Summary: Timing of Cover Crop Establishment in Spring Cereals

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Interest in planting cover crops has recently increased in North Dakota. The traditional method for seeding is to do so after a cereal grain crop. However, with our short growing season, the window to successfully establish a fall cover crop is limited. Most years, adequate moisture for germination is available for only 1 to 2 days after harvesting the small grain crop. If seeding later than this, germination of the cover crop is determined by the next adequate rainfall event, which may be days or weeks after harvest. Delayed germination drastically reduces the amount of biomass produced by the cover crop. Because labor is likely in short supply for most farms, combining and seeding at the same time can be challenging. This led us to ask the question: Where are the opportunities within the growing season to successfully establish a cover crop without impacting grain yield of the cash crop and not significantly increase production costs?

A small trial was conducted at the CREC as well as the Langdon, North Central (Minot), and Hettinger RECs, and at the Oakes Irrigation Site from 2015-2018 using barley as the cereal. The trial was continued at the CREC for an additional five years using HRSW as the cereal with the additional treatment of drilling at the 4-5 leaf stage.

The cover crop treatments were all one mixture of turnips, radishes, lentils, and flax planted into or after barley (2015-2017) or HRSW (2018-2022) as follows:

- Check (no cover crop seeded)
- At seeding with the drill (down the same seed tubes as the cereal)
- 4-5 leaf barley (herbicide application timing, broadcast applied)
- 4-5 leaf barley with the drill (only at the CREC)
- Anthesis (fungicide application timing)
- After harvest with a drill (traditional timing and method)

Table 1 shows the combined results from the three locations that were not severely impacted by drought and produced a harvestable grain crop: Carrington, Langdon, and North Central (Minot).

- In 2015, sufficient timely rains occurred after each cover crop seeding timing therefore all of the before harvest seeding timings produced significantly more biomass than the check and after harvest treatments.
- In 2016, there was an early dry spring with little significant rainfall after barley seeding. Despite that, a good barley crop was raised due to adequate subsoil moisture. However, the lack of rain impacted cover crop establishment and growth of all timings with none being significantly better than others.
- In 2017, again there was little significant rainfall after seeding, but there was adequate moisture close to the surface at the time of seeding to successfully establish the cover crop and then raise a respectable grain crop.

Table 1. Barley performance and cover crop production across locations from 2015 to 2017 based on various cover crop establishment timings.

Year	Treatment	Test Weight	Protein	Grain Yield	Biomass Total
		lb/b	%	bu/a	lb/a
2015	Check (no covercrop)	50.9	12.4	82.4	1797
2015	At seeding	50.7	12.2	87.8	2606
2015	4-5 leaf (broadcast)	51.4	12.2	81.4	3431
2015	Anthesis (fungicide timing)	51.4	12.4	81.6	2499
2015	After harvest	51.1	12.3	84.3	1871
2016	Check (no covercrop)	49.6	11.5	109.4	944
2016	At seeding	49.8	12.9	115.8	1061
2016	4-5 leaf (broadcast)	49.7	12.5	116.8	833
2016	Anthesis (fungicide timing)	49.8	12	111.7	982
2016	After harvest	49.9	12.4	107.5	1258
2017	Check (no covercrop)	47.4	11.5	92.4	868
2017	At seeding	46.4	11.9	86.1	1816
2017	4-5 leaf (broadcast)	47.2	11.7	87.6	1308
2017	Anthesis (fungicide timing)	47.2	11.5	90.2	1398
2017	After harvest	46.6	11.6	85.7	1188
Trial Mean		49.3	12.1	94.7	1591
C.V. (%)		1.8	3.2	10.6	40
LSD (0.05)		NS	NS	NS	660

Table 2 shows the combined results from additional years at the CREC with HRSW as the cereal crop.

- The year 2018 started out dry in April, followed by below-average precipitation in May, above-average precipitation in June, and below normal, but timely, precipitation the remainder of the growing season. A good grain crop and biomass were produced on adequate subsoil moisture. The two drilled treatments produced significantly more biomass than the check and other treatments.
- 2019 also had below-average precipitation in April and May, which was followed by above-average precipitation in June and July. The three early-season treatments produced significantly more biomass than the check, anthesis, and harvest treatments.
- 2020 rainfall was well below average for the entire season with the exception of July. Again, two drilled treatments produced significantly more biomass than the check and other treatments.
- 2021 also had little significant rainfall after seeding. This lack of rain impacted grain yield and cover crop establishment with no treatments being significantly higher than others.
- In 2022, April and May had rainfall amounts that were well above average, followed by well below normal precipitation the remainder of the growing season. The ‘at seeding’ treatment produced significantly more biomass than the check and after harvest planting.

Cover crop mix seeded with the cereal crop.

Table 2. Spring wheat performance and cover crop production at CREC from 2018 to 2022 based on various cover crop establishment timings.

Year		Test Weight	Protein	Grain Yield	Biomass Total
		lb/bu	%	bu/a	lb/a
2018	Check (no covercrop)	64.9	13.0	50.7	1963
2018	At seeding	65.1	13.2	51.1	2346
2018	4-5 leaf (broadcast)	64.7	13.6	50.3	1925
2018	4-5 leaf (drilled)	64.4	13.1	50.6	2315
2018	Anthesis (fungicide timing)	64.0	13.2	50.7	2113
2018	After harvest	65.4	13.4	50.2	1968
2019	Check (no covercrop)	58.4	15.3	20.4	752
2019	At seeding	58.6	15.7	15.2	1177
2019	4-5 leaf (broadcast)	58.3	16.3	21.8	1019
2019	4-5 leaf (drilled)	58.5	15.6	19.9	1195
2018	Anthesis (fungicide timing)	59.1	15.5	20.5	928
2019	After harvest	58.3	15.3	20.7	909
2020	Check (no covercrop)	58.3	15.7	22.1	726
2020	At seeding	58.7	16.1	22.1	1167
2020	4-5 leaf (broadcast)	59.6	16.1	21.9	1009
2020	4-5 leaf (drilled)	57.4	15.8	22.8	1279
2020	Anthesis (fungicide timing)	58.1	15.6	22.1	932
2020	After harvest	59.2	16.0	24.1	942
2021	Check (no covercrop)	64.6	15.8	15.2	211
2021	At seeding	64.9	15.7	15.2	247
2021	4-5 leaf (broadcast)	64.6	15.6	15.3	231
2021	4-5 leaf (drilled)	64.8	15.8	13.3	305
2021	Anthesis (fungicide timing)	64.6	15.6	13.9	249
2021	After harvest	64.7	15.7	12.5	222
2022	Check (no covercrop)	62.3	13.8	23.3	390
2022	At seeding	65.8	13.5	27.5	613
2022	4-5 leaf (broadcast)	65.4	13.5	25.8	494
2022	4-5 leaf (drilled)	66.0	13.6	24.5	480
2022	Anthesis (fungicide timing)	66.1	13.4	27.6	464
2022	After harvest	64.8	13.5	25.2	396
Trial Mean		62.3	14.8	26.6	965
C.V. (%)		2.0	3.2	9.7	19
LSD (0.05)		NS	NS	NS	212

In summary, these practices should be utilized in relatively weed-free fields to be successful, as the herbicide program may be limited by most of these treatments. It is important to note that none of the treatments had a negative impact on the first-year cereal production. Also, none of these treatments had a statistically significant positive or negative impact on the following years HRSW crop. Research conducted on campus has shown that in conventionally-tilled soil the nitrogen benefits of these cover crops haven't been seen in season or the following season. Ideally, this experiment would have been paired with no-till sites to determine if these treatments behave differently in no-till environments.