

Adaptation Trial of Improved Bee Forages in West Hararghe Zone of Oromia Region, Ethiopia

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Abstract: The study was conducted at Mechara Agriculture Research station and in Gemechis district kunisekeria FTC for two consecutive cropping seasons of, 2018 and 2019, with the objective of identifying adaptable and potential bee forages for honey production. Five herbaceous bee forages were sown in 2mX2m plot size in Randomized Complete Block Design with three replication. The bee forages were evaluated based on germination efficiency days to flower, number of flower heads/plant and intensity of honeybees on flowers. The result indicated that, there were mean difference for germination date, blooming date, flowering length, number of flower heads/plant for all study plant species. Among the study bee forage plants, both black and white buckwheat's were take short day to flower with mean value of 20 and 24 days. Similarly Sinapis alba was take a short day to flowering at Kuni sakaria FTC while Sinapis alba at Kuni sakaria FTC has the highest mean value in duration of blooming (45) days followed by white buck wheat at both site (43) days. Coriander has highest flower per head/plant (92) at both site followed by Sinapis at Kuni sakaria FTC. There was mean difference in bee visit between each plant species at all study sites. Coriander was highly visited by honey bees at Kuni sakaria FTC followed by white buckwheat at both site. In general, both black and white type of buckwheat and Coriander had high performance in lowland and highland of the zone whereas Phacelia tanacetifolia and Sinapis alba showed good performance at highland part of the study area. Therefore, further demonstration and scaling-up is needed at recommended area for the respective similar agro ecology of the West Hararghe Zone.

Keyword: Bee Forage, Date to Flowering, Duration of Blooming, Flower Perhead

1. Introduction

Beekeeping is one of the most important farming activities in Ethiopia [11].

Ethiopia is gifted with diverse and unique flowering plants of 6000 to 7000 species. Thus making it highly suitable for large number of colonies [2, 7-9]. However, the success of beekeeping primarily depends on the availability of prevalent bee forages which is based on its population density, nectar and pollen potentiality and prolonged flowering periods [3]. Availability of adequate perennial and annual sources of nectar and pollen is the most limiting factor in the survival, abundance and distribution of honeybees [10].

There are different species of plants that are identified as major source of honey and tolerant to semiarid climate of Ethiopia. This includes, *Becium grandiflorum*, which provides

white honey in northern parts of the country, *Melilotus alba*, *Fagopyrum esculentum*, are potential sources of golden honey in other parts of the world [1]. It was reported by the same authors *E. plantaginium*, *B. grandiflorum*, *M.alba* and *F. esculentum* performed were very well adapted under both rain fed and irrigation condition in mid rift valley of east shoa zone. On the other hand, reports from Sinana Agricultural Research Center revealed that *Phacelia tancetifolia*, *Sinaps alba*, *Corriandrum sativum* and black cumin are the major adaptable honeybee forages in Bale highland, being preferred by the foragers honeybees [5].

Herbaceous plants that grow as weed on cultivated field, neglected open lands, wastelands and grown as ornamentals are important source of bee forage [6] because they grow & flourish in short period of time and their seeds can be collected easily and sown for the next growing season. These herbaceous bee forages are seasonal and not available during

the dearth period. As the result currently the scarcity of bee forage is becoming serious problem in West Hararghe zone due to drought and rapid population growth. Hence the objective of this study was to evaluate and identify the best performing honeybee forages that contribute to the production of honey and other bee products in West Hararghe Zone.

2. Materials and Methods

2.1. Description of Study Area

The experiment was conducted in field at Mechara Agricultural Research Center (McARC) on station, Daro Labu and kunisekaria FTC of Gemechis Districts West Hararghe Zone of Oromia National Regional State, Eastern Ethiopia. The study site located at 8°10'00N latitude, 40°30'00 E longitude and the altitude ranges from 1300 - 2450m.a.s.l.

For this study, five annual bee forages, *Sinapis alba*, *Phacelia tanacetifolia*, black *Fagopyrum esculentum*, white *Fagopyrum esculentum* and *coriander* were collected from HBRC, SARC and evaluated for their performance at Mechara Agricultural Research Center on station t. Each bee forage species was sown on 2m*2m plot sizes with three replications in Random Completed Block deign. To keep proper spacing and avoid nutrient competition, spacing between rows, plots and blocks were 20cm, 1m and 1.5m

respectively. The necessary agronomic practices were carried out except no fertilizer application to keep its natural growing state. Then, data like germination date, bee visit frequency (intensity of honey bee), flowering date, duration of blooming and number of flower per head/plant were recorded. At 50% flowering, number of flower per heads were counted for each species by taking 1m² plot area as well as foraging intensity of honeybees on flowers was counted starting from 7:00 a.m. to 3: 00 p.m. for ten minutes at every 2-hour interval. Moreover, time from blooming to shading was also recorded.

2.2. Statistical Analysis

The collected data were statistically analyzed by descriptive statistics using Statistical Package for the Social Sciences) (SPSS) version 20.

3. Results and Discussion

In this study black and white type *Fagopyrum esculentum*, *Sinapis alba*, *Coriandrum sativum* and *Phacelia tanacetifolia* were planted in two different agro-ecological zones and mean values for the investigated parameters were indicated in Tables 1 and 2. For illustration of the performance of the bee forages, two years' data from each of the two locations is also presented in Tables 1 and 2.

Table 1. Performance of selected annual bee forages at Mechara on Station.

Plant Species	GD	DF	DB	FH
Black Fagopyrum esculentum	8.7±0.6 ^b	23.7±0.6 ^b	35.6±0.6 ^a	23.3±2 ^b
Coriandrum sativum	20.3±0.6 ^a	56±1 ^a	34±1 ^a	95.3±11 ^a
Phacelia tanacetifolia	8.3±0.6 ^b	0 ^b	0 ^b	0 ^b
White Fagopyrum esculentum	9.3±0.6 ^b	23.6±0.6 ^b	43.6±0.6 ^a	24.6±2 ^b
Sinapis alba	7.6±0.6 ^b	0 ^b	0 ^b	0 ^b

GD=germination date, DF=date to flowering, DB=duration of blooming, FH=flower per head.

Table 2. Performance of selected annual bee forages at Kunisekaria FTC.

Plant Species	GD	DF	DB	FH
Black Fagopyrum esculentum	8.3± ^b	20.6±0.6 ^b	33.3±1.5 ^{bc}	32.6±4 ^b
Coriandrum sativum	20±1 ^a	54±2 ^{ab}	32.6±1.5 ^{bc}	92.6±12.5 ^a
Phacelia tanacetifolia	7.6±0.6 ^b	68.3±1.2 ^a	25±1 ^c	15.6±1.5 ^b
White Fagopyrum esculentum	8.6±0.6 ^b	22.6±0.58 ^b	42.6±0.6 ^{ab}	19±1 ^b
Sinapis alba	7.7±0.6 ^b	22.6±0.59 ^{ab}	45.3±0.6 ^a	41.3±7 ^{ab}

GD=germination date, DF=date to flowering, DB=duration of blooming, FH=flower per head.

3.1. Germination Date

In germination date, the mean of all plants species has no significant difference except coriander. *Sinapis alba*, *Phacelia tanacetifolia*, *Fagopyrum esculentum* black and *Fagopyrum esculentum* white had the shortest germination date whereas *Coriandrum sativum* has long germination date at both site.

3.2. Date to Flowering

Both black and white *Fagopyrum esculentum* had short date of flowering at both Mechara On station and Kuni

sakaria FTC when compared to others. On the other hand *Phacelia tanacetifolia* has long date of flowering at Kuni sakaria FTC followed by *Coriandrum sativum* at Mechara On station. (Tables 1 and 2).

3.3. Blooming to Shedding (Flowering Length)

There was mean difference between treatment species in flowering length. *Sinapis alba* has taken longer flowering time at Kuni sakaria FTC which is not survived at Mechara On station. Similarly, *Fagopyrum esculentum* white has long flowering time at both sites. (Tables 1 and 2). Bee forage plants which have long flowering period starting from blooming to

shedding are highly preferred by honeybees for continues supply of nectar and pollen to boost honey production. Honeybees have a marked preference for one kind of plant species over the other, which may be equally abundant [4].

3.4. Number of Flower Heads/Plant

There were mean difference for a number of flower heads

per plants and *Coriandrum sativum* have higher number of flower head/plant at both sites. Similarly, *Sinapis alba* at Kuni sakaria has higher number of flower head/plant followed by white *Fagopyrum esculentum* at Mechara On station. Contrary *Phacelia tanacetifolia* had the shortest number of flower head/plant at kunisekeria FTC site which is not survive at Mechara. (Tables 1 and 2).

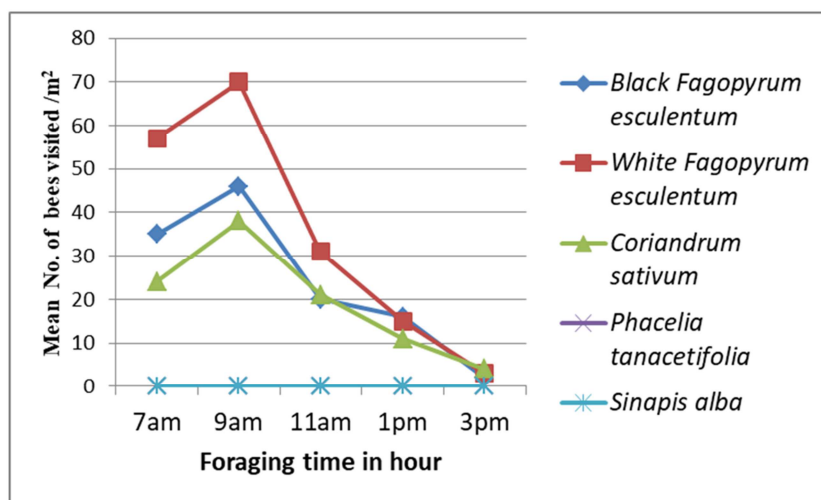


Figure 1. Foraging time and intensity of honeybees at different time/hr. of days at Mechara On station.

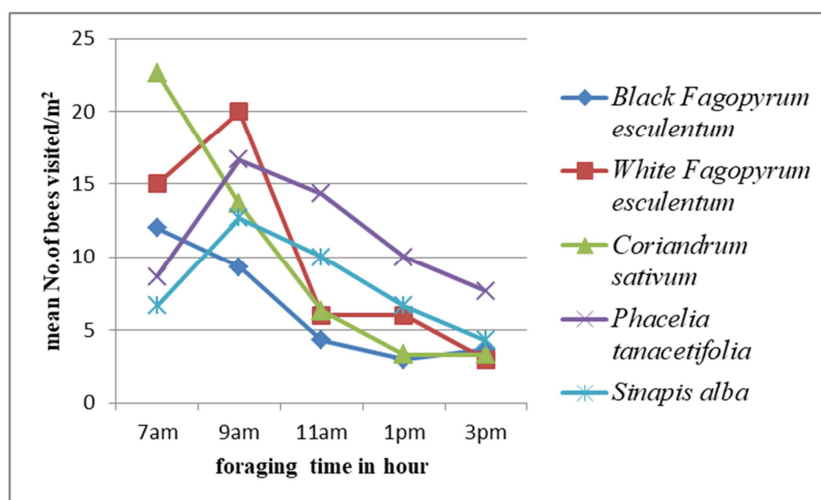


Figure 2. Foraging time and intensity of honeybees at different time/hr of days at Kunisekeria FTC.

3.5. Foraging Intensity of Honeybees

The intensity of honey bee on different study plant species were evaluated at both site in different time of a day (hr.) for ten (10) minute at every two hour interval starting from one hour (1hr) up to nine hours (7a.m - 3p.m). There was mean difference in bee visit between each plant species at all study sites. *Coriandrum sativum* at (7am) and *Fagopyrum esculentum* white at (9am) were highly visited at kunai sakaria FTC whereas *Fagopyrum esculentum* white (9am) and *Fagopyrum esculentum* black at (9am) were highly visited at Machera On station. (Figures 1 and 2). On the other hand, *sinaps alba* and *Fagopyrum esculentum* black plant

species were the least visited by honey bees at kuni sakaria FTC followed by *Coriandrum sativum* plant species at Machara On station. The study revealed that the foraging intensity of honey bees in the study areas were ranged from 7a.m to 3p.m and the honey bees more active in foraging from 7am to 9am for all study plants. Foraging intensity of the honeybees were few in the early morning and late in the evening due the cold weather condition affecting the flight of honeybees. The peak foraging time ranged from 10a.m to 2pm under rain fed and the foraging time of honeybee is varying from plant species to species based on nectar secretion time, volume and concentration and time of pollen release of plants [4].

4. Conclusion and Recommendations

Different herbaceous bee forages were evaluated for their performance at mechara Onstation and Kuni sakaria FTC of Gemechis district to select the best adaptable and more preferable bee forage by honey bees in order to solve the shortage of bee forage at study area. The study revealed that there were mean difference for study plants for germination date, blooming date, flowering length, number of flower heads/plant of different plant species. Additionally there were variation in foraging intensity of honeybee for the same plant species under different site due to the potential of bee forages availability at the peak flowering time and weather condition of the study plants in the study area. On the other hand, this variation was also seen for the same plant species at different time because of weather condition that exist at that time. Even though, the plants species used in this experiment showed better performance for honey bee forages at both study site (high land and lowland), the following recommendations were drawn,

- 1) *Coriandrum sativum*, both black and white type of *Fagopyrum esculentum* were performed very well under both study areas.
- 2) On the other hand, *Phacelia tanacetifolia* and *Sinapis alba* were well performed at high land part of the zone.
- 3) Further demonstration and scaled-up is needed at high land and low land of the zone.

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