

Influence of Oat Variety and Harvest Timing on Alfalfa Establishment in an Organic System

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Companion crops are commonly used for establishment of alfalfa in an organic crop production system. Small grains, including oats, are used as companion crops and are recommended for establishment of organic alfalfa.

A three-year field trial was established at the CREC in 2018 to evaluate organic alfalfa establishment methods using an oat companion crop and harvest timing of the companion crop. Treatments included four oat varieties that differed in maturity, plant height, and yield potential. Harvest timings were represented by oats harvested as either a forage or grain crop. Among the oat varieties was Sumo, an early, short variety developed at SDSU for use in organic production for companion cropping with alfalfa. The other three varieties are releases from the NDSU oat breeding program including Souris, a shorter variety that is competitive with early row closure; Rockford, a high yielding grain variety that is upright and tall with good straw strength; and Newberg, a tall, earlier, high yielding grain variety. The alfalfa variety used for these trials was Charger.

The oat-alfalfa companion crops were sown on May 3, 2018 on ground previously cropped to field pea. Oat seeding rate was 600,000 PLS/ac while alfalfa was seeded at 15 lbs/ac PLS. Both crops were sown at the same time with a plot drill in 7-inch rows at a 1-inch depth. Stand counts were taken 20 days after planting to determine established densities. Stands did not differ significantly among treatments with established stands for oats and alfalfa averaging 14 and 13 plants per square foot respectively. Days to heading for Souris, Rockford and Newberg averaged 55-56 days after planting while Sumo was 10 days earlier to heading.

The timing for forage harvest was based on when the varieties reached the early milk stage with Sumo harvested on June 28 and the other varieties July 5 (Table 1). Forage yield of the early variety Sumo was significantly lower than the other three varieties. The highest yield of 2.33 DM ton/acre was achieved with Newberg which was also the tallest variety.

Table 1. Performance of oat varieties harvested as forage during alfalfa establishment in 2018.

Variety	Harvest Date	Oat Stand plts ft ⁻²	Alfalfa Stand plts ft ⁻²	Days to Heading	Plant Height inch	Harvest Moisture %	Forage DM Yield ton/ac
Sumo	28-Jun	14.4	12.0	45.8	31.5	72.3	1.84
Souris	5-Jul	14.6	13.4	55.0	33.0	73.6	2.20
Rockford	5-Jul	13.5	13.2	55.3	35.7	75.5	2.09
Newberg	5-Jul	12.5	11.6	55.3	38.8	72.5	2.33
Mean		13.7	12.6	52.8	34.7	73.5	2.11
C.V. (%)		13.9	22.2	1.2	3.1	2.9	7.0
LSD 0.05		NS	NS	1.0	1.7	NS	0.24

Harvest timing for the oat grain treatments occurred on August 23 with all varieties straight cut as high as possible. Agronomic traits including oat grain yield and quality are reported in table 2. Newberg and Rockford were the highest yielding varieties with Rockford having the highest test weight and Sumo the highest grain protein content. The height of the alfalfa plants in the understory were similar across all varieties. No plant lodging occurred among the varieties in either harvest timing.

Table 2. Performance of oat varieties harvested as a grain crop during alfalfa establishment in 2018.

Variety	Days to Heading	Oat Height inch	Alfalfa Height inch	Grain Protein %	Test Weight lb/bu	Grain Yield bu/ac
Sumo	46.5	29.2	16.6	11.6	35.1	48.1
Souris	55.8	31.5	16.7	9.0	33.8	63.3
Rockford	56.0	36.6	16.3	8.9	36.4	71.9
Newberg	55.0	38.2	16.7	9.1	33.8	76.9
Mean	53.3	33.9	16.6	9.6	34.8	65.1
C.V. (%)	0.8	5.6	11.7	2.4	1.5	7.4
LSD 0.05	0.7	3.0	NS	0.4	0.8	7.7

Alfalfa was harvested in 2019 and 2020 to determine if harvest timing management in the establishment year had an impact on subsequent alfalfa performance. Two harvest cuttings were taken in 2019 and three in 2020. Data gathered from each harvest included plant height, harvest moisture and forage yield. Alfalfa plant height and harvest moisture was similar among treatments across harvest timings in both years with limited variations (data not shown). Mean forage yields in 2019 were 3.55 and 3.40 DM ton/ac for the forage and grain management treatments respectively (Table 3). Mean forage yields in 2020 were higher at 5.45 DM ton/ac for each management treatment (Table 4).

Table 3. 2019 alfalfa forage yields compared across oat harvest management treatments.

Variety	** Oat harvested for Forage **			** Oat harvested for Grain **		
	June 18	July 23	Total Yield	June 18	July 23	Total Yield
	----- tons DM/acre -----			----- tons DM/acre -----		
Sumo	1.68	1.87	3.55	1.65	1.81	3.46
Souris	1.73	1.73	3.46	1.54	1.83	3.37
Rockford	1.73	1.90	3.64	1.65	1.82	3.47
Newberg	1.69	1.88	3.57	1.64	1.64	3.28
Mean	1.70	1.85	3.55	1.62	1.77	3.40
C.V. (%)	11.6	3.2	5.3	13.0	7.0	8.6
LSD 0.05	NS	0.10	NS	NS	NS	NS



Third cutting organic alfalfa on September 1.

Table 4. 2020 alfalfa forage yields compared across oat harvest management treatments.

Variety	** Oat harvested for Forage **				** Oat harvested for Grain **			
	June 17	July 23	Sept. 2	Total Yield	June 17	July 23	Sept. 2	Total Yield
	----- tons DM/acre -----				----- tons DM/acre -----			
Sumo	1.95	1.94	1.54	5.43	2.18	1.86	1.42	5.46
Souris	1.96	1.86	1.52	5.34	2.12	1.97	1.45	5.55
Rockford	2.17	1.89	1.51	5.58	2.22	1.85	1.43	5.51
Newberg	2.08	1.83	1.57	5.47	2.08	1.90	1.30	5.29
Mean	2.04	1.88	1.53	5.45	2.15	1.90	1.40	5.45
C.V. (%)	6.1	7.8	6.7	4.1	5.9	4.1	9.3	3.3
LSD 0.05	0.20	NS	NS	NS	NS	NS	NS	NS

Data gathered after two years of alfalfa harvest following establishment shows that neither oat variety choice nor companion crop harvest management had any effect on alfalfa yield. Results gathered suggest that the choice of oat variety is more important to either maximize return in grain or forage yield during the year of alfalfa establishment.