Flower Species as a Supplemental Source of Pollen for Honey Bees (*Apis mellifera*) in Late Summer Cropping Systems

Rhonda Simmons, Ramesh Sagili, and Bruce Martens

Abstract

Honey bee forager preference of late summer flower species was examined in a one-acre field adjacent to the Central Oregon Agricultural Research Center's apiary in Madras, Oregon. Six flower species were selected based on potential pollen production and planted according to commercial recommendations. Honey bee visitations were recorded, pollen amount tabulated, and pollen grains separated for protein analysis. All species produced flowers by mid-July as carrot seed approached 70 percent maturity on average. Results indicated borage, alsike clover, and buckwheat to be the most preferred species for foragers when compared side by side. Desirable flowers had potential regrowth ability when mowed, allowing for precise flower synchronization. Overall, species planted provided good information for prospective nutritional supplement for honey bee pollinators.

Introduction

Balanced nutrition is critical for honey bee colony growth and immunity. Honey bees need a range of elements to fulfill their nutritional requirements for normal growth and development. Essential components include proteins (amino acids), carbohydrates, minerals, fats/lipids, vitamins, and water. In order to obtain essential requirements, nectar, pollen, and water are collected as needed by the colony. Lack of one or more of these components can lead to population decline, health of the colony, disease susceptibility, and ultimate loss of hive. There is an increasing amount of evidence showing that poor nutrition can be a major factor affecting honey bee health.

Central Oregon utilizes pollination services of over 14,000 hives from July through late August for vegetable seed production. The natural decline in availability of pollen during the end of vegetable seed production negatively impacts honey bee health due to poor nutrition. As vegetable seed crops approach maturity, foragers have difficulty locating sufficient pollen for their colony growth. Diversity of pollen sources is important for honey bee colony growth and immunity especially before overwintering. Vegetable seed pollination is the last pollination event for Oregon beekeepers and also coincides with the most critical time when bees need ample and diverse pollen. Supplemental feeding as a preparation for winter survival can improve health, making bees less susceptible to disease and pests.

The objective of this project was to determine potential flower species that could improve honey bee nutrition and thus improve honey bee health during pollination by providing supplemental nutrition. Assessment of flower species was based on flowering dates, honey bee flower visits, pollen protein analysis, and crop management.

Methods and Materials

This study began in April, 2013 and will continue until spring 2014 at the Central Oregon Agricultural Research Center apiary in Madras, Oregon. Six flower species were selected based on availability and desirable pollen production. Prairie Coneflower *(Ratibida columnifera),* Alsike Clover *(Trifolium hybridum),* Buckwheat *(Fagopyrum esculentum),* Borage (*Borago Officinalis),* Alyssum *(Alyssum maritimum), and* Sunflower *(Helianthus annuus)* were planted in 20 ft by 150 ft plots in 8-inch row spacing, using an Oyjord plot drill. Planting rates, depths, and dates are presented in Table 1. The trials were irrigated as needed with a 30-ft by 40-ft spacing, solid-set sprinkler (9/64-inch heads) irrigation system. No fertilizers were applied as soil tests showed adequate levels of nitrogen present in the soil profile.

Plant emergence for each species was recorded when 30 percent of plot was visible. Plots were hand weeded except for alsike clover which was sprayed with Raptor® at 4oz/acre and 1 pt/acre of Basagran®. Twenty-feet at the end of the plots were mowed using a flail mower, at 10-inch height in mid-July to test regrowth potential. Regrowth allows for better synchronization of flower bloom during the season.

Foraging bees were counted using hand-held tally counters over a 10 ft by 40 ft area as soon as all species of flowers were in consistent bloom. Area verses time was used due to high variability in number of flowers produced between species. Visitation was recorded as total number and percent nectar or pollen foragers and percent flower bloom was recorded each collection date. Front Porch Pollen traps were used in the pollen collection of this trial. The trap is set on the front of the hive; a plastic strip (or card) with asterisk shaped holes where the bees enter is placed as a barrier between the front of the trap and the entrance of the hive. When the card is in place, pollen is collected, when removed, the pollen collection stops. The simple removal of the card prevents opening the hive and collection is less invasive to the colony. Below the card is a wire mess floor that allows pollen removed from the legs by the asterisk openings to pass into a collection tray. Pollen was trapped for two days and then removed for 2 days, repeated over the course of 4 weeks with traps remaining off during the weekend. Pollen was collected, date recorded, and immediately placed into a freezer for later separation and analysis. Single pollen foragers were also collected using a hand held cordless vacuum aspirator (model 2820GA) designed by BioQuip to provide accurate identification of pollen. Pollen was separated in the lab by color and is currently awaiting nutrient analysis.

Results and Discussion

The natural decline in availability of pollen during the end of vegetable seed production season has been a concern for honey bees prior to overwintering. Several flower species were planted at the end of May to prevent frost sensitivity. Table 1 shows average bloom dates from 27 to 92 days after planting. All flower plots were in full bloom during the initial target stage (the last two weeks of vegetable seed production). Visitation counts of bees on flower species from August 12, 2013 until August 23, 2013 are presented in Fig. 1. Overall, borage, alsike clover, and buckwheat had more bee visitations during late season. Percentage of pollen foragers recorded on prairie coneflower ranged from 50-90 percent, alsike clover 40-70 percent, buckwheat 10-60 percent, borage 40-60 percent, alyssum 25-80 percent, and sunflower 10-50 percent. Prairie

coneflower, clover, and borage provided a steady number of pollen foragers over the course of the observation period (Fig 2). Pollen selection and preference change was evident in pollen collection samples. Color of pollen changed weekly as seen in Fig 3. In addition, nectar foragers were present and consistently working all flower types.

Clover, buckwheat, borage, and alyssum regrew within 3 weeks of mowing and produced flowers where sunflower and prairie coneflower did not recover from mowing.

Unfortunately, a hail storm on August 25, 2013 damaged the trial and we were unable to collect data further into the season. This damage complicated another objective of the study which involved determining removal of supplemental crop to ensure species would not become future weed problems for growers. Plant damage and wind carrying shattered seed from plots, may obscure spring evaluations. Plots were chopped and tilled in October and winter wheat planted as a rotational crop. Regrowth of flower seeds in spring and herbicide selection to remove escaped plants will be evaluated in 2014.

Preliminary data shows several worthy supplemental pollen sources (borage, buckwheat, and alsike clover) that can be used to enhance honey bee health in late season crops. Conclusions regarding best floral species will be made after completion of protein analysis of all the collected pollen. Work will continue using a narrowed list to determine flower timing and effects of sequential planting in 2014.

Table 1. Planting rate, depth, date of planting, date of emergence, first flower, and date of 50% (percent) flowering for six species of flowers grown at COARC, Madras, Oregon.

Flower Type	Planting Rate	Planting Depth	Date of Planting	Date of Emergence	Date of 1st Flower	Date of 50% flowering
	(lb/acre)	(in)				
Prairie Coneflower	5	0.25	4/18/2013	5/1/2013	7/19/2013	8/5/2013
Alsike Clover	4	0.25	5/9/2013	5/15/13	7/19/2013	7/31/2013
Buckwheat	50	1.0	5/30/2013	6/3/2013	6/28/2013	7/3/2013
Borage	15	0.5	5/30/2013	6/6/2013	7/22/2013	8/7/2013
Alyssum	5	0.25	5/30/2013	6/3/2013	6/26/2013	7/4/2013
Sunflower	10	1.0	5/30/2013	6/5/2013	7/22/2013	8/4/2013

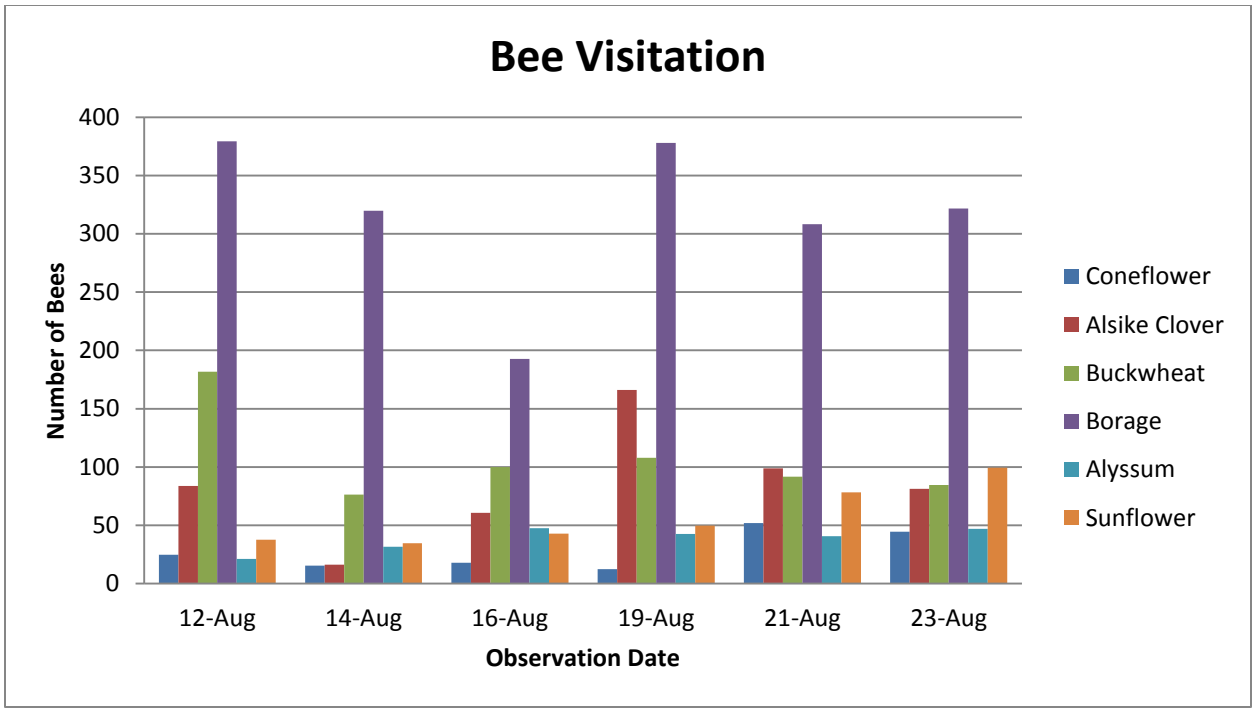

Fig. 1. Number of bees on flowers observed in a 10 ft by 80 ft plot area at COARC, 2013.

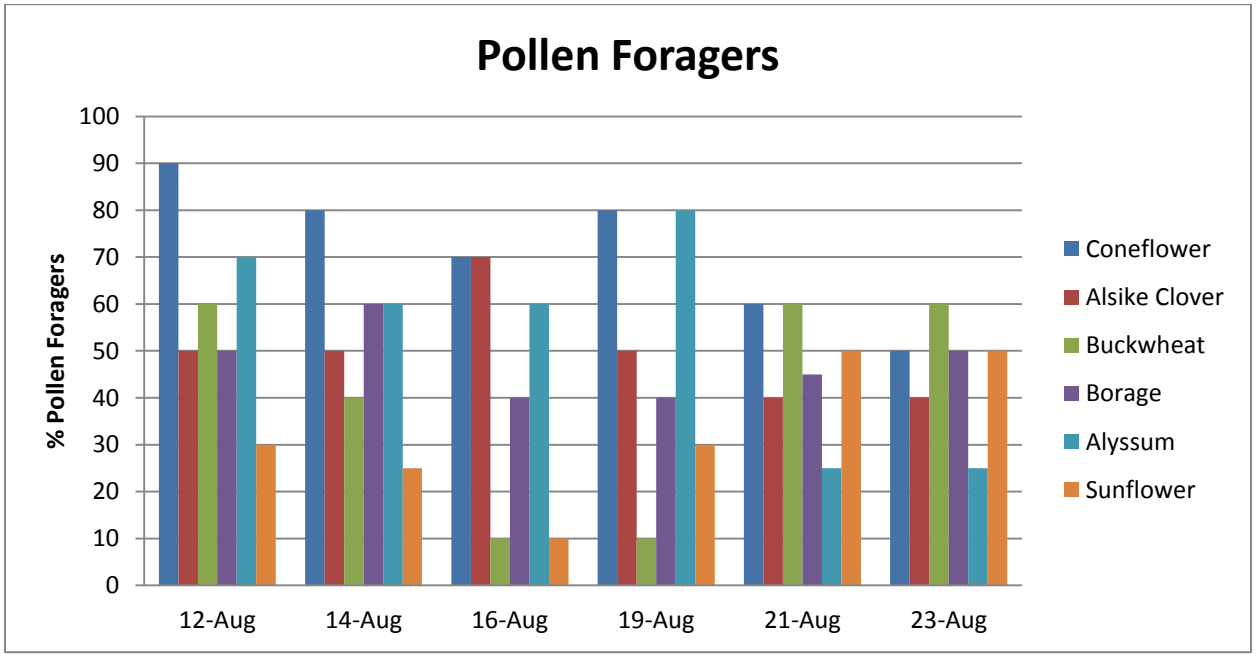

Fig. 2. Percent of bees foraging on pollen in a 10 ft by 80 ft plot area at COARC, 2013.

Fig. 3. Weekly change in pollen collection from July 26 to August 23, 2013.