Alfalfa Harvest Management Strategies for Northern Ontario: 1. Yield and Persistence

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Alfalfa is the most common forage legume used in Ontario for hay and silage production. In longer season areas, three cuts per year is recommended, with a critical fall rest period being set aside to allow root reserves to build prior to winter. Research conducted in Ontario during the 1970's on alfalfa harvest management and the critical fall rest period included sites as far north as Dufferin county, but did not include sites in northern Ontario. A general recommendation in the north is to take only two cuts per year and allow a rest period from approximately Aug 15 to September 25 or until two killing frosts have occurred. However, in some northern areas, such as the Temiskaming district, there is frequently sufficient growth to take three cuts per year. The effect of this management on stand survival and productivity has not been formally assessed. This trial was conducted over a 6 year period to evaluate several harvest management options for forage yield and quality, winter survival, and subsequent stand performance. This report discusses forage yield under various cutting systems and the subsequent forage yields in response to those treatments.

Methods: All trials were direct seeded to pure alfalfa, variety Centurion, at 13 kg/ha. Trials were seeded at New Liskeard in 1994 and 1995. Each alfalfa plot had a plot of timothy on each side to act as a guard. Six harvest management treatments were used (Table 1). Harvest management treatments were based on a combination of number of cuts, plant development, and calender date. Plant development was determined using the system of Mueller and Fick (1989) in which 100 plants were selected randomly and hand-separated by stage of development using a numbering system where 3 = early bud, 4 = late bud; 5 = early bloom, and 6 = late bloom. The cutting systems used were intended to mimic systems that would have practical applications on farm. For example, a standard and standard plus systems would be typical for a cow-calf or cash-crop hay operator, while the intense, short rest, and medium rest systems would more likely be used on a dairy operation.

Table 1. Harvest management systems evaluated.

System Name	Description	Target stage* or cutting date
Standard	2 cuts - early bloom	5/5
Standard Plus	3 cuts - 3rd cut by calender	5/5/Sept. 25
Intense	3 cuts - 3rd cut by calender	4/3.5/Aug.15
Short Rest	3 cuts - 3rd cut at bud stage	4/3.5/3.5
Medium Rest	3 cuts - 3rd cut at early bloom	4/3.5/5
Long Rest	3 cuts - 3rd cut at late bloom	4/3.5/6

* based on Mueller and Fick, 1989 where stage 3 = early bud, stage 4 = late bud, stage 5 = early bloom, stage 6 = late bloom

To evaluate the effect of the harvest management treatments on future stand productivity, the treatments were applied in the first production year, then 2 cuts were taken in the second production year to measure the response to the treatments the previous year. The harvest management treatments were then applied again in the third production year, followed by only two cuts in the fourth production year, again to measure the response to the treatments imposed in the 3rd year. By using this harvesting sequence, we were able to judge the effect of the three cuts systems on crop persistence over several winters (Table 2).

Table 2. Sequence of seeding, applying treatments and measuring response to treatments.

Seeding Year	Treatments	Response	Treatments	Response
1994	1995	1996	1997	1998
1995	1996	1997	1998 (Trt 1&3 only)	1999 (Trt. 1 & 3 only)

Results: Alfalfa established by direct seeding in 1994 was subjected to the six harvest management treatments in 1995. Forage yields were highest under the long rest and standard + treatments (Table 3). The standard 2 cut, intense (3 cut), and short rest (3 cut) systems were lowest in yield.

Table 3. Yield of alfalfa (kg DM/ha) sown in 1994 under 6 harvest management treatments (1995 and 1997) and in response to those treatments (1996 and 1998).

Treatment	1995 (Treatments)	1996 (Response)	1997 (Treatments)	1998 (Response)
Standard	8134 c[b]	8267a	9260 bc	11362
Standard +	12381ab	7829 b	10504ab	11745
Intense	7950 c	7275 c	8311 c	11613
Short Rest	9028 c	7443 c	9575 bc	11191
Medium Rest	10174 bc	7846 b	11060a	11992
Long Rest	12675a	8081ab	10164ab	10335
Mean	10057	7790	9812	11373
LSD[a]	2389	329	1419	ns
CV (%)	12.9	2.3	9.6	14.7

a: least significant difference
b: within a column, averages followed by a different letter at different at the 0.05 level of probability

The 1996 harvest measured the response to the 1995 treatments. Results showed that the standard 2 cut system and the long rest system produced the highest yields, while the intense and short rest systems produced the lowest yields. The 6 harvest management treatments were again

applied in 1997. Results were generally similar to 1995, with highest yields resulting from the long rest and the standard + systems, while the intense system was lowest yielding. In response to these treatments, the 1998 yields showed no significant difference among treatments, indicating that the harvest management treatments applied in 1997 did not affect winter survival and subsequent yield in 1998.

Alfalfa was established by direct seeding in 1995 and was subjected to the six harvest management treatments in 1996. Forage yields were similar among the standard +, short rest, medium rest, and long rest treatments. Yields were lowest for the intense treatment. In response to these treatments, the 1997 yields showed no significant difference among the six treatments. In 1998, the six harvest management treatments were to be imposed, but only the standard 2 cut and the intense system were completed. Poor fall growth and very wet soil conditions prevented the final harvest of the other treatments. However, there was no difference in yield between the standard two cut and the intense treatment in 1998, nor was there any yield difference in response to these treatments in 1999 (only a single cut was taken in 1999).

Table 4. Yield of alfalfa (kg DM/ha) under 6 harvest management treatments (1996 and 1998) and in response to those treatments (1997 and 1999).

Treatment	**1996 (Treatments)**	**1997 (Response)**	**1998 (Treatments)**	**1999 (Response)**
Standard	9949 bc[b]	10704	11242	5286 (1 cut)
Standard +	11862a	9645	-	-
Intense	8608 c	10170	9999	5183 (1 cut)
Short Rest	10632ab	10060	-	-
Medium Rest	10362ab	10611	-	-
Long Rest	10535ab	10609	-	-
Mean	10325	10300		
LSD[a]	1554	ns	ns	ns
CV (%)	10.0	5.2		

: least significant difference
b: within a column, averages followed by a different letter at different at the 0.05 level of probability

Discussion: When considering the advantages of any forage harvest management system, forage yield, forage quality, and stand persistence must be considered. The relative importance of each of these factors will vary with the type of farm operation, but in general, yield and stand persistence are very important. High yields are desirable to offset land-based costs such as rent or mortgage costs. In some operations, persistence may be needed for only 3 or 4 years before the land is rotated to other crops. In other operations, a forage stand may be kept in production

for 10 or more years if persistence is adequate.

The results of this study indicate that 3 cut systems often, but not always, outyield 2 cut systems. The total yield from two cuts taken at the early bloom stage is usually similar in yield to a 3 cut system where all cuts are taken at the mid to late bud stage, or where all 3 cuts are completed prior to mid-August. Higher yields occur where two cuts are taken at early bloom plus a third cut in late September, or where the first two cuts are taken at the mid to late bud stage and the third cut is taken at full bloom stage. In practice it is difficult to use stage of development (bud or bloom) to time fall harvests, since alfalfa flowering is reduced greatly by short days in the fall. Thus, if both cut 1 and cut 2 are taken at the bud stage, a long rest period of 40 to 50 days would be required to simulate a bloom-stage harvest in the fall.

In this study, stand persistence was based on the yield of forage in the year following the 3 cut treatments. Our expectation was that 3 cut systems that did not allow the plants to flower at least once during the summer (ie: intense system) or that ignored the critical harvest period (short rest system) would have lower yields the following year. However, this result occurred only in the 1996 harvest of the 1994 seeding. In all other response years (1998 - Table 3; 1997 and 1999 - Table 4) there was no difference in yield among the harvest management treatments. This suggests that at New Liskeard, a range of 3 cut systems can be utilized without a high risk of stand damage, but the risk of damage is greater when sufficient rest periods are not given. Finally, it should be noted that several factors other than harvest management will affect alfalfa survival. These factors include stand age, disease pressure, soil drainage, and soil fertility, especially potassium levels. Management to improve soil drainage and fertility in particular, will increase the chances of alfalfa survival under three cut management.

Conclusions:

1. Three cut systems that have all cuts taken at the bud stage will yield equal to or less than two cuts taken at the early bloom stage.

2. Three cut systems that allow one cut to reach the bloom stage will usually outyield a 2 cut system.

3. Three cut systems that have all cuts taken at the bud stage or that do not allow a long rest period prior to the final cut, are at a higher risk of winterkill, but lower yields as a result of such management occurred only once in four years in our tests. Note that our site is tile drained and has high potassium soil test values.

4. Three cut systems that allowed the plants to reach the bloom stage or allowed a long rest (40 days or more) prior to the final cut consistently yielded equal to the 2 cut system in our tests. While one would expect to eventually see a yield reduction under these three cut systems, it did not occur up to the 4th production year of the stands we tested.