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Effect of abundance of pollinators on yield parameter of Niger, *Guizotia abyssinica* (L.f.) Cass. Grown at different dates of sowing

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Abstract

The experiment on effect of abundance of pollinators on yield parameter of Niger, *Guizotia abyssinica* (L.f.) Cass. Grown at different dates of sowing was undertaken at college farm of Navsari Agricultural University, Navsari during *Kharif*, 2016. For the purpose, crop was sown at seven different dates and observations on number of pollinators visited during flowering period as well various yield parameters were recorded from the crop grown at particular dates of sowing. The mean number of pollinators visitation was higher on the crop sown on 30th July (15.36/m²/5 minute) which was statistically at par with the crops sown on 10th August (14.56/m²/5 minute) followed by 20th July (13.39/m²/5 minute) and 10th July (12.89/m²/5 minute). The crop sown on 30th July recorded significantly higher Seed yield per hectare (625.90 kg) which was at par with the crop sown on 10th August (531.56 kg). Positive and significant relationship was observed between the abundance of pollinators and yield parameters *viz.*, number of seeds per capitulum ($r = 0.667$), seed yield per plant ($r = 0.806$) and seed yield per plot ($r = 0.815$). It indicates that the abundance of pollinators or increase in pollination activity at particular date of sowing increased the seed yield of Niger.

Keywords: Abundance of pollinators, pollination, yield parameter, Niger, dates of sowing, correlation

Introduction

Niger, *Guizotia abyssinica* (L.f.) Cass. is an important oilseed crop cultivated in Ethiopia and India for millennia. The genus *Guizotia* belongs to family compositae (Asteraceae), tribe heliantheae and sub tribe coreopsinidae. Niger is grown over an area of 232.1 thousand hectares with an average production of 76.2 thousand tones in India. The productivity of Niger is low, around 328 kg/ha in India [2]. In Gujarat, Niger is cultivated on 16 thousand hectares of area with production of 5 thousand tonnes with productivity of 313 kg/ha [1]. The South Gujarat heavy rainfall zone particularly comprising of Dang, Navsari and Valsad districts are very potential areas where Niger is grown [6]. Niger is a completely out crossing species with a self-incompatibility mechanism [3, 7, 14, 15]. The cross fertilization was proven as early as in 1911 at Pusa by examination of 29 cultures raised from the seed of a single plant [3].

Honeybee pollinators are estimated to be involved in producing up to 30 % of the human food supply directly or indirectly; farmers rely on managed honeybees throughout the world to provide these services [4]. Honeybees are responsible for 70-80% of insect pollination [5]. The insect, particularly bees were major agents of pollination in Niger. Higher yields of Niger could be achieved if crop should be planted on suitable date of avoid rains coinciding flowering period of crop when visit of bee is essential for seed set. Utilization of bees in pollination not only increased the yield of various crops but also improves their quality. It helps for uniform maturity and early harvest of the crop. In Niger crop, open pollination (OP) and bee pollination (BP) increased the number of filled seeds, yield and also oil content percent [9]. Thus, exploitation of bees for pollination is one of the best strategies for enhancing the crop production. This study aimed at observing the foraging behavior of pollinators and their efficiency of pollination on seed setting, seed yield and seed quality of Niger crop and identify the best sowing time for quality and high seed production of Niger.

Materials and Methods

The field experiment was laid out in randomized block design (RBD) with three replications during *Kharif*, 2016 at college farm of Navsari Agricultural University, Navsari (Gujarat), India. The experiment consisted of seven different dates of sowing *viz.*, T₁- 1st of July, T₂- 10th

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of July, T₃- 20th of July, T₄ - 30th of July, T₅- 10th of August, T₆- 20th of August and T₇- 30th of August. Seeds of Niger variety GN-1 as a release variety of NRS, Vanarasi, NAU (Gujarat), India were sown with a spacing of 30 cm × 10 cm in net plot size of 3.9 m × 2.6 m. The cultural operations were done as and when required.

The abundance of different visitors was recorded by counting number of different visitors visited flowers of 1 m × 1 m area per five minutes at different hours of day during flowering period at weekly interval from crops grown at different dates of sowing and mean number of visitors visited the flowers in crops grown at respective date of sowing was worked out. Observations on number of capitulum per plant, number of seeds per capitulum, seed yield were recorded from ten randomly selected plant from each replication. In qualitative parameter, the observations on 1000 seed weight and germination percentage was also recorded for each date of sowing.

To study the effect of bee visitation and their possible role in qualitative and quantitative parameters of Niger crop, the correlation study was made with abundance of pollinators with yield parameters of Niger grown at different dates of sowing.

Results and Discussion

(A) Abundance of pollinators

The mean number of pollinators visitation was higher on the crop sown on 30th July (15.36/m²/5 minute) which was statistically at par with the crops sown on 10th August (14.56/m²/5 minute) followed by 20th July (13.39/m²/5 minute) and 10th July (12.89/m²/5 minute). The crop sown on 30th August (9.21/m²/5 minute) recorded significantly least number of pollinators which was statistically at par with the crops sown on 20th August (10.26/m²/5 minute) and 1st July (11.13/m²/5 minute) (Table 1).

Muddi (2012) [8] reported that among four different dates of sowing, crop sown on 7th June recorded higher per cent of honey bees as compared to the crop sown on 20th June, 3rd July and 18th July. The abundance of pollinators mainly depend on the prevailing environmental factor of the area.

(B) Effect of abundance of pollinators on quantitative yield parameters of niger

(I) Number of capitulum per plant

The number of capitulum per plant was significantly influenced by dates of sowing (Table 1). The crop sown on 30th July recorded significantly higher number of capitulum per plant (35.54) which was statistically at par with the crop sown on 10th August (34.68). The crop sown on 10th July was at par with the crop sown on 20th July (32.31). Significantly least number of capitulum was recorded in the crop sown on 30th August (29.11) which was statistically at par with the crop sown on 20th August (29.78) and 1st July (30.84). The number of capitulum per plant is generally affected by the environmental factors suited to plant growth. The present findings are in confirmation with findings of Priya Kivadasannavar *et al.* (2007) [12] who reported that number of capitulum per plant was significantly higher in crop sown on 15th July. Jagtap *et al.* (2014) [6] recorded higher number of capitulum per plant at crop sown on 25th July in their respective agronomic study. Muddi (2012) [8] reported higher number of capitulum per plant at crop sown on 3rd July.

(II) Number of seeds per capitulum

The examination of data on number of seeds per capitulum

affected by crop sown at different date presented in Table 1 revealed that the crop sown on 10th August recorded significantly higher number of seeds per capitulum (25.10 seeds per capitulum) which was statistically at par with the sowing of seeds with crop sown on 30th July (24.73 seeds per capitulum), 20th July (24.40 seeds per capitulum), 10th July (23.70 seeds per capitulum) and 1st July (23.23 seeds per capitulum). Significantly least number of seeds per capitulum was recorded in the crop sown on 30th August (19.53 seeds per capitulum) which was statistically at par with crop sown on 20th August (21.53 seeds per capitulum). These results are in agreement with findings of Pastagia (2006) [11] in Niger who recorded mean number of seeds per capitulum (17.93 seeds per capitulum) in open pollination treatment during crop sown at 5th July. Muddi (2012) [8] reported higher seeds per capitulum at crop sown on 3rd July. Previously, Priya Kivadasannavar *et al.* (2007) [12] reported that seeds per capitulum were significantly higher with July 15th sowing. Jagtap *et al.* (2014) [6] recorded higher seeds per capitulum at crop sown on 25th July in their respective agronomic study.

(III) Seed yield per plant (g)

The sowing dates of Niger crop significantly influenced the seed yield per plant (g) (Table 1). The crop sown on 30th July recorded significantly higher seed yield per plant (3.32 g) which was followed by the crop sown on 10th August (2.89 g) which was statistically at par with crop sown on 20th July (2.76 g), 10th July (2.68 g) and 1st July (2.58 g). Significantly least seed yield per plant was recorded in the crop sown on 30th August (2.24 g) and 20th August (2.50 g). The results are in accordance with Priya Kivadasannavar *et al.* (2007) [12] who reported that seed yield per plant was significantly higher with July 15th sowing (4.08 g). Muddi (2012) [8] reported higher seed yield per plant at crop sown on 3rd July (32.52 g/25 plants).

(IV) Seed yield per hectare (kg)

The seed yield was significantly influenced by dates of sowing (Table 1). The crop sown on 30th July recorded significantly higher seed yield per hectare (625.90 kg) which was at par with the crop sown on 10th August (531.56 kg) and the crop sown on 20th July (461.54 kg). Significantly least seed yield per hectare was recorded in the crop sown on 30th August (278.43 kg) which was statistically at par with 20th August (357.33 kg), 10th July (410.26 kg) and 1st July (408.61 kg). The present findings are more or less in conformity with Sharma and Kewat (1994) [13] who reported that crop sown on 15th July gave higher seed yield than the early sown crop i.e. on 30th June. The delayed sowing after mid-July resulted in low production. Thakur *et al.* (2000) [16] reported that sowing of *G. abyssinica* cv. Chhindwara-1 on 20th July produced the highest seed yield (5.36 q/ha). Both early and delayed sowings significantly reduced seed yield. Priya Kivadasannavar *et al.* (2007) [12] reported that seed yield was significantly higher with July 15th sowing. Jagtap *et al.* (2014) [6] revealed that sowing on second fortnight of July (15th to 25th July) produced the highest seed yield (kg/ha).

(C) Effect of abundance of pollinators on qualitative yield parameters of niger

(I) Germination percentage

The effect of pollination in the quality of niger seed in terms of germination percentage was assessed by putting seeds in petriplates and observing the germination of the seeds

collected from crop sown at different dates of sowing. The data presented in the Table 01 indicated that there was no significant difference existed among different treatments in terms germination percent. These findings are in line with the results of Muddi (2012) [8] who reported that date of sowing had no effect on germination percentage of seeds.

(II) Seed weight

To study the effect of insect pollinators on seed weight of niger the weight of 1000 seeds was taken. The mean data on 1000 seed weight presented in Table 1. There was non-significant difference existed among different treatments in terms of 1000 seeds weight. Similar trend was noticed by Muddi (2012) [8] who reported that date of sowing had no effect on weight of 1000 seeds. Painkra and Shrivastava (2015) [10] revealed that there was no significant difference in weight of 1000 seeds between different treatments of open pollination and pollination without insects.

(D) Correlation between abundance of pollinators and yield parameters of Niger

To study the effect of abundance of pollinators and their possible role in qualitative and quantitative parameters of Niger crop, the correlation study was made with number of pollinators and yield parameters of niger grown at different

dates of sowing. The correlation study revealed that all the parameters viz., number of seeds per capitulum, seed yield per plant and seed yield per plot were significant at 5 per cent level of significance with abundance of pollinators. The germination percentage and 1000 seeds weight which was not significant with abundance of pollinators (Table 2).

Positive and significant relationship was observed between the abundance of pollinators and yield parameters viz., number of seeds per capitulum ($r = 0.667$), seed yield per plant ($r = 0.806$) and seed yield per plot ($r = 0.815$) (Table 2). It indicates that the abundance of pollinators or increase in pollination activity at particular date of sowing has increased the seed yield of Niger.

These findings are in line with the results of Muddi (2012) [8] who reported that the correlation between bee visits and yields of open pollinated crop significant both at 0.01 or 0.05 per cent level except number of capitula which was not significant ($r = 0.929$) with bee visits which confirms the present findings. However, have there is no mean to measure the effect of bee pollination on number of capitula per plant that with increase in pollinators. The number of capitulum per plant mainly depend on the crop condition, have the positive correlation of abundance of pollinators with number of capitulum indicates that higher number of capitulum attracts more number of pollinators.

Table 1: Influence of date of sowing on pollinators visitation and yield parameters of Niger

Date of sowing	Mean no. of pollinators visits/5 min/m ²	Capitulum/plant	Seeds/Capitulum	1000 seeds Weight (g)	Seed yield (g)/Plant	Seed yield (kg)/ha	Germination (%)
01-07-2016	11.13 ^{cd}	30.84 ^{cd}	23.23 ^{ab}	3.72	2.58 ^{bc}	408.61 ^c	80.67
10-07-2016	12.89 ^{bc}	31.68 ^{cd}	23.70 ^{ab}	3.73	2.68 ^b	410.26 ^c	81.67
20-07-2016	13.39 ^b	32.31 ^{bc}	24.40 ^{ab}	3.86	2.76 ^b	461.54 ^{bc}	82.67
30-07-2016	15.36 ^a	35.54 ^a	24.73 ^a	3.97	3.32 ^a	625.90 ^a	83.00
10-08-2016	14.56 ^{ab}	34.68 ^{ab}	25.10 ^a	3.92	2.89 ^b	531.56 ^{ab}	83.33
20-08-2016	10.26 ^{de}	29.78 ^{cd}	21.53 ^{bc}	3.62	2.50 ^{bc}	357.33 ^{cd}	78.67
30-08-2016	9.21 ^e	29.11 ^d	19.53 ^c	3.56	2.24 ^c	278.43 ^d	78.00
S. Em. ±	0.60	0.91	1.03	0.20	0.14	36.42	2.61
CD at 5 %	1.86	2.81	3.17	NS	0.42	112.23	NS
CV %	8.41	4.93	7.69	8.99	8.76	14.37	5.57

Note: In each column, means followed by a common letter are not significantly different at 5% level

Table 2: Correlation of abundance of pollinators with yield parameters of Niger grown at different date of sowing

Parameters	Correlation Value (r)
Capitulum/plant	0.828 [*]
Seeds per capitulum	0.667 [*]
Seed yeild per plant	0.806 [*]
Seed yeild per plot	0.815 [*]
Seeds weight	0.390
Germination %	0.366

* Significant at 5% level of significance.

Conclusion

From the preliminary investigation on 'Effect of abundance of pollinators on yield parameter of Niger grown at different dates of sowing' it is concluded that due to self-incompatible nature of Niger flower, insect pollinators are the more importance in increasing productivity of Niger. Further, increase in the Pollinators activity during particular date of sowing increase the seed yield of Niger significantly. So the date of sowing of Niger should be selected based on the Pollinators populations which helps in increasing yield of Niger.

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