General Research Fund – Final Report

A. **Title**: Bee pollinators for increased oilseed yield of meadowfoam in the Willamette Valley

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B. Summary of Research

Background: Meadowfoam, *Limnathes alba* Benth, a key winter-annual rotation crop raised by Willamette Valley growers in western Oregon, has the additional benefit of providing them with income. Seeds from the crop are harvested for oil. For seed production, the many flowers that the crop produces annually need to be pollinated. While farmers typically rent honey bee hives for pollination of this crop, honey bee worker bees do not like to forage in the cool wet weather that often prevails during meadowfoam bloom. To maximize pollination during the few warm days that the region experiences in spring, producers rent high numbers of hives. However, in recent years, honey bees have declined due to colony collapse disorder and disease caused by mites, and hence their availability has decreased while rental costs have increased. Furthermore, production of meadowfoam nectar is known to be less than optimal for maintenance of honey bee colonies. Thus, alternative native pollinators are needed to provide greater stability in seed production and to reduce the costs that are currently required to rent honey bee hives. Hence, the objectives of the study were to determine the diversity and abundance of native bees present during meadowfoam, determine which bees forage on the crop, and to determine flower characteristics that would increase bee attraction.

Methods: In 2011 and 2012, bee traps were set up at four meadowfoam fields in the Willamette Valley from Monmouth in the north to Junction City in the south. Bees were collected from traps every week, preserved, pinned and identified. Counts were made of pollinators foraging on meadowfoam bloom during 10 sets of 2 minute observations made by walking along borders of meadowfoam fields. In addition, counts of honey bees and native pollinators were taken on replicated plots of 8 or more meadowfoam cultivars at OSU's Hyslop Farm on 13 occasions over a two-year period. For estimation of flower characteristics, flowers were collected at OSU's East Farm to investigate methods for quantifying levels of nectar production in a nursery of 200 distinct meadowfoam genotypes.

Results: The studies showed that a diversity of social and solitary native bees were trapped in bee traps at the four locations. In all, bees belonging to 8 genera in 3 families were recorded from the traps. These included 5 species of *Bombus*, (bumble bees), over 10 species of halictids belonging to *Agapostemon, Halictus, Lasioglossum*, *Dialictus*, and *Specodes* genera, and other bees belonging to the genus *Osmia* (blue orchard bees) and *Synhalonia*. In contrast to trap captures, little diversity was observed in bee foragers on meadowfoam bloom. Halictids (sweat bees) and syrphids (hover flies) were the dominant groups of foraging on the

flowers. During the 2 minute observations periods, halictid forager abundance ranged from an average of 1 to 11.5 while that of syrphids ranged from 0.9 to 3.4. In replicated variety trials, the average honey bee count per 80 ft^2 plot ranged from 24.7 for the cultivar 'Starlight' to 28.7 for the cultivar 'MF 192' in 2011. Although this difference was statistically significant, it could only be detected by combining results from repeated measurements on the plots through the flowering period. Varieties with higher bee counts tended to have higher bloom densities. Syrphid counts were greatest when there was some cloud cover. Several methods were investigated for estimating nectar production, including measurement of the diameter of the nectaries, and the use of Whatman filter paper wicks and capillary tubes. Due to the limited amount of nectar produced by meadowfoam flowers, the most reliable method for basic research studies may be to rinse the nectaries with distilled water, followed by analysis with gas chromatography. However, this method is not likely to be practical for screening large numbers of genotypes in a breeding program to improve nectar production.

Conclusions: The studies documented that, despite the diversity of native bees that are in flight during meadowfoam bloom, only halictids are attracted to meadowfoam and have potential as alternative pollinators to honey bees. In addition, syrphid flies could also be contributing to some extent to meadowfoam pollination. Future research is needed to determine how populations of these groups can be enhanced during meadowfoam bloom to reduce grower dependence on honey bee hives and also benefit them economically. Further research is also needed to develop rapid methods for quantifying levels of nectar production in meadowfoam and to determine if this trait can be improved through selection in a breeding program.

C. Additional scholarly activities.

The studies conducted with GRF support were included in presentations made at national and international meeting including the Annual Meeting of the Entomological Society of America in Reno in 2011, and the International Congress of Entomology in Daegu, South Korea, in 2012. The results will be incorporated into a manuscript to be submitted to the Seed Production Report in 2013. The new collaboration between the PI and the co-PI led to their further collaborating on an NSF REU (Research Experiences for Undergraduates) proposal submitted in September 2012.

D. Expenditure of grant funds

The GRF funds were used for hourly pay for students to help with conducting the experiments, travel to field sites, and for lab and field supplies for conducting the experiments.

E. External funding requests developed and submitted.

None so far as the data has just been analyzed.