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Exploring the role of marigold in honey bee conservation and its impact on Niger seed productivity

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Abstract

Pollination by honey bee plays a vital role in maintaining the natural balance of ecosystem and is the cornerstone of crop production. The dramatic declines in Insect pollinators including honeybees globally have raised concerns about the supply of pollination service to agriculture. Thus bring some part of agriculture land under marigold cultivation not only to generate income but also to conserve honeybees to cross pollinate their crops. The present study will discuss the economic significance of Marigold cultivation in honey bee conservation and to find out the role of honeybees on pollination and seed yield of Niger crop. The experiment was conducted at OUAT Farm, Semiliguda of Koraput district under Eastern Ghat High land zone of Odisha during Kharif 2023. The treatments were viz., T-1: Open pollinated with bee hive, T-2: Open pollinated without bee hive. The experiment was laid out in Randomized Block Design. The seed quality and seed yield of Niger crop were significantly increased when the honeybees were supplemented to the open pollination. The maximum seed yield (674kg/ha) was obtained under open pollinated with bee hive. Consequently, it is suggested that to keep sufficient number of honeybees colonies in the vicinity of Niger crop field during its flowering period to increase the pollination efficiency and seed yield of Utkal Niger-150.

Keywords: Honeybee pollination, marigold, Niger, seed production

Introduction

The natural habitat is disturbed for many reasons and the vegetation cover is declining now a day's worldwide (Kearns *et al.*, 1998) [16]. One of the major causes which have often been linked with pollinators decline is habitat degradation, pesticide misuse, diseases and intensive cultivation of lands may be the causes of decline in managed honeybees and wild pollinators (Gallai *et al.*, 2009) [10]. Agriculture plays a role in declining native pollinators through the modification and elimination of pollinator habitats and the use of agricultural chemicals including (pesticides, herbicides and fertilizers) (Donaldson, 2002) [9]. Honeybees and other pollinators are of immense importance for ecological safety and economic security systems due to its pollination activities. Human food security and bio-diversity are profoundly dependent on pollinators (Brodschneider and Crailsheim, 2011; Tautz and Heilmann, 2007) [3, 24]. Honeybee pollination is an indispensable ecological process to ensure sustainable crop production. Honeybees are the most important and superior pollinators of the natural ecosystem, as they store pollen and nectar for future purposes (Stubbs *et al.*, 1997) [23]. To fulfil their requirement, honeybees pollinate wide variety of flowers in mutualistic form right from cultivated to wild species and ornamental crops (Divekar *et al.*, 2021) [8]. However, there is clear evidence of the recent decline in bees colonies, and parallel decline in the population of plant species that are dependent on bees for outcrossing (Biesmeijer *et al.*, 2006) [1]. Therefore, enhancing the availability and diversity of floral resources is one of the major strategies for conserving honey bee population and diversity. Garden flowering plants are being frequently recognized as alternative options for substituting dwindling diversity of natural forage sources for bees and other flower-visiting insects (Garbuzov *et al.*, 2013) [11]. The basic food sources of honeybees are nectar and pollen. Hence the duration of flowering period and the availability of nectar and pollen determines the suitability of the area for bee keeping (Panigrahi, 2011) [20]. Therefore, the growing of marigold along with Niger (*Guizotia abyssinica* Cass) crop may enhance the

abundance of pollinators but may also change the diversity of pollinators. Marigold (*Tagetes erecta* L.) is one of the major flower crop exploited commercially belonging to the family Asteraceae, accounting for over half of all loose flower production in the world (Jyothi *et al.*, 2018) [15]. And is originated from central and southern America specially Mexico. Marigold is widely cultivated as bedding plant in landscape design. It is widely used in perfumes, insect and nematode repellent, nutrient supplement for poultry feed, anticarcinogenic agent. There is a general feeling that marigold can be grown throughout the year except in very cold winter when the plants are likely to be damaged by frost. The cultivation of marigolds is attracting flower growers on account of its easy culture, wider adaptability, and short duration to produce marketable flowers with a handsome amount of money as well as receiving popularity among the consumers due to its appealing colour, forms and good keeping quality (Datta & Singh, 2008) [4]. 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 (Greenleaf and Kremen, 2006) [12]. Marigold crop was introduced to enhance the honey bee activity and ultimately to increase the seed setting in Niger. Honeybees visit Niger flowers for collection of both pollen and nectar, which in turn results into florets get cross pollinated. Niger [*Guizotia abyssinica* Cass.] is most important minor oilseed crop of India that belongs to Asteraceae family. The seed number was more in honeybees pollinated crop than that in the crop without bees, indicating the possible value of insect pollination (Bhambure, 1958) [2]. It also has been reported that bee pollination results in a 22-33% increase in Niger yield (Panda *et al.* 1988) [19]. Therefore, this study was conducted to examine the impact of marigold cultivation on conserving the declining honeybee population and its effect on increasing seed yield in Niger through bee pollination.

Materials and Methods

The study was undertaken to ascertain the influence of marigold flowering plant on foraging behaviour of honeybee and their contribution to increasing the seed yield of Niger crop at OUAT farm, Semiliguda under Koraput district in Eastern Ghat Highland zone of Odisha during kharif 2023. The research station is located in the geographical parallels of 18°42'N latitude, 82°30'E longitude and an altitude of 884.0 m. The average annual rainfall varies between 1320-1520 mm. It is observed that about 80% of total annual rainfall takes place due to south-west monsoon between middle of June & mid October. The north-east monsoon gives erratic & insufficient rain fall. The district is drought prone because of the erratic and uneven pattern of rainfall. The soil of experiment site was red sandy to clay loam in texture and acidic in reaction. When the crops started flowering honey bees visited were recorded visually within each demarcated area from 9:00 hrs to 17:00 hrs at two hrs interval once every week. All cultural operations were uniformly done. The treatments were viz., T-1: Open pollinated with bee hive, T-2: Open pollinated without bee hive. The experiment was laid out in Randomized Block Design. Observations were recorded at the time of harvesting the yield, No. of capitula/plant and No. of seed /capitula were analysed statistically.

Results and Discussion

Foraging Behaviour of Honeybees

The foraging behaviour of honeybee on the capitulum of Marigold and Niger flower was observed from 9:00 hrs to 17:00 hrs during the full blooming period of the crop to till its complete cessation. During observation the relative abundance of bee was recorded during the morning at 9:00 -10:00 hrs (19 bees/10 min/m²) and gradually reached its peak at 11:00-12:00hrs (39 bees/10 min/m²), thereafter it started decreasing at 14:00-15:00 hrs (25 bees/10 min/m²) and the lowest activity was recorded at 16:00-17:00hrs (09 bees/10min/m²). The relative abundance of bees declined from the initial flowering to the maturity stage of the crop. As reported by (Kant *et al.*, 2013), foraging behaviour of bees was maximum during the early hour i.e. 10:00 to 12:00 AM later declined and second peak activity was observed during the late evening hours, which is in correlation with our study. Findings were also corroborated by the results of (Gupta *et al.*, 2020) [13] who reported that the lowest visitation rate was during the morning (9:30-10:30 hrs) and evening (15:30-16:30 hrs), while, highest was during midday (11:30-14:30 hrs.) Honeybees started foraging after anthesis of the main source of pollen and nectar. Honeybees visit its flower for harvesting pollen and /or nectar which in turn results into cross pollination (Dhruve, 2008) [6]. It was reported that, regardless of the stage of floret development, daily, nectar volumes tend to be highest at midday and low in morning and evening (Wist and Davis, 2006) [25] which is in accordance with our study.

Growth Traits & Floral Biology of Marigold Flower

The present study provides a holistic approach towards effective management of Marigold crops, which can be grown three times a year i.e. rainy, winter and summer season. As a result, Marigold flower can be available throughout the year, potentially aiding in enhancement of honeybee populations and conservation. The Inca Orange variety of *Tagetes erecta* (African marigold) under study is known for its bright orange flowers, with the plant reaching a height of 26.79 cm. It takes 68 days for the first flower open, and flower have a diameter 4.11 cm. The flower yield per plant 304.22 g, with an average of 35 flowers per plant. The seed yield per plant 13.24g, and the fresh weight of flowers is 7.60g. These finding are also in consonance with the result reported by (Deepa *et al.*, 2016) [5]. According to (Zamarlicki 1984) [26], knowing the bee forage species is the most crucial element in beekeeping and the survival of honey bees is correlated with the availability of bee flora. The knowledge of bee flora in the region is of paramount importance in terms of their utilization by honeybee for colony build-up and harvesting a good yield of honey including other bee products in addition to effective pollination (Divekar *et al.*, 2018) [7]. Marigold flowers may be helpful in enhancing the population and colonies of honeybees (Gupta *et al.*, 2020) [13] which is in accordance with our study. Moreover, this system marigold flower farming integrated with honeybees can ensure a substantial income generation and also helpful to increase the seed yield of Niger crop in open pollinated with beehive to sustain the livelihood of small & marginal farmers over the meagre income from self standing enterprises [17].

Effect of honeybee pollination on Niger seed yield parameters

Significant variation was observed among the treatments regarding number of capitula/plant, number of seeds/capitula, and seed yield. Data presented in Table-1 illustrated that the treatment T1- open pollinated with bee hive recorded significantly highest yield of 674 kg/ha, number of capitula 58/plant and number of seed 29/ capitula as compared to T2- open pollinated without beehive, which recorded the yield of 562 kg/ha, number of capitula 47/plant and number of seed 21/capitula. The treatment open pollinated with beehive (T1) recorded highest of 19.92 percent increasing yield over open pollinated without beehive (T2). Our findings of maximum yield

and other yield parameters were found in open pollination as reported earlier by (Sandipan *et al.*, 2017) ^[22]. It is revealed that increased pollination using honeybees in Niger crop correspond to those of previous works. These results indicated that honey bee pollination could increase the yield due to higher pollination efficiency of the honeybees. These results corroborate those found by (Rao and Suryanarayana.1990) ^[21] also reported three times higher yield in plots caged with honeybees as compared with plots caged without honeybees. Present findings of this research are in corroboration with different workers who reported increased yields due to bee pollination in different oil seed crops viz., sunflower (Oz Mehmet *et al.*, 2009) ^[18], Niger (Guruprasad, 2001) ^[14] and mustard (Murasing, 2000) ^[27].

Table 1: Effect of honeybees on Niger seed yield

Treatment	No. of Capitula/plant	No. of seeds/capitula	Seed yield (kg/ha)
T1: Open pollinated with beehive	58	29	674
T2: Open Pollinated without beehive	47	21	562

Conclusion

The declining Niger crop seed productivity can be attributed by several factors, but pollination is crucial. Promoting the use of beekeeping to pollinated Niger field during flowering would be advisable to increase both seed productivity and quality. The present study revealed that highest seed yield/ha was obtained from open pollination with honeybees, whereas crop excluded from honeybees had the lowest yield. The dramatic decline in honeybees' population is a critical issue for agriculture. Thus there is need to boost the awareness among the farming community about the magnitude of economic significance of marigold cultivation not only to generate income but also to conserve honeybees to cross pollinated their crops.

Conflict of Interest

All authors declared that there is no conflict of interest.

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