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Research Article

Evaluation of Different Spacing and Demonstration of Becium *Grandflorum* /"*Tebeb*"/ Bee Forage in South Omo Zone, Southern Ethiopia

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Abstract

The study was conducted in South Omo Zone Benatsemayworedachalikebele from 2019-2021 G.C in the title "Evaluation of different spacing and demonstration of Becium *grandflorum* /"*Tebeb*"/ bee forage in South Omo Zone, Ethiopia" with the objective of evaluate the effect of different spacing on canopy cover, plant height, branch number and flower number and adaptability of Becium *grandflorumbee* forage. Beciumg *randflorum* cutting laid out in randomized complete block design (RCBD) with four replications by four different spacing (2m, 2.5m, 3m and 3.5m). The record parameter results were plant height 1.11m, 0.99m, 1.24m and 1.27m with treatments 2m, 2.5m, 3m and 3.5m spacing respectively, number of branches per plant were 17.33, 13.33,20 and 21.66 with treatments respectively, canopy cover were 1.39m, 1.29m, 1.7m and 1.5m with treatments respectively and number of flowers per plant were 15567, 14043, 19753 and 20083 with treatments respectively were recorded. All parameters such as plant height, number of branches per plant, canopy cover and number of flowers per plant were not statistically significance ($p<0.05$). The highest flower number, branches per plant and plant height was recorded in treatment 3.5m whereas the lowest flower number, branch per plant, plant height and canopy cover was recorded in treatment 2.5m. However the recorded parameter results were not statistically significance treatment 3.5m and treatment 3m spacing were recommended for Becium *grandflorum* cutting plantation with sufficient soil moisture and good soil condition.

Keywords: Becium *grandflorum*; DebubOmo; flower number; spacing

Introduction

Beekeeping is entirely depending on the types of flowering plants available in any given area. Honeybees need flowering plants for nectar and pollen as source of food and flowering plants need honeybees for pollination. Plants are primary producers in terrestrial ecosystems and direct providers of many ecosystem services such as carbon sequestration, prevention of soil erosion, nitrogen fixation, maintenance of water tables, greenhouse gas absorption, and food and habitat providers for most other terrestrial and many aquatic life forms [4]. There is a need to understand honeybee plant relationship to study food preferences of honeybees and pollination requirement. Ethiopia has diverse ecological zones ranging from very humid to very arid zones. These zones have varying beekeeping potential most of which is unexploited [5].

Becium *grandiflorumis* a drought tolerant species endemic to the highlands of Ethiopia and Eritrea [5]. It is an indigenous perennial aromatic shrub and grows in highlands and mid altitude areas. It is locally known as Tebeb (Tigrigna) or Mentesie (Amharic) [7]. Honey bees visit flowers of Becium *grandiflorum* plant for collecting the pollen and/o nectar. The colour of the honey is creamy white and granulates rapidly [7]. Because of its attractive colour and also light to taste, the honey is preferred by many consumers. Becium

grandiflorum honey bee forage plant could be propagated through different methods like sowing seed, seedlings, air layering, ground layering and cuttings [7]. Cutting propagation method had better performance related to number of flowers, canopy cover, and seed yield performance [7].

Loss of honeybee forage plants has negative implications for beekeepers which mean loss of bee forge, loss of nesting sites for bees, loss of places to keep hives and low honey production.

In South omo zone, there is a decreasing trend in number of colonies, production and productivity due to decreasing trends of available honey bee forages [1, 2].

There for the objective of this study was evaluate the effect of different spacing on canopy cover, plant height, branch number and flower number as well as adaptability and demonstration of Becium *grandflorum* bee forage to the study area.

Materials and methods

Description of study area

The experimental study was conducted South Omo Zone BenatsemayworedaChaliKebel. Generally, the altitude of the woreda ranges between 600-1500 m.a.s.l. Its astronomical locations are 5.01^0 N -5.73^0 N latitudinal and 36.38^0 E -37.07^0 E longitudinally. There are three major agro ecologies namely bereha, kola and woynadega 5%, 81.3and 13.7% found in the woreda respectively. The mean annual RF ranges between 800-1300mm and the mean annual temperature ranges between 18-38°c. The woreda has an animal resources with an estimated of about 459,779 cattle, 146,868 sheep, 741,237 goats, 97205 poultry local and improved, 28877 equines, and 32500 bee colonies.

Treatments and experimental design

The treatments were laid out in a randomized complete block design (RCBD). The treatments were four different spacing with similar inter-row spacing 2m, 2.5m, 3m, and 3.5m, and replicated each treatments three times (4×3) making a total of twelve(12) plots with three meter between each plot. The spacing for the treatments was assigned to be T1, T2, T3, and T4 with a plant spacing of 2m×2m, 2.5m×2.5m, 3m×3m, and 3.5m×3.5m, respectively.

The planting material was 40 cm similar size Becium *grandflorum* cuttings were used and planting the cuttings with 450 during starting of rainy season when there were moisture sufficient in the soil. Within each plant spacing six Beciumgrandflorum cuttings per plot and seventy two cuttings were planted on twelve plots.

Data recording

Plant height

All survived plants from each plot were taken and the height of the plant was measured from the ground to the top end of the longest branch using a measuring meter. All the required plant height was taken from all plants in each plot and the mean height of the plants was calculated by the sum of all plants dividing by all plants in each plot separately.

Canopy cover

$$C.C = (D1 + D2)/2$$

Where D1 is diameter of the plant toward the larger coverage direction, D2 is diameter of the plant towards the small coverage direction and C.C – is canopy cover of the plant in m. And then the canopy cover of the plant was expressed in terms of the average diameter in meter.

Number of branches per plant

The number of branches per plant was calculated by counting the number of main branches from all plants within the plot, and the mean number of branches was taken by dividing the total number of branches in each plant by total plant.

Number of flowers per plant

The number of flowers per plant was also calculated by counting flower head and flowers per flower head from each plant within the plot then multiplied, and the mean number of a flower was recorded by dividing the total sum of each plants flower number by all plants in each plot.

$$T.N.F = N.F.H * N.F$$

Where T.N,F – total number of flowers per plant, N.F.H- Number of Flower Head per plant and N.F- Number of flowers per head of flowers.

Statistical data management and analysis

The collected data and measured at the study site was properly recorded and arranged using excel. One-way ANOVA was used to analyze the data, and correlation analysis was applied for specific variables using SPSS Version 20.

Result and Discussion

Effect of spacing on Becium grandflorum plant height

The result of variance analysis showed that there was different results recorded among treatments, those were treatment one(T1) 2mx2m average Becium *grandflorum* plant height was 1.11m, treatment two(T2) 2.5mx2.5m average Becium *grandflorum* plant height was 0.99m, treatment three(T3) 3mx3m average Beciumgrandflorum plant height was 1.24m and treatment four(T4) 3.5mx-3.5m average Becium *grandflorum* plant height was 1.27m. Even though there were different plant height results between treatments statistically there was no significance difference among treatments shown (Table 1).

Effect of spacing on Becium grandflorum branches per plant

The result of variance analysis showed that there was different results recorded among treatments, those were treatment one (T1) 2mx2m average Becium *grandflorum* branches per plant was 17.33, treatment two (T2) 2.5mx2.5m average Becium *grandflorum* branches per plant was 13.33, treatment three (T3) 3mx3m average Becium *grandflorum* branches per plant was 20 and treatment four (T4) 3.5mx3.5m average Becium *grandflorum* branches per plant was 21.66. Even though there were different branches per plant results between treatments, statistically there was no significance difference among treatments shown (Table 1).

Effect of spacing on Beciumgrandflorum canopy cover

The result of variance analysis showed that there was different results recorded among treatments, those were treatment one (T1) 2mx2m average Becium *grandflorum* canopy cover was 1.39 diameter, treatment two (T2) 2.5mx2.5m average Becium grandflorum canopy cover was 1.29 diameter, treatment three (T3) 3mx3m average Becium *grandflorum* canopy cover was 1.7 diameter and treatment four (T4) 3.5mx3.5m average Becium *grandflorum* canopy cover was 1.51 diameter. Even though there were different canopy cover results between treatments statistically there was no significance difference among treatments shown (Table 1).

Effect of spacing on Becium grandflorum number of flowers per plant

Producing number of flowers for honeybee used as pollen and nectar sources were the altimate goal of this research. Though the result of variance analysis showed that there was different flower number results recorded among treatments, those were treatment

one (T1) 2mx2m average Becium *grandflorum* produced flower number was 15567, treatment two (T2) 2.5mx2.5m average Becium *grandflorum* produced flower number was 14043, treatment three (T3) 3mx3m average Becium *grandflorum* produced flower number was 19753 and treatment four (T4) 3.5mx3.5m average Becium *grandflorum* produced flower number was 20083. Even though there were different flower numbers produced between treatments statistically there was no significance difference among treatments shown (Table 1).

Treatments	***Dependent variables.***				
	PH	***NPP***	***BPP***	***CC***	***NFP***
2M	1.1100	5.6666	17.33	1.39	15567
2.5M	0.9933	6.0000	13.33	1.29	14043
3M	1.2400	5.6666	20	1.70	19753
3.5M	1.2733	5.3333	21.66	1.51	20083
ESM	0.1455	0.45	4.70	0.17	4562.1
LSD	0.3560	1.1	11.51	0.42	11163
CV	15.44	9.75	31.87	14.49	32.18

CV= coefficient of variance, LSD= least significance difference, ESM= error of mean square, PH= plant height, NPP= number of plants per plot, BPP= branches per plant, CC= canopy cover and NFPP= number of flowers per plant.

Table 1: statistical mean comparison of plant height, number of plants per plot, branches per plant, canopy cover and number of flowers per plant.

The correlation between plant height, branch number, canopy cover and flower number

The relationship between plant height, branch numbers, canopy cover and flower number were investigated using a simple correlation coefficient. There was a strong positive correlation between the number of branches and plant height, number of branches and canopy cover, number of branches and number of flowers per plant, plant height and canopy cover, plant height and number of flowers per plant and canopy cover and number of flowers per plant (r = + .841), (r = + .593), (r = + .965), (r = + .657), (r = + .727) and (r = + .579) respectively shown as (Table 2). These research results of correlation coefficient of branch number with number of flowers were strong positive correlation also similar with [3, 6 and 7] results of similar honey bee forage species.

	Branch	***Height***	***Canopy***	***Flower number***
Branch	1	.841**	.593*	.965**
Height		1	.657*	.727**
Canopy cover			1	.579*
Flower number				1

**Correlation is significant at the 0.01 level.

*Correlation is significant at the 0.05 level.

Table 2: The correlation between plant height, branch number, canopy cover and flower number.

Figure 1: *Becium grandiflorum* bee forage plant flower.

Figure 2: *Becium grandiflorum* bee forage plant branches.

Conclusion and recommendation

Becium *grandflorum* bee forage could be adapted in the study area and similar agro ecologies, with sufficient of moisture could produce flowers for long period of time and the flower was highly preferable by honey bees for both pollen and nectar sources. From the research result there were more flower number produced in treatment3.5m and 3m. Even though there were different results recorded with in different parameters, parameters such as plant height, number of branches per plant, canopy cover and number of flowers per plant were not statistically significance ($p<0.05$).There was a strong positive correlation between each parameter.

Becium grandflorum bee forage cutting could be planted 3m by 3m and 3.5m by 3.5m spacing during moisture sufficient and good soil condition to produce many more flowers for honey bees as pollen and nectar sources. Carrying capacity of Becium *grandflorum* bee forage also investigated.

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