United States Department of Agriculture

FINAL STUDY REPORT
Aberdeen PMC, Aberdeen, Idaho

POLLINATOR CRP MIX COMPARISON

FINAL REPORT

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ABSTRACT

NRCS pollinator plantings currently recommend a mix consist of 75% or more forbs and 25% grass. Native Intermountain West plant communities however do not match these proportions and may result in difficulties with weed competition and management. Aberdeen PMC installed adjacent 2.5 ac pollinator plots, one with 75% forbs and 25% grasses and the other with 50% forbs and 50% grasses. Increased amounts of forb seed resulted in a corresponding increase in forb cover. Likewise, adjusting the percentage of grass seed resulted in an expected change in grass presence. Our results indicate that a high percentage of forb seed did not result in a significant increase in weeds. Weed pressure was high in both plantings, and noxious weeds needed to be controlled in both. Within only a few years noxious weeds become a serious concern. Without continual field evaluation and spot treatments, the plantings could become major weed infestations and a threat to neighboring lands. NRCS field offices should be aware of the inherent issues associated with these practices to be able to inform landowners prior to installation. Pollinator plantings may need to be terminated early if weeds become too problematic.

INTRODUCTION

The Conservation Reserve program of the 2008 USDA Farm Bill promotes the establishment of pollinator friendly habitat, with the desired goal in these pollinator plantings to establish a variety of pollinator species with some flowering in each of the three flowering periods – early, mid and late growing season. The mixture can also include native grasses not to exceed 25% of the total mixture.

Intermountain grass and grass-dominant plantings with a small component of forbs and shrubs are common and largely successful; however, pollinator plantings consisting predominantly of forbs pose problems not typically encountered with grass plantings. Forbs, especially native forbs, are in many cases not competitive against weed species. Forb plantings also severely limit the herbicides available for controlling broadleaf weeds.

Plantings consisting of high percentages of forbs represent an unnatural plant community in the Intermountain West. Healthy rangeland in the Intermountain West consists of approximately 5 to 25% shrub cover, 40 to 60% grasses and 5 to 20% forbs. There is concern that the 25% grass composition requirement may not provide the necessary competitive ability needed to persist in weed prone sites. More information is needed to understand pollinator planting dynamics and management in our region.

MATERIALS AND METHODS

In 2011, the PMC established 5 acres of pollinator habitat for display and to research management requirements involved in pollinator friendly plantings. The planting was established in field 28 of the

PMC Fish and Game farm 5 miles northeast of Aberdeen. Soil at the planting site is a Declo silt loam with pH of 7.4 to 8.4. Average annual precipitation is 9.39 inches.

In 2010, the year prior to planting, the field was planted to field corn and managed for wildlife habitat. The stubble was mowed in the spring of 2011. The field was irrigated after mowing to get weed seeds and volunteer grains to germinate. The field was then sprayed with 64 oz Glyphosate/ac on May 11 and then seeded on May 18. The western 2.5 acres of the field were planted to a mixture consisting of 25% grasses (mix 1), while the eastern 2.5 acres were planted to a mixture of 50% grasses (mix 2).The field was irrigated through the growing seasons of 2011, 2012 and 2013 to approximate 14 to 16 inches of annual precipitation, the suitable range for the species in the seed mixture. The planting was not irrigated in 2014 or 2015. In 2011, the establishment year, the fields were mowed three times after planting to prevent weeds from going to seed. In 2012, 2013, 2014 and 2015 noxious weeds such as broadleaf pepperweed (*Lepidium latifolium*), musk thistle (*Carduus nutans*), burdock (*Arctium minus*), Canada thistle (*Cirsium arvense*), and field bindweed (*Convolvulus arvensis*) were spot-treated with the equivalent of 64 oz Glyphosate/ac.

The two pollinator mixes were developed to compare forb establishment and persistence with varying grass composition. The mixes were designed to provide blossoms for foraging insects in all three flowering periods (Table 1). Each mixture has the same species components, but they have different proportions of forbs and grasses. The first mix follows NRCS guidelines and contains a 25% grass component and 75% forbs (Table 2). The second mix is designed to more closely approximate natural healthy rangeland conditions. This mix contains the same species components, but the grasses are doubled to comprise 50% of the total mix, and the forb amounts are halved. The mixtures contain only 7 pollinator species. This reflects the limited number of available forb species suitable for use in arid to semi-arid environments, especially those with late summer bloom periods.

Table 1. Pollinator planting mixture components

			Bloom Color and Time			
Scientific Name	Common Name	Variety	spring	summer	late summer	Origin
Pseudoroegneria spicata	Bluebunch wheatgrass	Anatone				Native
Leymus cinereus	Basin wildrye	Magnar				Native
Poa ampla	Big bluegrass	Sherman				Native
Achillea millifolium	Western yarrow	Great Northern	✿	✿		Native
Linum perenne	Blue flax	Appar	✿			Introduced
Medicago sativa ssp. *falcata*	Falcate alfalfa	Don	✿			Introduced
Sanguisorba minor	Small burnet	Delar		✿		Introduced
Onobrychis vicaeifolia	Sainfoin	Common	✿	✿		Introduced
Helianthus annuus	Sunflower	Common			✿	Native
Machaerranthera canescens	Hoary tansyaster	Common			✿	Native

The seed in each of the mixes was separated according to seeding depth, one mix for drilling seed at 1/4 to 1/2 inch and a second, broadcast mix for shallow (0 to 1/8 inch) seeding (see appendix). Because the planting was done using a Truax Rough Rider range drill with alternate row seeding capabilities, the

standard seeding rates (Ogle and others, 2011b) were also cut in half. By doing an alternate row seeding, the number of rows planted is effectively halved and seeding rates are therefore adjusted. Seeding rates and drill calibrations are shown in the appendix. All seed was mixed with rice hulls as an inert carrier to facilitate flow through seeding equipment using specifications found in St. John and others (2005).

Table 2. Seed mixture percentages

#	Variety	Common Name	25% grass	50% grass
			% of mix	% of mix
1	Anatone	Bluebunch wheatgrass	5	10
2	Magnar	Basin wildrye	5	10
3	Sherman	Big bluegrass	15	30
4	Great Northern	Western yarrow	5	2.5
5	Appar	Blue flax	10	7.5
6	Don	Falcate alfalfa	10	5
7	Delar	Small burnet	15	7.5
8	Eski	Sainfoin	20	10
9	Common	Sunflower	10	5
10	Common	Tansyaster	5	2.5

Evaluations took place on July 12, 2011, June 15, 2012, June 17, 2013, May 13, 2014 and June 10, 2015. In 2011 through 2014, a single 200 ft transect was laid diagonally in each field beginning 100 ft from the southwest corner. Plant densities of target species were measured using a frequency grid based on that described by Vogel and Masters (2001). The grid measured approximately 40 x 41 inches, having four ten inch columns (to incorporate 1 drill row per column) and five rows, totaling 20 cells. Counts were made of the cells that contained at least one plant. Evaluations were made at 20 foot intervals making a total of 10 frames evaluated per seed mixture. The total cells were added for each species to determine average plants/ft². It is important to note that because cells with plants were counted and not number of plants per cell, the best possible score is 200 hits per ten frames which converts to 1.85 plants/ft^2. Actual plant density may be higher than the numbers indicated below.

In the 2015 evaluation, two 200 ft transects were used in each planting to gather line-intercept plant frequency data. Data points were observed every two feet. Storied observations were made of all species encountered at each point of intercept, and not merely the uppermost canopy.

It was difficult to find target species in the masses of weeds at the time of the first season evaluation. The native grasses were particularly difficult to find and were not counted in the evaluation. In 2012 through 2015 target grass species were more easily identified and were included in the evaluation.

RESULTS AND DISCUSSION

2011

In 2011, the 25% grass seed mix produced approximately 2 times more total forbs than the 50% grass mixture (Table 3); however, overall weed densities were similar for both planting mixes. These differences are to be expected early in the first growing season as the seeded plants are generally not big enough to cause direct competition for resources. Few target grasses were observed, as young grass leaves are easily missed in the thick weeds.

Despite previous farming practices and weed control efforts, there was an abundance of annual weeds present in both fields. The most prevalent weed species in 2011 included witchgrass (*Panicum capilare*),

shepherd's purse (*Capsella bursa-pastoris*), field bindweed (*Convolvulus arvensis*), volunteer wheat (*Triticum aestivum*), lamb's quarters (*Chenopodium album*), prickly lettuce (*Lactuca serriola*), red-root pigweed (*Amaranthus retroflexus*), prostrate pigweed (*A. blitoides*), nightshade, (*Solanum* sp.) and tumble mustard (*Sisymbrium altissimum*). Mowing provided fair control of annual broadleaf weeds, but witchgrass continued to dominate the fields throughout the season (Figure 1). In late summer, sunflowers covered the field with a thick understory of witchgrass (Figure 2).

2012

Densities of all seeded species stayed the same or increased from 2011 to 2012. The plants were likely more numerous from volunteering, and were also larger and easier to find. Overall densities of target species were not different between the 25% and 50% grass plots in 2012. In 2012 total target species densities were 4 times greater in the 25% grass mix and 9 times greater in the 50% grass mix compared to 2011, with much of the increase being accounted for by the establishment and observation of grasses in 2012. Grass densities were 2 times higher in the 50% grass mix than the 25% grass mix as expected. There were approximately 2 times more alfalfa and sainfoin plants observed in the 25% grass plots than in the 50% grass plots. Sunflower and blue flax densities were essentially equal between the two treatments in 2012, as volunteers from seed shed the previous year (especially from sunflower) eliminated the original proportions. Yarrow densities were 7 times greater in the 25% grass plots than the 50% grass plots. Hoary tansyaster was observed in the planting but not encountered in the evaluated transects.

Figure 1. A solid stand of witchgrass. The planting was mowed 3 times to reduce the risk of weeds setting seed. Photo take July 20, 2011.

Figure 2. Despite mowing, sunflowers persisted and produced flowers in the first growing season. Photo taken September 12, 2011.

Total weed density was 40% lower in 2012 than 2011; however weed densities were not significantly different between the 25 and 50% grass treatments. The most abundant weed species encountered in 2012 was spear saltbush (*Atriplex patula*). This species may have been mistaken for lamb's quarters in 2011. Other weed species encountered in 2012 included Canada thistle, dandelion (*Taraxacum officinale*), kochia (*Bassia scoparia*), sowthistle (*Sonchus* sp.), cheatgrass (*Bromus tectorum*), yellow salsify (*Tragopogon dubius*), and biennial cinquefoil (*Potentilla biennis*). Other species seen in the planting but not in the evaluated transects included hound's tongue (*Cynoglossum officinale*), bull thistle (*Cirsium vulgare*), musk thistle, and catnip (*Nepeta cataria*).

2013

The planting composition changed dramatically from 2012 to 2013. Grass and forb target species densities declined in both plantings. In the 25% grass mixture, grass densities decreased from 0.15 plants/ft² to 0.04 plants/ft². Similarly, in the 50% grass planting, densities decreased from 0.30 to 0.14 plants/ft². Forb densities decreased in the 25% grass seeding from 2.49 to 1.01 plants/ft², a 60% reduction, and from 2.83 plants/ft² to 1.28 plants/ft² in the 50% grass seeding, a decrease of 55%. Many species including falcate alfalfa, small burnet and sainfoin decreased between 33 and 50% from the

previous year. Annual sunflower declined as much as 60% from 2012, which explains the majority of the decrease in total target species density for the year.

Most weed species had similar densities compared to 2012 with the exception of prickly lettuce which increased approximately 300%. Prickly lettuce densities increased from 0.5 plants/ft² to 1.75 plants/ft² in the 25% grass planting and 0.45 plants/ft² to 1.45 plants/ft² in the 50% grass planting.

2014

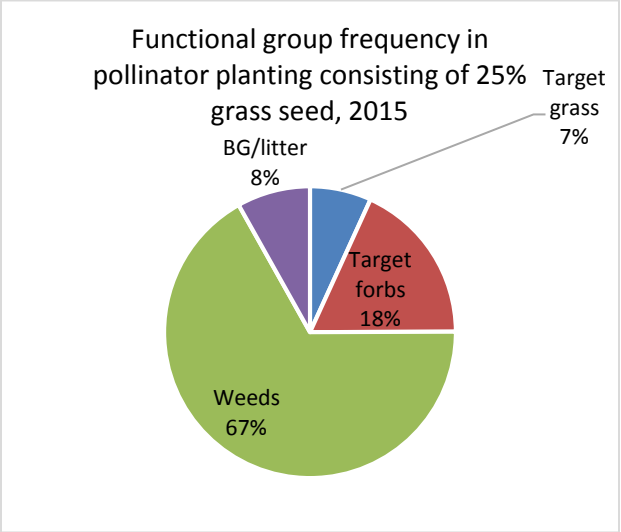
In 2014 spring precipitation caused a flush of new seedlings, most notably of Appar blue flax. Approximately 2 times more forbs were recorded in the 25% grass mix compared to the 50% grass mix. Similarly grass densities in the 50% grass mix were double those of the 25% grass mix. Additionally, a significant reduction of weeds was observed in the 50% grass mix compared to the 25% grass mix, indicating that the increased grass percentage is at least somewhat effective at competing against non-target species. Prickly lettuce densities stayed at approximately the same level as last year. This continues to be a problem late in the season when the lettuce overtops many of the flowering target species. Dispite increasing stands of prickly lettuce, the forb component remained largely intact and functional (Figure 3).

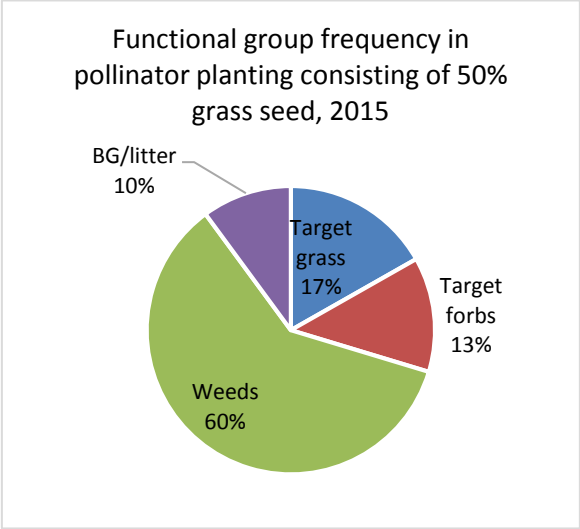
Figure 3. Falcate alfalfa, small burnet, blue flax and basin wildrye can be seen. June 20, 2014.

2015

Cover class frequency data from 2015 indicate that doubling the amount of grass seed (and halving the amount of forb seed) in the mix produced corresponding changes in overall plant cover. The 50% grass mix stand was comprised of approximately 17% target grasses as compared to 7% cover in the 25% grass mix. Similarly, target forb cover increased from 13 to 18% from doubling the forb seed. Though not quite doubling the stand, it did follow the predicted trend. Weed cover; however, was only reduced from 67% to 60% by doubling the grass seed.

Figure 4. Cover frequency pie charts for 25% grass mix and 50% grass mix.





DISCUSSION

Acceptable establishment densities for NRCS plantings range from 1 to 2 plants/ft² (Ogle et al., 2011a). In 2011, the evaluated plant densities fell short of this standard; however this is likely due to the grasses not being included in the evaluation. In 2012 both treatments averaged more than 2 plants/ft². In 2013 plant densities of target species had decreased to nearly 1 plant/ft².

In the first growing season we saw little pollinator value in the two fields planted as most perennial forbs are not expected to blossom during the first growing season. Additionally, annual weeds forced multiple mowing treatments which removed the majority of flowers available for foraging insects. Annual sunflower persisted and blossomed despite the mowing; however, and provided food for foraging bumblebees in late summer and early fall. In 2012 there was no mowing and the perennial forbs were allowed to flower. Abundant pollinator activity was witnessed at the time of evaluation. Very little tansyaster was seen at the evaluation time; however more was observed later in the season, but was largely overshadowed by sunflower. Sunflower plants were small in June, with the majority of plants showing 2 to 4 true leaves, approximately 3 inches tall. In September the sunflower had formed a dense stand with plants averaging 3 to 8 feet tall.

Figure 5. Native bee (bottom left) and bee fly (right) visiting yarrow flowers in June, 2013.

During the second year the planting appeared to be an excellent pollinator resource. Native and European bees were observed foraging on all of the target forb species. The planting also provided excellent cover and forage for wildlife. Deer were observed in the planting and grazing was observed on sainfoin, small burnet, and prickly lettuce. Birds were also abundant in the planting.

In 2013 and 2014 target forbs and grasses were less prevalent than in 2012. Numerous blooms were still available however, and pollinator visitation was observed for all target forbs (figure 5). In the second

half of the season the planting site was densely crowded with prickly lettuce which overtopped most of the target species (figure 6).

Weed species present a serious impediment to successful long-term pollinator plantings. Weedy species like prickly lettuce can overtop target forbs potentially making them less visible from the air and reducing pollinator visits. Weeds also compete for resources with target species reducing desired forb densities over time.

Figure 6. Prickly lettuce dominates the pollinator planting in mid-summer, 2013.

Noxious weeds are also a concern. Idaho state noxious weeds observed within the pollinator planting include musk thistle, Canada thistle, field bindweed, broadleaf pepperweed, and hound's tongue. Spot treatments of herbicides may be necessary to control and prevent the spread of noxious weeds. Farming practices and field history indicate that many of these species were not present prior to the planting and may have been introduced with non-certified seed. Use of certified seed is highly recommended to ensure seed quality.

Very few options exist for controlling broadleaf weeds in forb plantings. Hand rogueing and spot spraying are only feasible for small, concentrated infestations. Conversion of forb/pollinator plantings to weed dominated ground seems likely.

CONCLUSION

There are many challenges in managing forb and pollinator plantings. Maintaining forb populations while controlling noxious weeds is perhaps the most limiting factor in stand longevity. Within only a few years, our plantings were invaded with noxious weeds, some of which had never been encountered before at the PMC. Without continual field evaluation and spot treatments, the plantings could easily become serious weed infestations and a threat to neighboring lands. NRCS field offices should be aware of the inherent issues associated with these practices to be able to inform landowners prior to installation. Pollinator plantings may need to be terminated early if weeds become too problematic.

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Table 3. Pollinator planting plant densities (plants/ft²) from July 2011 through June 2013.

Target species	2011 25% Grass	2011 50% Grass	2012 25% Grass	2012 50% Grass	2013 25% Grass	2013 50% Grass	2014 25% Grass	2014 50% Grass
	----------Plants/ft²----------							
Bluebunch wheatgrass			0.06	0.11		0.02	0.01	0.05
Basin wildrye.			0.06	0.13	0.03	0.08	0.05	0.07
Big bluegrass			0.03	0.06	0.01	0.04		0.05
Total grasses	0.00	0.00	0.15	0.30	0.04	0.14	0.06	0.17
Western yarrow	0.02	0.02	0.07	0.01	0	0.02	0.02	0.02
Blue flax	0.07	0.03	0.07	0.15	0.09	0.17	0.49	0.46
Falcate alfalfa	0.07	0.02	0.28	0.20	0.16	0.15	0.29	0.09
Small burnet	0.19	0.07	0.17	0.16	0.07	0.04	0.04	0.01
Sainfoin	0.08	0.09	0.29	0.15	0.09	0.06	0.27	0.05
Sunflower	0.16	0.05	1.61	1.86	0.60	0.70	0.72	0.39
Tansyaster								
Total forbs	0.59	0.28	2.49	2.53	1.01	1.14	1.83	1.02
Total target species	0.59	0.28	2.61	2.83	1.05	1.28	1.89	1.19
Weed species								
Witchgrass	1.86	1.78			0.03	0.04		
Shepherd's purse	0.36	0.23	0.06	0.07	0.04	0.03		
Field bindweed		0.01				0.01	0.03	
Wheat	0.04	0.14						
Lamb's quarters	0.19	0.07						
Prickly lettuce	0.04	0.01	0.5	0.45	1.75	1.45	1.81	1.51
Redroot pigweed	0.25	0.16				0.04		
Prostrate pigweed	0.02							
Nightshade	0.01			0.01				
Tumble mustard		0.01		0.01				
Spear saltbush			1.0	0.88	0.05	0.02	0.31	0.23
Canada thistle			0.01		0.02	0.01	0.17	
Dandelion			0.04	0.02	0.01	0.05	0.08	0.05
Kochia			0.10		0.03	0.01	0.03	
Sow thistle			0.04	0.02				
Cheatgrass			0.01					
Salsify			0.01	0.01				
Cinquefoil				0.01				
Total weed species	2.77	2.41	1.76	1.48	1.93	1.66	2.43	1.79

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Table 4. 2015 Cover Frequency			
		25% grass mix	50% grass mix
Target grasses		Cover frequency	Cover frequency
	Bluebunch	0.3	0.4
	Basin wildrye	6.5	16.0
	Big bluegrass	0.0	0.4
Target forbs			
	Yarrow	0.6	1.0
	Blue flax	3.2	4.0
	Falcate alfalfa	6.2	2.7
	Small burnet	0.0	0.4
	Sainfoin	3.6	2.7
	Sunflower	4.5	1.5
Weeds			
	Sheperd's purse	0.6	1.5
	Lettuce	33.4	42.0
	Canada thistle	9.4	5.8
	Atriplex	6.8	7.8
	Dandelion	0.3	5.8
	Kochia	13.6	0.0
	Tumblemustard	1.9	0.4
	Lambsquarters	0.3	0.0
	Cheatgrass	0.3	1.2
	Musk thistle	0.0	0.8
	Bare ground/litter	8.1	10.1

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Appendix. Drill Calibrations

Mix 1 drill

Variety	Common Name	% of mix	Pure stand rate* lb PLS/acre	% PLS	lb/bu**	lb PLS/ac PLS*% of mix	bulk seed (lb/ac) PLS/%PLS*100	volume (% of bu) bulk seed/lb/bu*100
Anatone	bluebunch wg	5	4.00	84.60	21.70	0.20	0.24	1.09
Magnar	basin wildrye	5	4.00	92.70	18.50	0.20	0.22	1.17
Delar	small burnet	15	10.00	94.00	23.10	1.50	1.60	6.91
sainfoin	Sainfoin	20	17.00	90.00	28.60	3.40	3.78	13.21
sunflower	sunflower	10	11.50	90.00	23.00	1.15	1.28	5.56

Mix 1 broadcast

Variety	Common Name	% of mix	Pure stand rate* lb PLS/acre	% PLS	lb/bu**	lb PLS/ac PLS*% of mix	bulk seed (lb/ac) PLS/%PLS*100	volume (% of bu) bulk seed/lb/bu*100
						0.00	0.00	0.00
						0.00	0.00	0.00
Sherman	big bluegrass	15	1.00	90.00	17.90	0.15	0.17	0.93
Great Northern	yarrow	5	0.25	90.00	20.60	0.01	0.01	0.07
Appar	blue flax	15	2.00	97.00	46.10	0.30	0.31	0.67
Don	yellow alfalfa	10	2.50	90.00	60.00	0.25	0.28	0.46
tansyaster		5	1.00	35.00	12.00	0.05	0.14	1.19

* 1/2 of rate in Ogle and others, 2011b

** St. John and others, 2005

Mix 2 drill

Variety	Common Name	% of mix	Pure stand rate* lb PLS/acre	% PLS	lb/bu**	lb PLS/ac PLS*% of mix	bulk seed (lb/ac) PLS/%PLS*100	volume (% of bu) bulk seed/lb/bu*100
Anatone	bluebunch wg	10	4.00	84.60	21.70	0.40	0.47	2.18
Magnar	basin wildrye	10	4.00	92.70	18.50	0.40	0.43	2.33
Delar	small burnet	7.5	10.00	94.00	23.10	0.75	0.80	3.45
eski	Sainfoin	10	17.00	90.00	28.60	1.70	1.89	6.60
sunflower	sunflower	5	11.50	90.00	23.00	0.58	0.64	2.78

Mix 2
broadcast

Variety	Common Name	% of mix	Pure stand rate* lb PLS/acre	% PLS	lb/bu**	lb PLS/ac PLS*% of mix	bulk seed (lb/ac) PLS/%PLS*100	volume (% of bu) bulk seed/lb/bu*100
Sherman	big bluegrass	30	1.00	90.00	17.90	0.30	0.33	1.86
great northern	yarrow	2.5	0.25	90.00	37.00	0.01	0.01	0.02
Appar	blue flax	7.5	2.00	97.00	46.10	0.15	0.15	0.34
Don	yellow alfalfa	5	2.50	90.00	60.00	0.13	0.14	0.23
tansyaster	common	2.5	1.00	35.00	12.00	0.03	0.07	0.60

* 1/2 of rate in Ogle and others, 2011b
** St. John and others, 2005

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