

NATIVE BUMBLE BEE DIVERSITY, ABUNDANCE, AND POLLINATION IN CRIMSON CLOVER AND HAIRY VETCH SEED PRODUCTION FIELDS IN WESTERN OREGON

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Introduction

Crimson clover (*Trifolium incarnatum*) and hairy vetch (*Vicia villosa*) are two crops with increasing importance in western Oregon. Due to a decline in grass seed production, acreage of alternative crops like clover and vetch seed increased by nearly 50% in western Oregon between 2007 and 2010 (USDA Farm Service Agency, 2010). These two crops are important forage legumes and have recently gained value as cover crops in a diverse range of production systems across the United States because of their ability to fix nitrogen.

Due to cool wet weather conditions, pollination is particularly critical for seed crops such as crimson clover and hairy vetch which bloom in the spring and early summer in western Oregon. Some bees, such as honey bees, do not fly on cool and rainy days. In contrast, many native bees, including bumble bees, are more efficient under less than optimal weather conditions. Western Oregon has a rich fauna of native bees, especially bumble bees. However, for good yield, the life cycle of the bee needs to be synchronized with the bloom of the crop. There is little information on the diversity and abundance of bees present during bloom for these early blooming seed crops.

Studies in red clover, which blooms in the summer, have documented that there is high diversity and abundance of native bumble bees in western Oregon (Rao and Stephen, 2009). Similar information has been lacking for the early blooming crops such as crimson clover and hairy vetch. These crops bloom when climatic conditions do not favor honey bee flight. Hence, they are largely dependent on naturally occurring bees. The buildup of bumblebee colonies depends on availability of food resources in spring and early summer. Thus, crops that bloom in the spring are of particular importance for establishment of new nests and production of workers that pollinate crops that bloom later in the spring and summer. Therefore, in this study, information on the diversity and the abundance of native bumble bees was assessed to determine whether adequate numbers are present for optimum pollination.

Methods

The study was conducted on 4 crimson clover and 4 hairy vetch fields in Washington County during the spring and early summer of 2011. Data were collected during the month of May when crimson clover was in bloom and in late-May through June when hairy vetch was in bloom. During the time of the study, rented honey bee hives were present on 3 of 4 crimson clover fields and on 0 of 4 hairy vetch fields.

Diversity was measured by collecting bees for species identification using modified funnel traps fitted onto a clear plastic

collecting jar approximately 15 x 15 cm (Stephen and Rao, 2007). Two polypropylene vanes, 24 x 13 cm x 3 mm, inserted into a poly screw cap located above the collecting jar were used as an attractant. Traps were left in the field for 48 hours each week. Specimens were removed from the trap and each bumble bee was identified by species.

At each site, bumble bee abundance was estimated during 10 sets of 2 minute counts when visual observations were made while walking the field. Counts were completed 2 times per day, once in the morning and once in the afternoon. Counts were conducted throughout the entirety of bloom for each of the crops.

In addition, 50 seed heads were collected at random from the 4 crimson clover fields. A random subsample of 25 seed heads was further selected. Each of the 25 seed heads was examined closely and the number of flowers per seed head was recorded to estimate seed yield per head. This component was not completed on hairy vetch due to the natural variability in the number of seeds produced per seed pod.

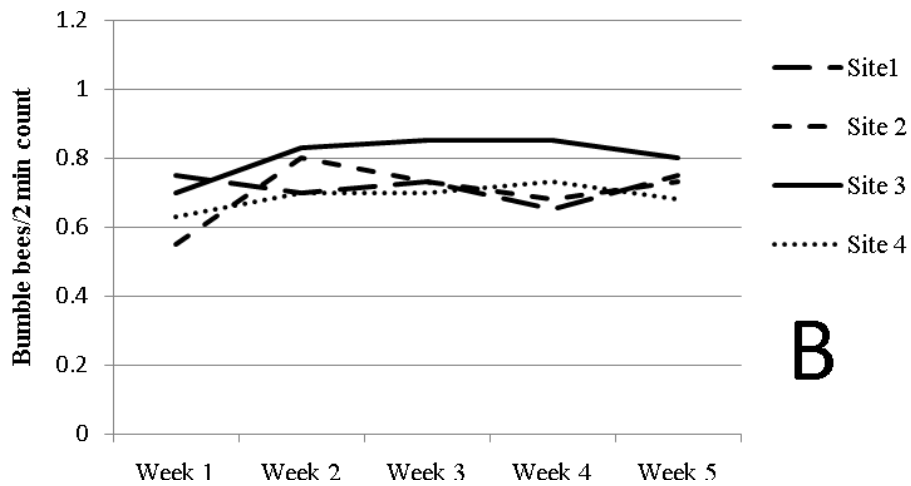
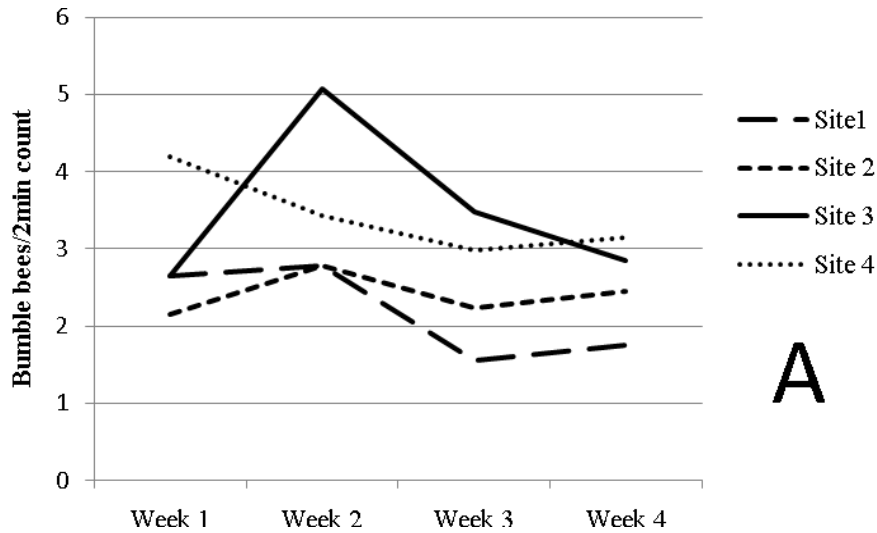
Results and Discussion

Diversity. Several native bumble bee species were identified in the traps. Species identified in the crimson clover fields included *Bombus vosnesenskii*, *B. nevadensis*, *B. melanopygus* and *B. appositus*. Each of these species, except *B. melanopygus*, was identified in the hairy vetch fields. This is not surprising as *B. melanopygus* is the first bumble bee species to emerge in the western Oregon and hence populations could have reduced by the time of bloom in hairy vetch.

Abundance. Bumble bee and honey bee foragers were present in both the crimson clover and hairy vetch fields but counts were low during bloom. Bumble bees counts were higher in crimson clover than hairy vetch fields. The abundance of bumble bees in crimson clover fields ranged from 0 to 10 individuals per count (mean = 2.89) (Figure 1A). Abundance of bumble bees in the hairy vetch fields ranged from 0 to 3 individuals per count (mean = 0.73) (Figure 1B). Abundance of bumble bees peaked in crimson clover fields during week 2 with 3.52 individuals identified per count and in hairy vetch fields during weeks 2 and 3 with 0.75 individuals identified per count.

Low average temperatures and above average rainfall was recorded during the study period. These weather related abnormalities likely contributed to low abundance of native pollinators in this study. Such conditions may have delayed the

buildup of colonies. Thus, workers were not yet present in the field resulting in low numbers of individuals, mostly made up of queens.



A = Crimson Clover. B = Hairy Vetch.

*Honey bee hives were present at sites 1, 2, and 4 in A.

Figure 1. Average number of native bumble bees observed foraging on crimson clover and hairy vetch blooms in seed crop fields in Washington County, Oregon during the spring of 2010.

Estimation of seed yield per seed head. An average of 74.4% of flowers produced seeds in the 4 crimson clover fields. Percentages ranged from 65.9% to 83.2%. Despite low abundance figures, the crimson clover crop was adequately pollinated and normal seed yields were achieved.

There was no positive correlation between presence of honey bee hives and increased seed yield.

The study needs to be repeated over 2-3 years to determine year to year variations and to see if the low abundance of native bumble bees observed in 2010 was driven by poor weather conditions during bloom. In addition, future studies are needed to determine if bumble bees are foraging on crimson clover and hairy vetch blooms for pollen or just honey. Estimations are also needed on the abundance of honey bee workers with pollen loads in both these crops. Finally, a comparison of seed yield in fields with and without honey bee hives will provide insights on whether or not native bumble bee populations are adequate for pollination of these two crops in western Oregon.

References

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