	Produce a tar in which bees get stuck and exposed to bird attack
3.	Eret	Aloea spps	Aloeaceae	Sept-Nov	Shrub	Human	Irritating the throat
4.	Kinche	Parthenium hysterophorus		Year-round	Herb	Human	Irritating the throat
5.	Kinchib	Euphorbia tirucalli	Euphorbiaceae	Nov	Shrub	Human	Irritating the throat
6.	Kuliza	Ranunculus mustifidus	Ranunculus mustifidus	Sept-Oct	Shrub	Human	Irritating the throat
7.	Kulkual	Euphorbia spps	Euphorbiaceae	May-June	Shrub	Human	Irritating the throat
8.	Mech	Guizotia scaraba	Poaceae	Sept-Nov	Herb	Human	Bitter taste
9.	Saligna	Acacia saligna	Fabaceae	Oct-Nov	Tree	Bees	Weakened colonies
10.	Yewof Kollo	Lanthana camara	Verbenaceae	Year-round	Shrub	Bees	Repellent
11.	Tobbacco	Nicotiana glauca	Nicotiana glauca	Year-round	shrub	Bees	Repellent and bee killer

According to the respondents, a total of 11 poisonous plant species were identified during the survey (Table 1; Figure 1). Hence, Helianthus annuus and Agave spps were produced, after which the honeybees got stuck and damaged and sometimes exposed the foragers to birds attacks. Lantana camara and Nicotiana glauca plant species were repellent and honeybee killers, while Acacia saligna plants weakened and were responsible for the dwindling of the colonies during their flowering period. The other plant species like Euphorbia spp., Parthenium hysterophorus, Euphorbia tirucalli, Aloe berhana, and Ranunculus mustifidus were reported to cause vomiting, allergic reactions, headaches, diarrhea, and bad taste to the consumers by irritating consumers' throats while consuming the honey from these sources.

Some of the identified poisonous plants in the present study were reported in different parts of the country by different authors. [10]. reported Cassia slamea, Croton macrostyches, Aloea brahana, Ziziphus macronata, Phytolacica dodecandra, and Suspania spps as plants toxic to honeybees in the Amaro and Enebse districts. [11]. also reported the existence of toxic plants like Helliantus anus, Verbena officinalis, and Euphorbia tirucalli in the Sekota district. [12]. also reported that Crton macrostachy, Hellianthus annus, Ephorbia spps, Simiza, Justitia schemperina, and Acacia decurrens were the major

honeybee flora known by their poisonous effect in western Amhara region.

In the present investigation, the effect of poisonous plants was on both live bees and the honey that they produced, and finally it could be poisonous for humans. In this regard, honeybees are poisoned from the pollen and the nectar of the plant and/or direct physical damage during flower visitation and/or cause paralysis, abnormality, and even death. According to this, 44% of the respondents said that the symptom of the poisonous plant was sticking their wings and legs of honeybees, while 16% of the interview beekeepers said the poisonous plant could have caused a diarrhea (Table 2). Moreover, this study showed that knowledge of beekeepers about the effect of poisonous plants on honeybees was limited unless a designed poisonous plant validation experiment was done.

TABLE II. SYMPTOMS OF THE POISONOUS PLANT SHOWN IN HONEY BEES AND HUMANS

Symptom	Frequency	(%)
Paralysis	9	4
Diarrhea	36	16
Vomiting	9	4
Irritating	20	9
Allergic	20	9
Headache	9	4
Sticky	99	44
Bad taste of honey	23	10

Even if the main source of pollen and nectar for honeybees is from the flower part of the plants, honeybees may come into contact with the leaf, bark, and latex of the flowering plants. During this, the poisonous part of the plant might be damaged and/or dead. In this regard, 58% of the respondents believe that mostly the poisonous part of the plants was their flower, and the bees were forced to exploit the nectar and pollen from those poisonous plants during the dearth period when the best honeybee plants were absent in the locality. According to the beekeepers, the location of these poisonous plants was mostly in and around home gardens, fences, and watershed areas of the study area, and therefore honeybee colonies are preseted nearby these plants and highly exposed to damage (Table 3)

TABLE III. LOCATION OF THE POISONOUS PLANTS RESTRICTED

Location	Frequency	(%)
Home garden	31	70
Farmland	5.8	13
Fence	32.2	72
Watershed area	27	61
Other	4	9

Concerning the measures those beekeepers took to control honeybees from the damage caused by these poisonous plants, most (91.1%) of the beekeepers said they did not take any measures on it (Table 4). Because they said these identified plants had advantages as fences, water and soil conservation purposes, and some of them are used for animal feed and fuel. In this regard they did not try to remove on their locality near to their backyard apiary.

TABLE IV. MEASURES TAKEN TO PREVENT COLONIES FROM GETTING POISONOUS PLANTS

Measures	Frequency	Percent
Burning	8	3.6
Weeding	11	4.9
Placing the hive far from the poisonous plant	1	0.4
No measure taken	205	91.1

IV. CONCLUSION AND RECOMMENDATION

The survey results indicated that most of the respondents did not know about the presence of poisonous plants; rather, few experienced beekeepers had awareness about these plants. The poisonous plant might have either direct physical damage to honeybees or cause internal abnormality, which can lead to death. Some plants were repellent and honeybee killers, while others weakened and were responsible for the dwindling of the colonies during their flowering period. The other plant species were reported to cause vomiting, allergic reactions, headaches, diarrhea, and bad taste to the consumers by irritating consumers' throats. The identified poisonous plant species were located abundantly in the home garden, fence, and watershed areas of the study area where apiaries existed. Due to additional advantages of the plant species, beekeepers did not try to remove the plants from the area where honeybee colonies are available. Moreover, by this survey, the identified poisonous plants may or may not be poisonous plants unless checked by critical investigation of chemical analysis or by feeding of honeybees. Hence, it could be recommended that a detailed chemical analysis of these identified plants should be conducted to devise and implement appropriate control and prevention measures.

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