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Short communication

Overhead sprinkler irrigation affects pollinators and pollination in pumpkin (*Cucurbita maxima*)

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ABSTRACT

Cucurbits are monoecious plants and most of them depend on pollinators for fruit set. However, studies suggest that pumpkin and squash fields are pollination deficient. Pollinator limitation, suboptimal flower sex ratio, and exploitative competition between invasive ants and bees are a few major suggested reasons for this. Pumpkin flowers have a corolla cup and secrete nectar throughout anthesis, which make them attractive to bees. In south India, honey bee (*Apis cerana*) is the major pollinator of pumpkin flowers. Like pollinators, water is also a limiting factor for growth and production of flowers in pumpkin. It has been suggested to use overhead sprinklers to irrigate and fertilize pumpkin fields. We hypothesized that the sprinkler affects the visitation characteristics of foraging bees in flowers and pollination, and so, we performed an experiment to test this. For this reason, we recorded pollinator visits on staminate and pistillate flowers for 15 min and poured water in the flower cups and examined the water retention time and the visitation characteristics of pollinators in both staminate and pistillate flowers, and fruit set in pistillate flowers. Water remained inside the staminate and pistillate flower cups until the flower senescence. Honey bees entered and foraged nectar/pollen in flowers during the waterless condition. In water-filled flowers, honey bees hovered around or landed only on the corolla and did not forage floral resources or contact the reproductive parts. As a consequence, none of the water-filled flowers developed fruits. Therefore, the overhead sprinkler irrigation, despite cover a large area effectively, may not be an appropriate irrigation method for pumpkin during flowering period.

1. Introduction

The plant family Cucurbitaceae has a large number of edible crop plants in the genera, *Cucurbita, Cucumis, Luffa, Benincasa, Momordica,* and *Citrullus*. They are commonly called as cucurbits. Cucurbits are monoecious plants, *i.e.* they produce staminate (male) and pistillate (female) flowers on different axils, but, on same plants. They produce a large number of staminate flowers than pistillate flowers (Stapleton et al., 2000; Allesh et al., 2019). Anusree et al. (2015) found that over 98%, 90%, and 70% of the total flowers produced, respectively, on bitter-gourd, ash-gourd, and pumpkin, respectively, are staminate. Allesh et al. (2019) studied flowers of 325 plants of pumpkin (*Cucurbita maxima*) in two complete flowering seasons (2015–2016 and 2016–2017) and found that 31,656 flowers and 6,055 flowers produced were staminate and pistillate, respectively. Allesh et al. (2019) also suggested that high staminate/pistillate flower sex ratio is required for optimal pollination in pumpkin.

Most of the cucurbits are pollinator-dependent for fruit set (Petersen et al., 2013; Carr and Davidar, 2015). Global studies suggest that pumpkin is pollination deficient (Garibaldi et al., 2013), and the following reasons have been suggested for pollination deficiency in pumpkin: (1) lack of diversity (Petersen et al., 2013) or functional group diversity of pollinators (Hoehn et al., 2008), (2) poor pollinator-friendly management of field (Julier and Roulston, 2009), (3) competitive and interference competition from the invasive ants to the pollinators (Sinu et al., 2017), and (4) suboptimal staminate to pistillate flower sex ratio in field (Allesh et al., 2019).

Pumpkin is pollinated by honey bees, bumble bees, and squash bees in different parts of the world (Petersen et al., 2013), but, in south India, honey bee is the major pollinator of pumpkin flowers. The flowers are showy yellow and large with a cup formed by the fusion of five petals. This cup holds a cone shaped anther in staminate flowers and a three-lobed ringed stigma in pistillate flowers in the inner middle part of the flower. The nectar is accumulated at the basal part of the reproductive structures of the flowers in the flower cup. Both the staminate and pistillate flowers produce adequate amount of good quality nectar as a reward for the floral visitors (Ashworth and Galetto, 2001), and it is secreted continuously throughout the entire period of anthesis.

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