

POLLEN COLLECTED BY NATIVE BUMBLE BEE COLONIES PLACED ADJACENT TO RED CLOVER

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Introduction

Red clover (*Trifolium pratense* L.) is an important forage legume crop grown for seed in the Willamette Valley of western Oregon. Cross pollination by insects is a pre-requisite for seed production, and bees serve as the primary pollinating agents of red clover. While honey bee hives are generally rented for pollination, bumble bees are considered to be more efficient pollinators of red clover (Rao and Stephen, 2009). Unfortunately, bumble bees are commercially unavailable in Oregon as their importation is prohibited due to the risk of disease introduction to resident pollinator populations. Hence, growers must rely on populations of wild bumble bees for pollination. Also, the recent decline in honey bee populations due to the incidence of parasites and disease has increased grower interest in evaluating the efficacy of bumble bees as alternative pollinators for red clover.

Bumble bees are generalist foragers and visit a variety of plant species located in the vicinity of their nests to obtain food resources (Alford, 1975). Unlike honey bees, bumble bee workers are believed to be largely incapable of communicating the location of food resources to colony members as individuals decide independently which flowers to forage upon within the landscape (Goulson, 2010). Thus, the foraging efficiency of a bumble bee colony depends on the collective behaviors of individual workers (Heinrich, 1979). Unfortunately, the pollen foraging behavior of the majority of bumble bee species is unknown given the difficulty of locating and monitoring nest sites in nature (Goulson, 2010). This information is vital for evaluating the efficacy of bumble bee pollinators in crop plants such as red clover. The objective of this study was to characterize pollen collected by individual foragers and stored within colonies throughout the bloom period of red clover. This study was focused on *Bombus vosnesenskii* which is the dominant native bumble bee in the Willamette Valley (Rao and Stephen, 2010).

Methods

This study was conducted in a red clover seed production field in Polk County, Oregon. Colonies of *B. vosnesenskii* were reared by a regional bumble bee propagator (Bee Man Exterminators LLC, Olympia, WA) using local, spring-collected queens. A total of eight colonies were established within wooden nest boxes (10 x 8.5 x 7.5 in.) and placed on four separate three-tiered shelves, 3.3 ft. from the red clover field in early July. Bloom in red clover typically lasts until mid-August in the Willamette Valley but the red clover field used in this study was cut for hay early resulting in early bloom and seed harvest. Hence, colonies were only monitored during three weeks in July and a week in August when the crop was in bloom.

To examine pollen reserves in nests, samples of stored pollen in three pollen pots per colony were extracted weekly, weighed and processed to determine floral composition. Prior to being weighed, pollen samples were dried at 140°F for 24 hrs. Each pollen sample was then diluted using methods of Telleria (1998) and 1ml was extracted to use in analysis. Pollen samples were processed using acetolysis (Erdtman, 1960) and light microscopy to determine floral composition. A total of 900 grains per sample (28,800 grains total) were identified to determine floral composition.

Plants located in the vicinity of the red clover field were also surveyed throughout bloom and pollen was collected from each plant in bloom during the four weeks of the study, and processed for use as a reference.

Results and Discussion

We observed an increase in both the quantity and diversity of pollen collected by bumble bee colonies placed adjacent to the red clover field over the four weeks of the study. The weight of stored pollen reserves tripled between the first and second sampling periods after which it continued to steadily increase (Figure 1). Bumble bee colonies store pollen reserves for only 2-3 days (Alford, 1975), and hence pollen weight is likely correlated with colony size. The steady increase in pollen could thus represent the period of rapid colony growth.

The composition of the pollen changed over the four weeks of the study (Figure 2). Initially, half of the pollen in the pots consisted of red clover pollen and the remaining half was that of blackberry. In the remaining three weeks, close to three fourths of the pollen was comprised of red clover while the remaining consisted of pollen from other weeds surrounding the field as blackberry was no longer in bloom.

The high proportion of blackberry pollen in the pots may suggest that bumble bees prefer to forage on blackberries over red clover. However, another factor that potentially affects bumble bee foraging in red clover in early July is competition with honey bees (Rao and Stephen, 2009). Growers typically rent 1-2 hives per acre for pollination of red clover seed crops, and initially honey bee workers appear to forage on the crop. However, after a few weeks, they appear to move to other foraging resources in the vicinity in which nectar is more easily accessible compared to red clover (Westgate and Coe, 1915; Peterson et al., 1960). This period coincides with higher abundance of bumble bees in red clover seed production fields in the Willamette Valley (Rao and Stephen, 2009). The overall high abundance of red clover pollen in the pollen pots in bumble bee colonies provides further evidence of their role as key

pollinators of the crop in the region. Further research is needed to determine whether the lower abundance in early July is due to competition with blackberries or with honey bees.

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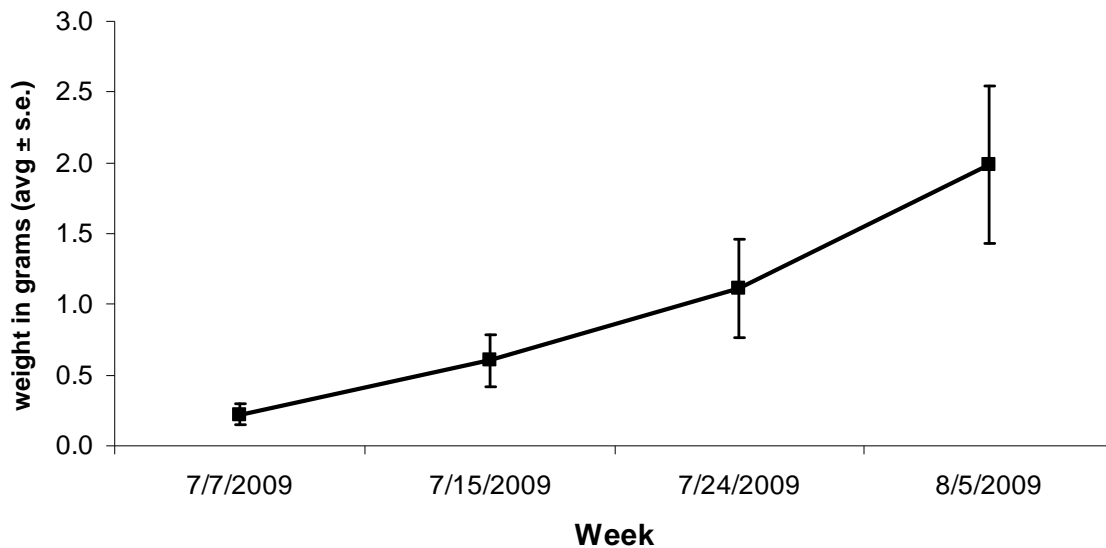


Figure 1. The cumulative weight of stored pollen reserves in eight colonies of *Bombus vosnesenskii* placed adjacent to a red clover seed production field during bloom.

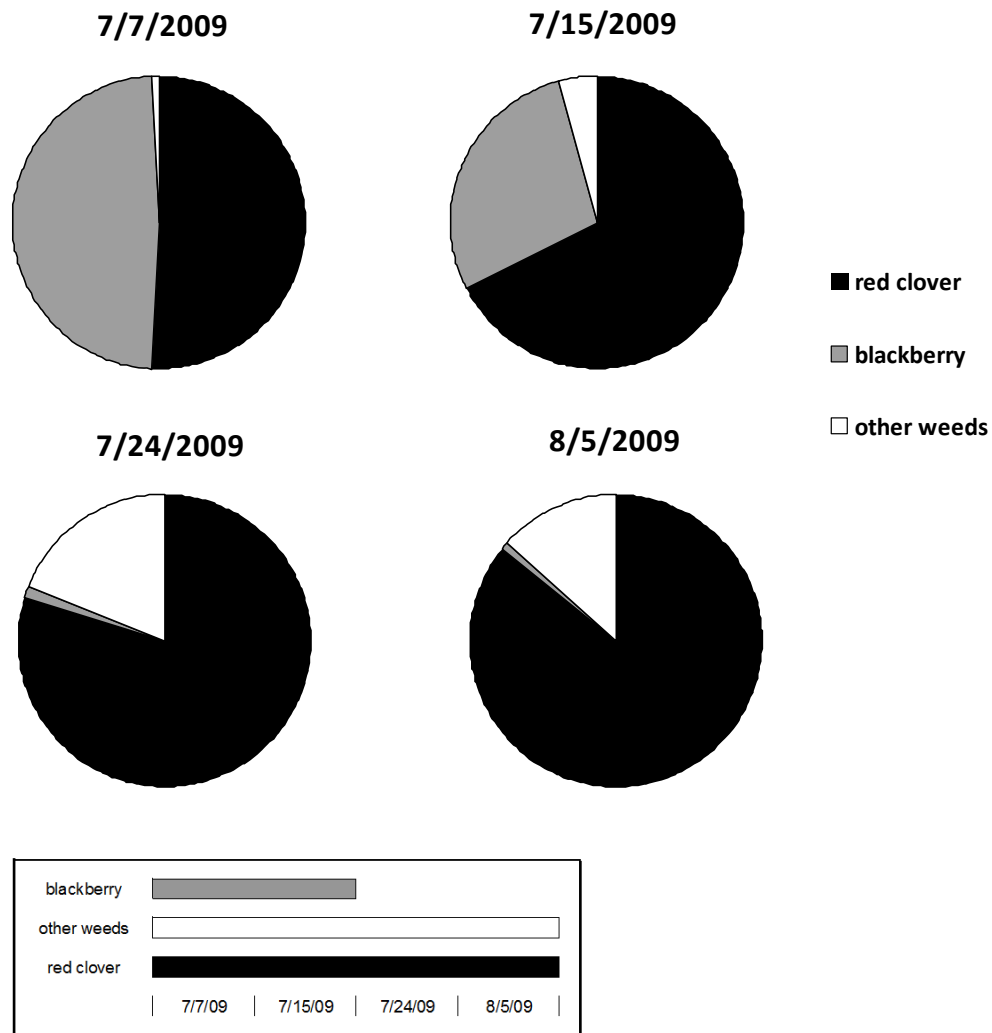


Figure 2. The floral composition of stored pollen reserves in eight colonies of *Bombus vosnesenskii* placed adjacent to a red clover seed production field and the bloom period of plants in the vicinity of the field.