TITLE: Promoting bee health and nutrition through flowering lawns

RESEARCH LEADERS: Alec Kowalewski, Turfgrass Specialist, Carolyn Breece, Faculty Research Assistant, Oregon State University

A.K. CONTACT INFO: (541) 737-5449, alec.kowalewski@oregonstate.edu
C.B. CONTACT INFO: (541) 737-5440**,** carolyn.breece@oregonstate.edu

COOPERATOR: Ramesh Sagili, Associate Professor-Apiculture, Oregon State University
R.S. CONTACT INFO: (541) 737-5460, ramesh.sagili@oregonstate.edu

Executive Summary:

Popular interest in pollinator habitat within the home lawn is ongoing and increasing. This coupled with the environmental service provided by increased pollinator populations presents a strong need for research and data pertaining to pollinator habitat in the home lawn. Therefore, the overall objective of this research is to identify a mixture of seeds that would yield an aesthetic flowering lawn with abundant pollen and nectar resources to attract bees, i.e., a Pacific Northwest Bee Lawn.

On September 14, 2016, we established a field research trial at the Oregon State University Oak Creek Center for Urban Horticulture in Corvallis, OR. For this project six different seed mixtures were established: 1) perennial ryegrass (negative control), 2) Fleur de Lawn, 3) bee lawn mixture I, 4) bee lawn mixture II, 5) flowering ground cover mixture, and 6) bee meadow mixture. We surveyed each plot for plant diversity and pollinator visitation over a two year period.

Findings from this research determined that blooming flowers and foraging bees were observed in nearly all plots except the perennial ryegrass negative control plots. Findings also determined that perennial ryegrass and clover are aggressive, and outcompeted our flowering plants. It is important to note that clover attracts many pollinators and is a substantial nectar source. However, careful balancing of the quantities of perennial ryegrass, clover seed and other flowers is essential to a successful, diverse, flowering lawns. When trying to incorporate flowering plants from seed into existing lawns dominated by turfgrass and clover, thatching was a more successful seedbed preparation method in spring than in the fall.

Bee meadows, or un-mowed flowering plants established as a lawn alternative, could substantially increase pollinator populations. Black eyed Susans, cosmos, and California poppies were some of the more dominant species in the Willamette Valley. Research suggests that Black eyed Susan will outcompete other species and become the dominant plant in these environmental conditions.

Introduction:

Acknowledging honey bees' crucial role as pollinators, especially in agriculture, concerned citizens often express a desire to help honey bee populations and ask what they can do for bees in their communities. An easy and effective venture for citizens and managers of urban landscapes is to increase the flowering plants in their landscapes, particularly those with high pollen and nectar content. We propose that landowners can take this a step further and incorporate flowering plants into their lawns, or creating "bee lawns". Alternative lawns have been gaining popularity since the 1990s (Brede, 2000), and just recently including "bee lawns" (Lane et al. 2016). In 1994, Oregon State University researcher, Tom Cook, developed an "eco-lawn" (commercially available as Fleur De Lawn) (Cook, 2005). This seed mixture included grasses, clover, and a variety of flowering plants. The primary function of the Fleur De Lawn was to provide homeowners with an aesthetically pleasing low-maintenance lawn. Pollen and nectar abundance for attracting bees was not considered when developing this plant mixture.

Objectives:

The overall objective of this research was to identify a mixture of seeds that would yield an aesthetic flowering lawn with abundant pollen and nectar resources to attract bees, i.e., a Pacific Northwest Bee Lawn.

Procedures:

On September 14, 2016, we established a field research trial at the Oregon State University Oak Creek Center for Urban Horticulture in Corvallis, OR. Prior to the initiation of research, we sprayed the experimental area with a non-selective herbicide (Round-Up Pro) twice (14 days apart), then roto-tilled and hand raked in preparation of seeding. Just prior to seeding, we added a ½ " layer of composted organic matter to the experimental area.

We divided two 100' x 10' beds into 18 equal (10'x10') plots. Each plot was randomly assigned one of six different treatments or seed mixtures, and each treatment had three replicate blocks (see attached diagram). The six seed mixtures included in this study were 1) perennial ryegrass (negative control), 2) Fleur de Lawn, 3) bee lawn mixture I, 4) bee lawn mixture II, 5) flowering ground cover mixture, and 6) bee meadow mixture. The commercially available eco-lawn mixture 'Fleur de Lawn' is a combination of colonial bentgrass, strawberry and Dutch white clover, wild English daisies, yarrow, and baby blue eyes. The experimental bee lawn mixture I contained perennial ryegrass, Dutch white clover, microclover, baby blue eyes, California bluebell, and roman chamomile. Experimental bee lawn mixture II is a combination of perennial ryegrass, Dutch white clover, microclover, snow in summer, yarrow, and creeping thyme. The flowering ground cover mixture contained no grass and is composed of Dutch white clover, microclover, ajuga, viper's bugloss, snow in summer, and creeping thyme. The

bee meadow mixture, or the positive control, comprised of flowering species known to attract pollinators. These include coneflower, viper's bugloss, California poppy, sunflower, blanket flower, borage, coreopsis, black-eyed Susan, crimson clover, and bachelor's buttons.

Beginning in the spring of 2017, we weeded plots monthly, and irrigated with 0.25" of water three times per week (Image 1). The perennial ryegrass, Fleur de Lawn, bee-lawn mixture I, bee-lawn mixture II, and flowering ground cover mixture were mowed weekly at a height of 3". We did not mow the bee meadow mixture.

In summer 2017, we determined that the plots were established and ready for a plant and pollinator count. We organized an event with volunteer "Citizen Scientists" on September 15, 2017 (Images 2, 3, and 4). Citizen Scientists received training in bee identification and proper survey techniques. We surveyed each plot for plant diversity, counted bees in 1-minute intervals, and counted flowering plants in 1'x1' sub-plots. We also had educational displays of common pollinators and a habitat walk with a local expert. We surveyed plots for plant composition in September 2017 and 2018. For each plot, surveyors counted each plant in 1'x1' subplots.

First Year (2017) Accomplishments:

On September 15, 2017, the Fleur de Lawn seed mixture was predominantly colonial bentgrass (64.7%) and clover (34.3%) (Table 1). These plants are able to persist in low fertility environments when subjected to frequent mowing, which likely allowed them to outcompete the others seeds within the planted mixture.

Experimental bee lawn mixture I and II were predominantly perennial ryegrass (44.3% and 53.0%, respectively) and clover (55.7% and 47.0%, respectively) (Table 1). Similar to bee lawn mixtures, the perennial ryegrass plots were 52.7% perennial ryegrass, and 47.3% clover**.** Frequent mowing and low fertility generated an environment that was conducive to clover, which likely invaded into these plots, a common occurrence within home lawns that are not fertilized.

In the fall of 2017, the flowering ground cover mixture was predominately clover (82.7%), and again, the low fertility and frequent mowing within these plots provided an environment that allowed the clover to outcompete the other flowering ground covers (Table 1). Surprisingly, turfgrass was observed within these plots at a substantial level (17.3%), which was likely the result of invasive grasses that regularly encroach upon lawns within the Willamette Valley (dryland bentgrass, creeping bentgrass, colonial bentgrass, and annual bluegrass).

The composition of the bee meadow seed mixture was made up of cosmos (21.2%), California poppy and black-eyed Susan's (15.9% each), followed by viper's bugloss, coreopsis, crimson clover and bachelor's button (10.6% each), and sunflower (5.3%). Coneflower, blanket flower and borage, while seeded in the fall of 2016, were not observed in the fall of 2017.

On September 15, 2017, we observed no bees within the perennial ryegrass, Fleur de Lawn, and experimental bee lawn mixture I plots. In the experimental bee lawn mixture II plots, we observed an average of one bee per 1 sq ft per one minute, and in the flowering ground cover mixture, an average of three bees per 1 sq ft per one minute were observed. These mowable plots averaged a very low flower blossom count (1.8 clover flower blossoms per 1 sq ft) at this time, which is not surprising because the peak season for clover flowering is late spring/early summer. The bee meadow averaged four bees per 100 sq ft per one minute and 254 flower blossoms per 100 sq ft.

We were surprised at the aggressive growth of the grass and clover in our experimental mixes. This growth affected the establishment of our flowering plants in each mix. We were optimistic that our post-season plot treatments (scalping, thatching, inter-seeding) would encourage the establishment of the flowering plants in spring 2018.

Second Year (2018) Accomplishments:

Upon analysis of our 2017 data and a visual review of the plots, we concluded that the grass and clover in each "mixture" plot were aggressively outcompeting the flowering plants. In mid-October 2017, we scalped (mowed at 0.5") and collected the clippings from the mixture lawns to minimize competition of grass and clover, and we thatched (verti-cut) to create patches of bare soil ready for new seeds (Image 5). We then inter-seeded flower seeds according to each mixture (Image 6). We hoped to see these flowering plants successfully establishing in the presence of grass and clover in spring 2018.

In April 2018, we determined that our October seedlings had again been outcompeted by grass and clover. In May 2018, we thatched the plots again, and interseeded with larger quantities of flowering plant seeds (Image 7). The new additions to bee lawn mixture I included roman chamomile, alyssum, and California bluebell. Bee lawn mixture II was supplemented with thyme, five spot, and baby blue eyes. The flowering ground cover mixture additions included California bluebell, thyme, alyssum, and baby blue eyes. The bee meadow was supplemented with additional seed of the same composition as in 2017. No additional grass or clover seed was added to plots in 2018.

By July 2018, seedlings had successfully established and many were beginning to bloom. We observed California blue bell, alyssum, and clover blooming in several plots (Image 8 and 9). We also observed many honey bees visiting the flowers. However, by late July, we discovered that the majority of our flowering plants could not withstand a lack of irrigation, and we lost much of the flowering plant component of our bee lawns. Due to the loss of flowering plants, we did not do a bee count in summer 2018. We surveyed for plant composition in September and October (Image 10).

In 2018, the colonial bentgrass and clover populations within the Fleur de Lawn seed mixture decreased slightly (64.7 to 58.3% and 34.3 to 30.6%, respectively), while the percentage of weed population increased from 1 to 10.2% (Table 2).

Similar to 2017 results, the experimental bee lawn mixture I and II were predominantly perennial ryegrass (47.2% and 48.1%, respectively) and clover (49.1% and 50%, respectively) in 2018 (Table 2). Slight increases in weed cover were observed within the bee lawn mixture I and II plots (2.8% and 0.9%, respectively). As a result of the fall 2017 and spring 2018 interseeding events, small populations of chamomile were observed within bee lawn mixture I, and alyssum in bee lawn mixture II.

In 2018, the perennial ryegrass plots were substantially more perennial ryegrass (73.1%, compared to 52.7% observed in 2017) and less clover (17.6%, compared to 47.3% observed in 2017) (Table 2). Frequent mowing and low fertility generated an environment that was conducive to clover, which likely invaded into these plots, a common occurrence within home lawns that are not fertilized. However, similar to the Fleur de Lawn seed mixture, the perennial ryegrass plots had substantially high weed populations in 2018 (7.4%), compared to 2017 (0.0%). Small populations of alyssum were observed in the perennial ryegrass plots and likely the result of seed contamination from the fall 2017 and spring 2018 interseeding events.

In the fall of 2018, the flowering ground cover mixture was predominately clover (66.7%), and again, the low fertility and frequent mowing within these plots provided an environment that allowed the clover to outcompete the other flowering ground covers (Table 2). Turfgrass was observed within these plots at a substantial level (17.3% in 2017 and 25.9% in 2018), which was likely the result of invasive grasses that regularly encroach upon lawns within the Willamette Valley (dryland bentgrass, creeping bentgrass, colonial bentgrass, and annual bluegrass). Similar to the Fleur de Lawn and perennial ryegrass plots, weed populations increased from 0.0% in 2017 to 4.6% in 2018.

In 2018, the composition of the bee meadow mixture was dominated by black eyed Susan (72.7%), which substantially increased in cover from 2017 (15.9%). Other plants observed in 2018 include blanket flower (12.1%), coreopsis (6.1%), lupin (6.1%) and borage (3.0%). Coneflower, while seeded in the fall of 2016 and 2017, was not observed in the fall of 2018. While cosmos, California poppy, viper's bugloss, crimson clover, bachelor's buttons and annual sunflower were observed in 2017, these plants did not return in 2018 as they were likely outcompeted by the aggressively growing black eyed susan.

Final Conclusion:

After much trial and error, we were encouraged by our July 2018 bee lawns. Our thatching efforts successfully provided seeds a space to establish among the grass and clover. Blooming flowers and foraging bees were observed in nearly all plots except the perennial ryegrass negative control plots. Had the plots been irrigated throughout the summer, we would have been interested to see if the initial establishment of the flowering plants could withstand the pressure of the grasses and clover later in the season.

Successful establishment of flowering lawns takes careful planning and treatment of existing lawns. We found perennial ryegrass to be prohibitively aggressive during our attempts to interseed with flowering plants, even after vigorous lawn manipulation. The clover species we planted were also aggressive and outcompeted our flowering plants, however, clover attracts many pollinators, as it is a substantial nectar source. Careful balancing of the quantities of clover seed and other flowers is essential to a successful, diverse, flowering lawn. Thatching existing lawn to expose bare ground for flower seeds was more effective in spring than in fall. The combination of clover and perennial ryegrass had the lowest weed populations at the end of this two year study, suggesting that this plant competition is optimum for preventing weed encroachment.

Irrigation is a crucial component to a flowering lawn. Most drought-resistant flowering plants are not likely to produce enough nectar to attract pollinators. Therefore, a committed watering schedule is necessary to produce continuous blooms and a lush, green "lawn" aesthetic.

Bee meadows, or un-mowed flowering plants established as a lawn alternative, could substantially increase pollinator populations. Black eyed Susans, cosmos, and California poppies were some of the more dominant species in the Willamette Valley. Black eyed Susan may outcompete other species and become the dominant plant in these environmental conditions.

Benefits and Impact:

Findings from this research provide home owners with options to traditional home lawns that increase pollinator populations. These options include a variety of mowable ground cover mixtures with and without turfgrass, and flowering meadows, which could be established in place of lawns to substantially increase pollinator populations with the landscape.

Additional and Future Funding:

Popular interest in pollinator habitat within the home lawn is ongoing and increasing. This coupled with the environmental service provided by increased pollinator populations identifies a strong possibility for future funding. The plant genus and species evaluated in this research represent a small population of flowering ground covers, flowing meadow plants, and turfgrass genus. Considering these factors, the potential for research funding is strong and will be jointly pursued by the OSU Turfgrass and Apiculture Programs.

Table 1: Mean percent plant cover (0-100%) observed within the five seed mixtures that were mowed weekly at 3.0" at the Oak Creek Center for Urban Horticulture in Corvallis, OR, observed September 15, 2017 (Year 1).

	Percent plant cover (0-100%)		
Seed Mixture	Turfgrass	Clover	Weeds
Fleur de Lawn	64.7	34.3	1.0
Bee lawn mix I	44.3	55.7	0.0
Bee lawn mix II	53.0	47.0	0.0
Perennial ryegrass	52.7	47.3	0.0
Flowering ground cover mix	17.3	82.7	0.0

Mixture composition:

Fleur de Lawn: colonial bentgrass, strawberry and Dutch white clover, wild English daisies, yarrow and baby blue eyes

Experimental bee lawn mixture I: perennial ryegrass, Dutch white clover, microclover, baby blue eyes, California bluebell, and roman chamomile

Experimental bee lawn mixture II: perennial ryegrass, Dutch white clover, microclover, snow in summer, yarrow, and creeping thyme

Flowering ground cover mixture: Dutch white clover, microclover, ajuga, viper's bugloss, snow in summer, and creeping thyme

Table 2: Mean percent plant cover (0-100%) observed within the five seed mixtures that were mowed weekly at 3.0" at the Oak Creek Center for Urban Horticulture in Corvallis, OR, observed September 14, 2018 (Year 2).

	2018 percent plant cover (0-100%)						
Seed Mixture	turfgrass	clover	yarrow	daisy	alyssum	chamomile	weeds
Fleur de Lawn	58.3	30.6	0.9	0.0	0.0	0.0	10.2
Bee lawn mix I	47.2	49.1	0.0	0.0	0.0	0.9	2.8
Bee lawn mix II	48.1	50.0	0.0	0.0	0.9	0.0	0.9
Perennial ryegrass	73.1	17.6	0.9	0.0	0.9	0.0	7.4
Flowering ground cover mix	25.9	66.7	0.0	0.0	2.8	0.0	4.6

Mixture composition:

Fleur de Lawn: colonial bentgrass, strawberry and Dutch white clover, wild English daisies, yarrow and baby blue eyes

Experimental bee lawn mixture I: perennial ryegrass, Dutch white clover, microclover, baby blue eyes, California bluebell, and roman chamomile

Experimental bee lawn mixture II: perennial ryegrass, Dutch white clover, microclover, snow in summer, yarrow, and creeping thyme

Flowering ground cover mixture: Dutch white clover, microclover, ajuga, viper's bugloss, snow in summer, and creeping thyme

Photo gallery

Image 1: Weeding. June 23, 2017.

Image 2: Counting bees in 1'X1' square plots in the flowering ground cover mixture. September 15, 2017.

Image 3: Counting bees in the bee lawn II mixture. September 15, 2017.

Image 4: Counting bees in the bee meadow (un-mowed positive control). September 15, 2017.

Image 5: Scalping and thatching. October 17, 2017

Image 6: Flower seedlings! November 1, 2017.

Image 7: Thatching bee lawn plots. May 10, 2018.

Image 8: Baby blue eyes, alyssum, and clover in bloom. July 6, 2018.

Image 9: Alyssum, in bloom. September 6, 2018.

Image 10: Black eyed Susan, coreopsis and blanket flower observed September 6, 2018.

Literature cited

Brede, Doug. *Turfgrass Maintenance Reduction Handbook: Sports, Lawns, and Golf*. Sleeping Bear Press, 2000.

Cook, Tom. 2005. Low maintenance turf? Oregon State University, Department of Horticulture.

Lane, I., E. Watkins, M. Spivak, and M. Meyer. 2016. Flowering Bee Lawns for Pollinators. University of Minnesota extension publication.