Effect of Mixed Cover Crop Functional Groups on Barley Yield and Quality

Kent A McVay, Qasim Khan
Montana State University, Southern Agricultural Research Center, Huntley, MT

INTRODUCTION

The literature is robust on the effects of **single species** cover.

They are a good fit in humid areas where they:

- Scavenge nutrients
- Minimize leaching losses
- Keep soil covered for erosion control
- Provide weed suppression

But! in the semi-arid area

It's always a trade for water which makes it difficult to fit into existing rotations (economically)

There is less information on the potential of **mixed species** cover crops. But there is reason to believe they may behave differently.

- A greater diversity of biomass is returned (compared to single species)
- Mixing may:
  - enhance decomposition
  - provide faster turnover of nutrients
  - provide a more diverse environment for:
    - earthworms, arthropods, fungi, bacteria, and other soil organisms.

All of which could impact soil quality.

Mixed species can be grouped by function such as:

- oilseeds
- root crops
- legumes
- grasses
- warm season
- cool season
- perennial or biannual

MATERIALS AND METHODS

A two year rotation in the wheat growing region of Montana (precipitation ~400 mm yr $^{-1}$) was started in spring 2014. near Huntley MT. This rotation does not make economic sense as compared to traditional wheat/fallow. But if positive changes in soil quality can be quantified after a number of cycles, then this research will help us improve crop rotation decisions.

Table 1. Cover crop treatments and plant population targets.

Group	Treatment	Target population (m^{-2})
Grasses	Barley	183
	Forage Sorghum	16
Legumes	Dry pea	97
	Soybean	48
Taproots	Turnip	65
	Safflower	70
Check	Fallow	
Mixtures	Mix minus grasses	Target above/4
	Mix minus legumes	Target above/4
	Mix minus taproots	Target above/4
	All mix	Target above/6

DESIGN DETAILS

Strip-strip plot
No-till using SeedMaster air drill, plot sprayer for weed control
Soil type: Fort Collins clay loam

Cover crops (Table 1)

- Established in mid-May 2014, in 2015 (a 2nd location)
- Terminated by frost (late September)
- Plot size 5 m X 20 m
- Biomass estimated by harvesting 2 m row, separating by species
- Plot size 5 m X 20 m

Barley crop

- Planted Apr 3, 2015 using
- Rows oriented perpendicular to cover crop strips
- Plot size 5 m X 5 m
- Nitrogen (N) rates of 0, 22, 45, and 67 kg ha-1
- N placed in separate paired rows
- Urea was the N source
- Harvested August 16, 2015
  - Grain yield
  - Protein
  - Grain sizing

RESULTS

Table 2. Cover crop biomass production (kg ha^{-1}) for each year.

Treatments	2014	2015
Barley	2162 abc*	1419 fg
Forage sorghum	1794 bcd	12411 a
Turnip	33 e	265 g
Safflower	2670 a	7267 b
Pea	1581 cd	1689 efg
Soybean	1417 d	3250 def
Mix all	2031 bcd	4164 cde
Mix minus grasses	2007 bcd	3525 def
Mix minus legumes	2281 ab	6226 bc
Mix minus taproots	1880 bcd	4479 cd

*Different letters in each column indicate significance at 0.05 level using Fisher's LSD

Table 3. Soil nitrate (kg ha^{-1}) prior to planting, spring 2015.

Treatments	0 to 15 cm	15 to 60 cm
Fallow	19.0 a*	46.8 a
Barley	16.8 ab	36.2 abcd
Forage sorghum	11.8 ab	20.2 cd
Turnip	14.6 ab	38.1 abc
Safflower	9.9 b	31.7 abcd
Pea	17.4 ab	42.6 ab
Soybean	10.1 b	19.4 d
Mix all	12.3 ab	27.4 bcd
Mix minus grasses	9.9 b	26.7 bcd
Mix minus legumes	17.1 ab	38.1 ab
Mix minus taproots	16.2 ab	44 ab

*Different letters in each column indicate significance at 0.05 level using Fisher's LSD

Figure 1. Barley yield as a function of cover crop treatment at non-limiting nitrogen rate, 2015

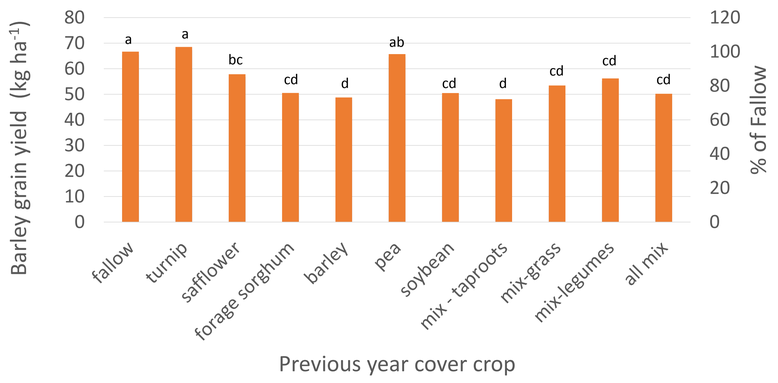


Figure 2. Barley yield in 2015 as a function of cover crop biomass production in 2014.

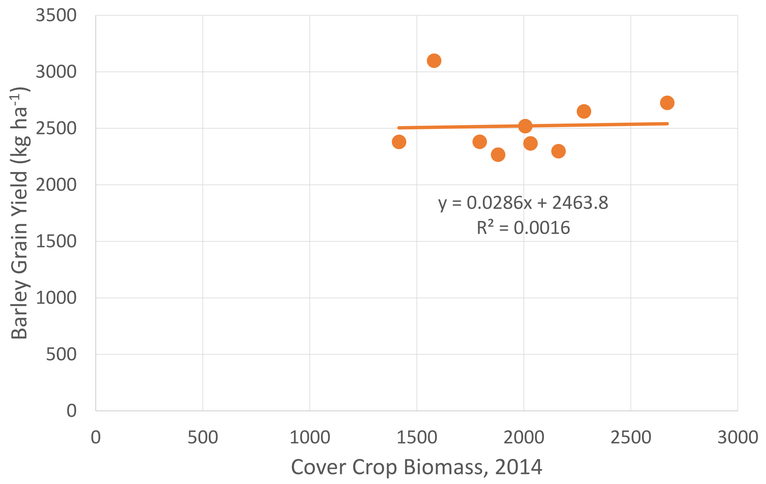


Figure 3. Barley yield in 2015 as a function of preseason soil water content.

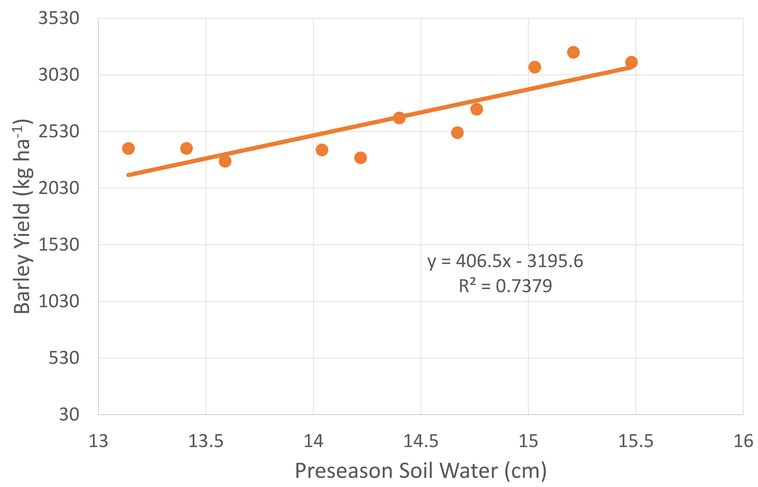
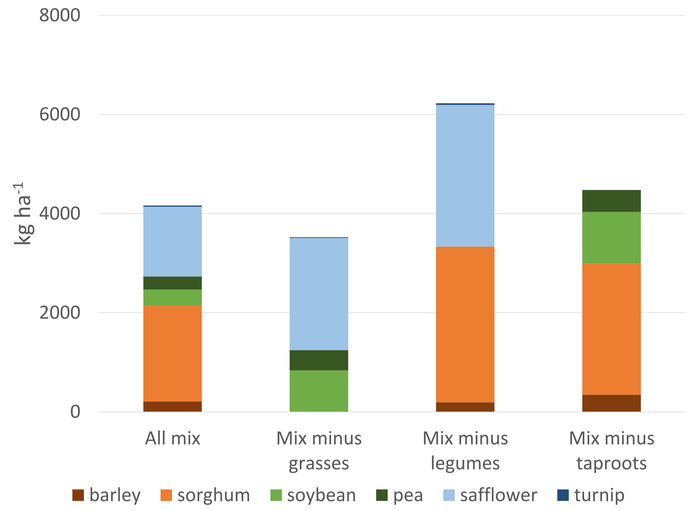


Figure 4. Distribution of functional groups in cover crops mixes for 2015.



DISCUSSION

Cover crop production in 2014 averaged 1.9 Mg ha^{-1} with all treatments except turnip producing similar amounts of biomass. This year (2015) cover crop productivity was greater with forage sorghum and safflower producing significantly more biomass as single species than that of the other entries or of the mixes. This should provide for an interesting response by the grain crop in 2016.

Barley yield on average was 70% of the yield following fallow when following a cover crop. Exceptions to this included turnip (where a lack of turnip growth provided similar grain yield response as fallow) and pea, where barley yielded nearly 97% of the fallow treatment. Analysis of variance (not shown) indicated no significant interactions of nitrogen rate by cover crop. Figure 3 clearly shows that in this first year, the impact of the cover crop on barley yield, for both mixed and sole cover crops was primarily due to the depletion of soil water as compared to fallow.

Turnips are clearly not a good choice of cover crop for this location, or possibly for this system where cover crops are established in mid to late May. We have seen good growth of turnips in late fall in other studies. We continue to struggle to find complementary combinations of warm and cool season species for cover crops. It may be that for us where cool season grain crops dominate, the cover crop mixture needs to be composed primarily of warm season species.