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Adaptation and Characterization of Major Pollen and Nectar Source Plants in Wag-Lasta Amhara Region, Ethiopia

Agazhe Tsegaye[1*], Alemu Tsegaye[1], Addisu Bihonegn[2], Ayalew Girmay[1], Meresa Lemma[1] and Yesuf Ibrahim[1]

[1*]Sekota Dry Land Agricultural Research Center, P.O. Box 62, Sekota, Ethiopia
[2]Andassa Livestock Research Center, P.O. Box:27, Bahir Dar, Ethiopia
Corresponding author email: agazhetseagye@gmail.com

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ABSTRACT

The study was conducted to evaluate the adaptability and characterization of pollen and nectar source plants and in Wag-Lasta area at Jinqaba apiary site of Sekota dryland agricultural research center between 2016 and 2018 years. *Leucas abyssinica, Hypoestus trifolia and Plantago lanceolata were bee forage species used in this experiment. Seeds were sown and seedlings were raised in nursery beds. The seedlings were then transplanted to plots of a 2m x 2m size with 0.25m and 0.3m between plants and rows respectively for H.trifolia and P.lanceolata plant species while 1m distance between plants and rows was used for L.abyssinica plant species in a completely randomized block design with four replications. The plant species were evaluated for emergency date, survival rate, and number of flowers per plant, blooming duration and foraging intensity of honeybees. Finding from the present experiment revealed that L.abyssinica, H.trifolia, and P.laneolata plant species was emerged after 16.3, 14, and 10.8 days after sowing. Regards of days to flowering, L.abyssinica, P.lanceolata, and H.trifolia plants required about 57, 45, and 43 days to flowering. L.abyssinica plant species had long blooming duration (77.5 days) and relatively large number of flowers (2805.0). The mean number of honeybees visited in five minutes was not significantly different at ($p>0.05$) in the main flowering time of bee forages. A mean number of 5.2, 3.8, and 2.9 foragers were counted on L. abyssinica, P.lanceolata, and P.laneolata plant species. In this regard all evaluated honeybee forage species were adapted and well performed and could be an additional option of honeybee forages in the study area. More specifically due to relative long blooming duration and highest flower number, L.abyssinica species could be a first priority and recommended to promote in the study area and similar environment.*

1. INTRODUCTION

Beekeeping is one of the most important farming activities in Ethiopia since ancient times (Girma Deffar 1998). Production of honey and other products from honeybees depend on availability of floral resources (bee forage plants) and is a very important field for beekeepers (Amssalu Bezabeh *et al* 2004). Bees obtain nectar, pollen, or both from flowers, which are the mainstay of honeybee's life. Nevertheless, the bees and plants they depend on, like all renewable natural resources, are constantly under threat from lack of knowledge and appreciation of these endowments (Girma Deffar 1998).

The current scenario of the Amhara region suggested that the principal resource base for beekeeping, honeybee flora is becoming seriously degraded in the course of time. The increasing human population and the high demand for farmlands are factors to put pressures on forest lands and mountainous areas to be used for crop production and livestock grazing. Deteriorating natural resources due to ecological degradation caused by soil erosion, overgrazing and deforestation is also considered as a principal cause for the ever-declining productivity of honeybee flora. The alarmingly dwindling natural vegetation and lack of beekeepers' practice in planting bee forage plants in turn results in weakening of honeybee colonies and their production. Moreover, recurrent drought and the non-selective herbicide application are also the main factors for the reduction of bee flora availability in the region (Girma Ejigu 2005). These are some of the challenges for sustainable beekeeping development in Amhara region. At present, as the environmental changes are very rapid, beekeeping couldn't remain sustainable as it was in the past unless some efforts are made to improve bee forage availability in the region through selection and adaptability of promising bee forage plant resources which could fit to the ecology and prevailing local conditions.

Honeybee productivity can be improved through the use of good quality and adapted bee forages. Bee nutrition (which ultimately increases their population) can be improved through planting or encouraging more-or-less permanently for the development, conservation, and protection of bee forage plants with high resource yielding capacity and could easily be adapted to the biotic and abiotic environmental stress conditions (Equar Gebru *et al* 2016). Depending on the fact that differences in adaptability and agro ecology, every locality has a distinct type of bee forage plants. According to Equar Gebru *et al* (2016) report, *H.trifolia* and *L.abyssinica* species were the highly selected nectar and pollen source bee forage plants in Tigray. Abebe Jenberie *et al* (2014) explained that *G.abyssinica*, *Bidens spp*., *A.tortolis*, *B.grandiflorum*, *H.trifolia* are the most important pollen source plants in Sekota district. Therefore, the objective of this study was to evaluate the adaptation and characterization of pollen and nectar source plants in Wag-Lasta, Amhara Region.

2. MATERIALS AND METHODS

2.1. Description of the study area

This study was conducted at the Jinqaba apiary site of Sekota Dryland Agricultural Research center between 2016 and 2018 for two years. Jinqaba is geographically located at 12040 N latitude and 3900 E longitudes with an elevation of 2026 mean above sea level. The site was selected based on accessibility to transport and to conduct the study under its in-situ advantages and it is because Jinqaba is considered to be a representative of Waghimra and Lasta areas.

2.2. Experimental set up and materials

Seeds for preparation of seedlings were come from Mekelle agriculture research center. Seeds were sown and seedlings were raised in nursery beds. The seedlings were then transplanted to plots of a 2m x 2m size, with 0.25m and 0.3m between plants and rows respectively for *H.trifolia* and *P.lanceolata* plant species while 1m distance between plants and rows was used for *L.abyssinica plant species* in a completely randomized block design with four replications.

2.3. Data collection

All necessary data on emergency date; survival rate; days to flowering; blooming duration; number of flowers per plant; seed yield and foraging intensity of honeybees were recorded to the end of the experiment. At 100% flowering, number of flower heads per plant was counted randomly from five plants per plot. Honeybee foraging intensity was recorded for five minutes every hour from 6:00 AM to 6:00 PM.

Emergency date: number of days from sowing to emergency of seedlings.
Survival rate: it is calculated using a formula SR = PS*100/PP where SR stands for survival rate, ***PS:*** refers to the number of plants survived and PP explains number of plants initially planted.
Days to flowering: number of days starting from emergency to the beginning of setting flower.
Blooming duration: the number of days between beginnings of flowering to the end of flowering.
Total number of flowers per plant (FN): it is the total number of flowers counted per plant. Total number of flowers per plant was calculated using a formula FN = H.F *N.F.H where, H.F represents total number of flowers per plant, H.F stands for number of head flowers per plant, while N.F.H represents number of flowers per head. N.F.H is calculated form 10 randomly sampled head flowers per plant. Foraging intensity: it implies the number of honeybees visit the flower within five minutes. It was done in one hour interval of a day from 6:00AM to 6: 00PM.

2.4. Data analysis

Finally, the collected data were coded and tabulated in Microsoft Excel spreadsheet program. Analysis of variance (ANOVA) was used to compare the variables using SAS software version 9.1. Least significant difference (*LSD*) was also employed for mean comparisons among variables. Line graph has been used to show the foraging intensity of honeybees in hours of a day.

3. RESULT AND DISCUSSIONS

3.1. Emergency date and survival rate

The mean emergency date was significantly different ($P<0.01$) among the experimental plant species. *P.lanceolata* has emerged in short days (10.8 days) as compared to *L.abyssinica* and *H.trifolia* species (Table 1). This implies the species with short days of emergency are assumed to be good in rain deficit areas of the Waghimra and Lasta areas and/or it can also provide nectar and pollen in short period of time.

There was significant difference in survival rate between honeybee forage plants ($p<0.05$). Hence *P.lanceolata* has demonstrated best survival rate (100%) than *L.abyssinica* species (95.8%) and *H.trifolia* species (89.9%) (Table1). Hence all most all seedlings of study species were survived in the local conditions of the study area and it is interesting that selected and locally adapted honeybee forage plantation could be taken as a promising measure in honeybee flora shortage in boosting honey yield of the study area.

Number of days to flowering

Generally, the flowering period for

L.abyssinica, *H.trifolia* and *P.lanceolota* were almost from October to December which is the main honey harvesting season of the area. This provides added advantage of producing more honey it is because co-flowering plants provide collective nectar and pollen food sources for honeybees. The mean number of days to flowering and full flower was significantly different between *L.abyssinica* and others (*H.trifolia* and *P. lanceolata* species) at $p<0.01$. *L.abyssinica* plant species took relatively long time (57 days) to flowering than other compared plant species (Table 1). In this regard, *P.lanceolata* and *H.trifolia* plant species took 43 and 45 days to have a flower for honeybees forage respectively. Hence these plant species showed short days to flowering and this helps honeybees to have bloom before other plant species available.

Blooming duration

The study revealed that among the studied plant species, *L.abyssinica* showed a significant difference ($p<0.05$) in the number of days in blooming among experimental plants (77.5 days) while *H.trifolia* and *P.lanceolata* plant specied had showed about amean of 64 and 60.3 days of flowering duration respectively (Table 1). In the case of *L.abyssinica* species it was observed that blooming starts from the branches close to the stems and goes to the end of the branches. When the first bloomed flower gives seeds, the flowers at the end of the branch still have flowers and vice versa. Hence, bee forage plants taking longer blooming time are very important for honey production whereas those which have short flowering duration are used for bee colony buildup.

Flower biomass

Average number of flowers per plant for *H.trifolia*, *P.lanceolata, and L.abyssinica* honeybee forage species were recorded about 1345.2, 1826 and 2805 flowers respectively. In this regard in terms of flower number all honeybee forage species had a significant difference ($p<0.01$) and *L.abyssinica* honeybee forage species was recorded relatively the highest flower number per plant (Table 1). This is due to its growing habit and crown size of the plant. The number of flowers in a single plant depends on the plant having branches and/or its canopy diameter. Tura Bareke *et al* (2014) revealed that a plant with more branching produces more flower heads per plant and a greater number of flowers per plant.

Table 1: Performances of selected bee forages

Species	ED	SR (%)	DF	BD	FN	NBV/5min	SY (gm.)
L.abyssinica	16.3^{a}	95.8^{ab}	57.8^{a}	77.5^{a}	2805.0^{a}	5.2	93^{c}
H. trifolia	14.0^{b}	89.9^{b}	43.0^{b}	64.0^{b}	1345.2^{b}	2.9	181.5^{a}
P. lanceolata	10.8^{c}	100^{a}	45.0^{b}	60.3^{b}	1826.0^{ab}	3.8	150.5^{b}
Mean	13.7	95.2	48.6	67.28	1992.1	3.18	141.7
CV	9.71	7.6	12.8	10.8	7.3	48.8	17.1
Sign (5%)	**	*	**	*	**	NS	**

Note: ** and ** denotes significant differences at p<0.05 and 0.01 and NS denotes there is no significant differences at p>0.05. ED= Emergency data; SR=Survival rate; DF=Days to flowering; BD=Blooming duration; NBV= Number of bees visited; and SY= Seed yield.*

Foraging intensity of honeybees

The foraging time of honeybees varying from species to species based on nectar secretion time and pollen potentiality of plants. For instance the peak foraging time ranged from 12:00am – 2:00pm for *V.amygdalina*, *C.citrinus* and *C.proliferus* plant species (Tura Bareke *et al* 2014). The mean number of honeybees visited in five minutes was not significantly different at ($p>0.05$) in the main flowering time of

bee forages. However foragers were highly attracted and prefer *L. abyssinica* among the species (5.2 foragers counted in five minutes sampled time) and they stayed from 10:00am to 1:00pm in foraging (Figure1) *P.lanceolota* was highly foraged by honeybees when 7:00 am- 11:00am, while *H.trifolia* foraged when 1:00pm to 3:00pm. In the present study visiting bees were few in the early morning and late evening for all studied species. The variation among number of bee count in treatments were associated with different factors such as attractiveness of the flower, number of flower heads per plants nectar and pollen yield of plants and weather condition. This is also in agreement with Crane (1990) the intensity of bee visit is measure of potentiality of plants for nectar and pollen production.

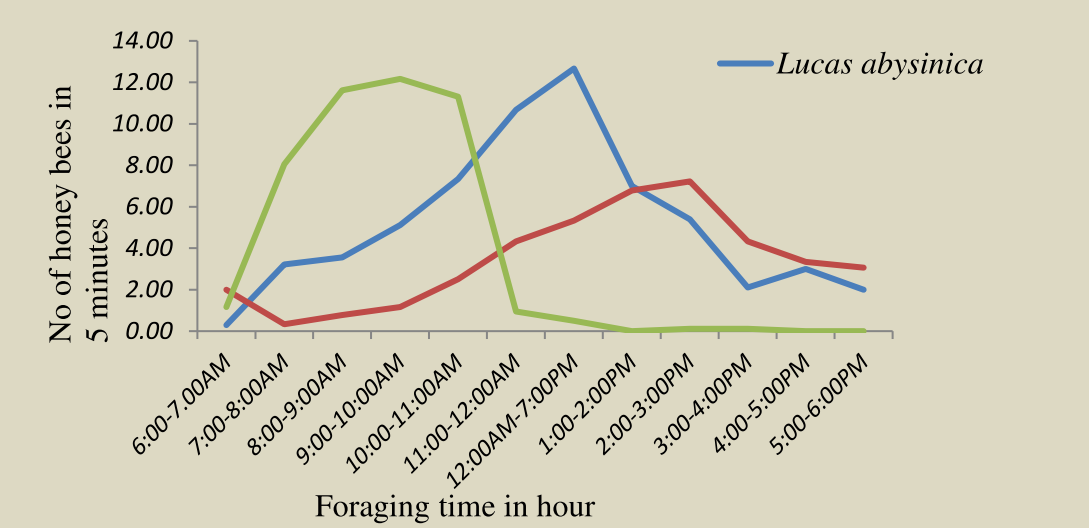

Figure 1: Foraging time and intensity of honeybees at different hours of a day

The variation in the number of bees counted foraging is associated with different factors such as attractiveness of the flower, number of flower heads per plants, nectar and pollen yield of plants and weather condition (Tura Bareke *et al* 2014). The intensity of bee visit is measure of potentiality of plants for nectar and pollen production. Generally, from beekeeping point of view, it is economical to select plant species with higher bee foraging intensity which may be associated with quality of pollen and/or nectar, availability of more flower heads, and longer flowering period to provide continuous food source for the honeybee colonies (Tura Bareke *et al* 2014).

4. CONCLUSIONS AND RECOMMENDATIONS

In conclusion, this study investigated that all plant species showed good survival rate and vegetation growth performances to the local condition of the area. Hence all most all seedlings of study species were survived in the local conditions of the study area and it is interesting that selected and locally adapted honeybee forage plantation could be taken as a promising measure in honeybee flora shortage in boosting honey yield. More over in *L.abyssinica* plant species relatively large number of flowers per plant was recorded with long flowering time. In the present study all the studied honeybee forage species were visited by foragers however the intensity and peak foraging time was different.

To enhance the current shortage of bee forage and help for increasing honey production, all evaluated, adapted and well performed bee forage species could be an additional option of honeybee forages in the study area. More specifically due to

relative long blooming duration and highest flower number, *L.abyssinica* plant species could be a first priority and recommended to promote in the study area and similar environment. Likewise further evaluation particularly on agronomic evaluation (seed rate and spacing), propagation techniques and nectar and pollen yield should be tested for all these important honeybee forages.

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