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Full Length Research Paper

Pre-scaling of Honeybee Colony Multiplication Technology Package in Oromia Region, Ethiopia.

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Pre scaling of colony multiplication technology package conducted in Ejere and Wolmera Woredas, Oromia region, Ethiopia with the main objective of disseminate colony multiplication technology package. As to the method, these Woredas selected purposively based on the purpose of shortage of honeybee colony for expansion of beekeeping activities and colony multiplication as additional source of income. Farmers research and extension groups (FREG) were used for technology dissemination. One FREG which contain 15-23 beekeepers established at each pre-scaling up site and there is one site in each selected Village Administration. Accordingly, one site at Ejere and three sites at Wolmera selected. A total of four FREGs established and 74beekeepers participated in pre scaling up process. Common site of FREG members beekeepers used as center of learning and technology dissemination. At each sites, farmers, development agents and experts trained. Colony multiplication activities undertaken in partnership with FREG members, development agents and experts. As to the result, on average of 14 mother honeybee colonies splitted and 47 nuclei colonies formed at each season at pre scaling up sites. This means, on average of 3.5 nuclei honeybee colonies per hive can be multiplied from single box hive. Out of 47 nuclei colonies formed 40 colonies transferred to standard 10 frame hive and success rate is 85.1%. In conclusion, colony multiplication can be a good source of additional colony for expansion and source of income. Therefore, stakeholders should work in building the capacity of the beekeeper to effectively apply colony multiplication technology package.

Keywords: Honeybee, Queen, Colony multiplication, nuclei colony.

INTRODUCTION

BACKGROUND AND JUSTIFICATION

The queen honey bee is fundamental to a colony's survival and function. She is the only member of the hive capable of producing more female offspring to keep the colony going. The chemical pheromones produced by a queen bee impart a unique identity to each colony and its members. The presence of these pheromones also keeps the colony cohesive and orderly. A queen is the repository of a colony's heritable genetic traits. These genetics influence many aspects of colony behaviors, such as their defensiveness, parasite tolerance and disease resistance, rate of population growth, and the efficiency of winter food consumption. Honeybee colony rear queen naturally to replace a lost queen, replace the queen when swarming or to supersede a failing queen, beekeepers manipulate a colony to duplicate one or more of these natural circumstances (Johnstone, 2008). Bee colonies raise queens naturally. Inducing a colony to rear queens merely encourages this natural phenomenon, subject to the beekeeper's conditions and schedule (Buchler et.al, 2012).

Queen rearing is done to allow beekeepers to stock their own hives when queens die or need replacing, to save money by raising their own queens and surplus queens can be sold to others in the area who need them, bringing extra income to the beekeeper. By selectively raising their own queens, beekeepers can take control of the characteristics they desire in their own bee stocks and

once the basic elements of the queen-rearing process are under stood, practically any beekeeper can raise surplus queens (Buchler et.al, 2012).

The contributions of beekeeping in poverty reduction, sustainable development and conservation of natural resources have been well recognized and emphasized by the government of Ethiopia and non-governmental organizations (NGOs). Their effort to maximize this constribution challenged by limited access of bee colonies for beginners in association with absconding and high prices of colonies. The population of domestic colonies has declined from 5.15 million in 2009 (CAS, 2009) to 4.99 million in 2011 (CAS, 2012). Some of the reasons for the decline in the population of honeybee colonies in Ethiopia include absconding and reduction of swarming due to introduction of movable frame hives (Yigzaw et al, 2010).

Colony multiplication and marketing using swarming colonies is an important source of income for sellers and source of bee colony for purchasers in the Northern part of Ethiopia (Nuru, 2008, Teweldemedhn and Yayneshet, 2014). Colony marketing is a common practice in Tigray. This is an important source of income for many sellers, both traders and producers, and an important source of colony for beekeepers; for startup, expansion and replacement. In other parts of the country, colony trapping using bait hives has remained as the main source of colony (Tesfaye and Tesfaye, 2007; Solomon, 2009).

Different techniques of queen rearing have been developed. But all methods are based on the fact that nurse bees can turn young female larvae into queen by feeding royal jelly (David, 2008). Splitting method is recommended to be suitable for Ethiopia (Nuru and Dereje, 1999). Therefore the main intention of this activity is to pre- scale up honey bee colony multiplication technology package in Ejere and Wolmera Woredas and to build beekeepers capacity in applying beekeeping technologie

Objectives

- To pre-scale up colony multiplication technology package in the Ejere and Wolmera Woredas
- To build local capacity in applying colony multiplication technology package
- To reduce the prevailing shortage of bee colonies

MATERIALS AND METHODS

Description of the Study Areas and Period

The research was conducted in West Shoa Zone namely Ejere Woreda and Oromia Special Zone Surrounding Finfinne(OSZSF), Wolmera Woreda from 2014 to 2017. Detail description of the study areas presented as follow.

Ejere Woreda

Ejere Woreda is one of the Woredas in Western Shoa Zone of Oromia regional state. It is about 44km West of Addis Ababa. The Woreda is located at 38^{o}-22'E longitude and 9^{o}-2'N latitude (OBoFED, 2014). The Woreda is bordered on the South by the Southwest Shewa Zone, on the West by Dendi, on the Northwest by Jeldu, on the North by Meta Robi, on the Northeast by Adda Berga, and on the East by Walmara (OBoFED, 2014). Altitude ranges from 2060-3085 meter a.s.l. The climate condition of the area is 45% highland and 55% mid altitude (OBoFED, 2014). A total population for this Woreda is 86,934, of whom 44,222 were men and 42,712 were women; 10,071 or 11.59% of its population were urban dwellers (OBoFED, 2014).

The area receives an average annual rainfall of 1075mm, more than 80% of which falls between May and September (wet season). The average annual temperature ranges between 26^{o}c-27^{o}c, with a mean of 26.5^{o}c(OBoFED,2014). The prevailing farming system in the area is mixed farming system. The total cattle population in the area is 93152(Ejere Woreda animal production and health office, 2014).

Wolmera Woreda

Wolmera Woreda is one of the Woredas in Oromia Special Zone Surrounding Finfinne, Oromia region. Wolmera Woreda is about 30 km away in West of Addis Ababa along the Ambo rode at 9^{0}02N and 38^{0}34E. Altitude ranges from 2000-3380 m.a.s.l. (Bureau of Agriculture [BoA], 2013). The Woreda is bounded in the North by Sululta Woreda, in the South by Sebeta Awas Woreda, in the West by Burayu city administration and in the East by Ejere Woreda

The Woreda is classified in to two agro climatic zones namely Dega 61%, Woynadega 39 % (BoA, 2013). The area is characterized by mean annual rainfall of 1067mm and mean temperature of 18 ^{0} c. The main rain season is from the months of June to September which accounts for 70% rainfall while the remained 30% is from February to April (BoA, 2013). The Woreda has a total population of 146,227 of which 72,301(49.4%) are males and 73,926(50.6%) are females. In term of area residence 100,857(68%) population has been living in the rural areas while 45,370(31%) has been living in the urban centers (BoA, 2013).

Crop- livestock mixed farming system characterizes agriculture in the Woreda. The major crops in the farming system are wheat, teff, barley, and faba bean. In the Woreda, about 3,566 hives exist out of which about 1853 was traditional, 870 transitional and 843 box hives (BoA, 2013).

Study Design

To pre-scale up and disseminate colony multiplication technology package in both Woerdas, four pre-scaling up sites (one at Ejere and three at Wolmera Woreda) which is communal land of FREG members used as center of learning, mother honey bee colonies (Apis mellifera bandansii) used for splitting and honeybee colony multiplication purpose and Farmers Research Extension Group (FREG) participated.

Farmer Selection and Sampling Technique

For this study, Ejere and Wolmera Woredas were selected purposively for pre-scaling up of colony multiplication technology package based on the assumption of shortage of honeybee colony for expansion of beekeeping activities and colony multiplication as additional source of income. At the beginning of the implementation, memorandum of understanding was signed with respective livestock office and awareness creation workshop was made to introduce the objective of the activity and expected out puts. Four pre-scaling up sites selected purposively based on convenience of the sites to disseminate the technology package. 15-23 beekeepers were selected purposively as members of FREG and one FREG established at each pre-scaling up sites. A total of four FREG, established for pre-scaling activity.

Technology Transfer Approaches and Methods

FREGs were used for technology dissemination. At each pre scaling up sites, one FREG which contain 15-23 beekeepers established. All activities in the technology dissemination process were undertaken with these FREG members. As to the method, practical training was given twice in the first and second years of the research period on selection of mother colonies, techniques of colony strengthening, rearrangement of mother colony, splitting, harvesting queen pupae, nuclei colony formation, nuclei colony management and protection of pest and predators. After training, mother colonies selected based on selection criteria like good brood pattern, high honey production and pest rest resistance of the mother colonies. Selected colonies strengthened through two-three round intensive feeding of sugar syrup. Strengthened colonies, rearranged, queen excluder inserted, splitted in to two, queen pupae harvested, nuclei colonies formed and nuclei colony management activities undertaken with FREG members seasonally.

Method of Data Collection

Primary data on numbers of sites and farmers selected; FREGs established; farmers, development agents and experts trained; nuclei hives constructed; mother colonies feed rearranged and splitted; queen pupae prepared, hatched and harvested; nuclei colonies formed and managed and number of stakeholders involved collected and documented using data collection sheet, personal observation of sites and group discussion. Secondary data also collected from respective Woreda livestock office, literatures, research reports and internet search.

Method of Data Analysis

Quantitative data collected from pre-scaling up colonies analyzed using descriptive statics such as percentage, mean and tables. SPSS computer software was also used to compute raw data. On the other hand, qualitative data was analyzed through explanation of idea, opinion and concept explanation method.

RESULT AND DISCUSSION

Capacity Building

Capacity of the beekeepers, DAs and local experts to apply honeybee colony multiplication technology package built through two rounds theoretical and practical training conducted on station at Holeta bee research center and respective Woreda. Training given mainly focused on improved beekeeping management practices, strengthening colony, rearranging resources in the hive, queen excluder insertion, splitting mother colony in to two, queen pupae harvesting, nuclei colonies formation and nuclei colony management. Besides the training, FREG members, DAs and experts were participated on regular honeybee follow up activities seasonally during the activity period. As shown on table 1 below, capacity of 74 beekeepers, 6 DAs and 3 experts built basically on practical demonstration of the technology package. In addition, technical staff of Holeta Bee Researcher Center, researchers and technical assistants and field assistants took part in pre-scaling up of the activity on selection of mother colonies, colony strengthening, and rearrangement of mother colony, splitting, harvesting queen pupae, nuclei colony formation, and nuclei colony management at pre-scaling up sites during research life span.

Technology Dissemination

Colony strengthening

Honeybee colony multiplication requires strong mother colony to prepare queen cells after splitting. To make this happen, the mother colony should be strengthened through intensive feeding of the colony during dry season of the year. Accordingly, all colonies at pre scaling up sites strengthened through feeding of sugar syrup at least twice per year. Failure in strengthening the colony might result in no response after splitting. Number of mother colonies strengthened at each pre scaling up sites shown below (table 2).

Colony splitting

After all mother colonies strengthened, colonies to be splitted selected with FREG members mainly based on brood pattern, high honey production and pest rest resistance of the mother colonies. Before splitting, resource in the hive divided on brood and honey chamber equally and queen excluder inserted one day in advance. After queen excluder inserted, selected mother colonies with queen excluder splitted in to two on the second day. Splitted colony with queen transported to backyard of willing beekeepers at least 500 meter and queen less colony kept in its original place to avoid unit. On average, 14 mother colonies splitted at all pre scaling up sites (table 2).

Queen pupae prepared and nuclei colonies harvested

Queen less colony prepared queen pupae and hatched after 9 days of splitting. Hatched pupae harvested, fixed on frames and nuclei colonies formed with 3-5 frames. The number of nuclei colonies formed per queen less colony was higher at Sadamo site, which were 4 on average. The probable reason for this response is that strength and resource in the hive of mother colonies was better at this site (table 2).

Figure 1 a, beekeepers training b, harvesting queen pupae c & d nuclei colony formation

Role of Colony Multiplication in Reducing Shortage of Bee Colonies

Managing nuclei colonies formed to with stand dearth period and protection from pests and predators has great impact on significance of colony multiplication. Nuclei colonies formed may abscond or dwindle due to pest attack or starvation. Success rate in managing and transferring nuclei colonies formed to standard/ 10 frame hive is higher 92.31 % at Goleliban than the other sites. FREG members gained on average of 12, 13, 7 and 8 additional colonies yearly at Goleliban, Sadamo, Sororo and Wajitu as a result of colony multiplication. When converted to monetary value, they gained ETB 9600 (on average of 800 birr/colony), 10400, 5600 and 6400 as additional source of income from sell of multiplied colonies at Goleliben, Sadamo, Sororo, and Wajitu sites, respectively (1USD=27.72ETB in 08/12/2017).

Table 1: Number of beekeepers, Development Agents, Experts participated on training and pre scaling up

No	Sites	Farmers	DAs	Experts
1	Goleliban	19	2	3
2	Sadamo	15	1	
3	Soro	15	2	
4	Wajitu	25	1	
Total		74	6	3

Table 2: Colony multiplication activities data at pre scaling up sites

No	Sites	Colony strengthened	Colony splitted	Queen pupae prepared	Nuclei colonies formed	Nuclei colonies transferred to standard hive	Success rate in %
1	Goleliban	23	4	19	13	12	92.31
2	Sadamo	19	4	23	16	13	81.25
3	Sororo	13	3	23	8	7	87.5
4	Wajitu	6	3	11	10	8	80
Total		61	14	76	47	40	

CONCLUSION AND RECOMMENDATIONS

In conclusion, honeybee colony multiplication can be a good source of additional colony for expansion and source of income. Therefore, stakeholders should work in building the capacity of the beekeeper to effectively apply colony multiplication technology package and livestock office of respective Woredas should give strong attention to further dissemination of technology package.

CONFLICTS OF INTERESTS

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ABBREVIATIONS

BoA: Bureau of Agriculture
CSA: Central Statistical Agency
DA: Development Agent
EAB: Ethiopian Apiculture Board
ETB: Ethiopian Birr
FREG: Farmers Research and Extension Group
HBRC: Holeta Bee Research Center
OBoFED: Oromia Bureau of Finance and Economic Development
OSZSF: Oromia Special Zone Surrounding Finfinne