Effect of Harvest Frequency and Weed Management on Established Roundup-Ready (RR) Alfalfa Yield, Quality, and Stand Longevity

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Background

Roundup Ready® (RR) alfalfa increases producer herbicide options for weed control in pure stands of alfalfa. This technology increases application timing flexibility and provides broad spectrum weed control without damage to the alfalfa. First released in 2005, an injunction was placed on the sale and planting of RR alfalfa in 2007 by a US District Court in California. Producers with fields established prior to March 30, 2007 were not required to remove stands, but pollinators were not to be added to fields, equipment used was to be properly cleaned following harvest, and seed or material harvested was to be stored separately from non-RR alfalfa. In June 2010, the US Supreme Court overturned the injunction, and in January 2011, USDA Animal and Plant Health Inspection Service granted non-regulated status. RR alfalfa seed is available to producers in the spring of 2011.

Since 2002, Michigan State University has conducted field trials of RR alfalfa to address anticipated producer questions of cutting intensity and weed removal on management, yield, quality, and stand persistence (stand density).

Methods

Alfalfa yield, weed yield, forage quality, and stand density were compared on an established stand of RR alfalfa at East Lansing beginning spring 2005 and ending spring 2010. Glyphosate was applied to the entire trial in the fall of the seeding year (2003) to eliminate any non-RR plants. Beginning in 2005, two harvest frequencies were imposed: moderate harvest intensity (MHI) which was 3 to 4 cuttings per year, and high harvest intensity (HHI) which was 4 to 5 harvests per year. Three herbicides were evaluated within each harvest frequency block: glyphosate (Roundup WeatherMax®) as needed (but limited to once per year), hexazinone (Velpar®) in the spring of every other year, and no herbicide (untreated). Yield was obtained with a flail-harvester, and a subsample was retained for dry matter determination and forage quality analysis. Stand density was determined by plant counts collected in the spring and fall of each year by digging two 1-ft^2 areas from a portion of the plot not used for yield determination. Plant count sampling was increased in the final year to two 5-ft^2 areas and taken from the harvest portion of each plot to increase the precision the measurement.

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The predominant weeds in this study in the order of prevalence were: dandelion, large crabgrass (*Digitaria sangunalis* L.), white campion (*Silene lotifolia* L.), horseweed (*Conyza canadenis* L.), shepherdspurse (*Capsella bursa-pastoris* L.), and broadleaf plantain (*Plantago major* L.).

Results Harvest Frequency Comparison

Total forage yield (alfalfa + weeds) was greatest the first year treatments were imposed (2005) and decreased with successive years (Fig. 1A). Initially, total forage yield was greater in the HHI than in the MHI, but by the end of the trial, greater yields were obtained from the MHI. In the fourth and sixth production years, alfalfa yield was greater in the MHI and weed invasion was greater in the HHI.

The more frequent harvests of the HHI reduced stand vigor which allowed weeds an opportunity to establish.

Higher forage quality, measured as Relative Forage Quality (RFQ), was usually obtained under the HHI treatment compared with the MHI treatment (Fig. 1B). Forage quality was higher for the HHI in 4 of 5 years and followed the expectations that alfalfa harvested earlier would be higher in quality than when alfalfa was harvested at later maturity.

The rapid decline of stand density in the first two production years and subsequent decreased decline is common for alfalfa (Fig. 3A). Intra-species competition for water, light, and nutrients is the likely cause for this rapid reduction in stand.

Although the stand density of the HHI was no different than MHI throughout the six years of the study. Alfalfa stand densities at the end of the trial were below the accepted minimum (4 plants/ft^2) for maintaining a pure stand for commercial production.

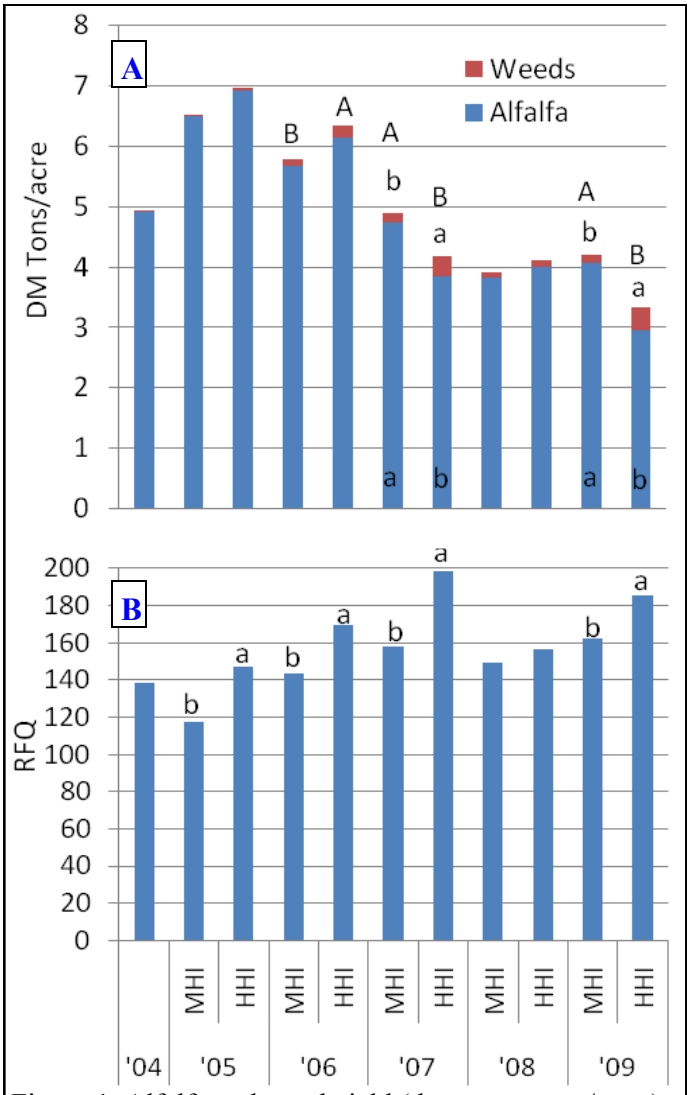

Figure 1. Alfalfa and weed yield (dry matter tons/ acre) (A) and Relative Forage Quality (RFQ) (B) of Roundup Ready alfalfa under two harvest frequencies [moderate harvest intensity (MHI) and high harvest intensity (HHI)] at East Lansing, MI. [1]

[1] The lowercase letters at the base of the bars represent significant differences for the alfalfa yield at $P<0.05$. The lower case letters at the top of the bars are for weed yield and the upper case letters are for the total (alfalfa + weed) yield.

Results of Weed Management Comparison

Total forage yield was generally not affected by herbicide treatment (Fig. 2A). In the final year of the study, the untreated and Velpar plots produced greater total forage yield than the glyphosate plots, which was a result of less alfalfa in the glyphosate. As in the harvest frequency comparison, there were significant differences in alfalfa yield in the fourth and sixth years. In these years, the Velpar treatment produced the greatest, or was equal to the greatest treatment. Residual weed control provided by Velpar may have reduced weed competition and resulted in greater yields.

Both glyphosate and Velpar treatments effectively removed weeds from the plots, but weed removal did not consistently affect total forage or alfalfa yield.

Relative Forage Quality (RFQ) was usually not affected by weed removal with herbicides (Fig. 2B). In the final year, the Velpar and the untreated were slightly higher in RFQ than the glyphosate plots, perhaps due to the presence of the annual weed, Prostrate knotweed (*Polygonum aviculare* L.), but all treatments produced prime-grade forage.

Weed removal with herbicides had no measurable effect on alfalfa stand persistence (Fig. 3B). There was no evidence of greater stand density where either herbicide was applied. For all treatments, the recommendation after six production years would be to rotate to a new crop.

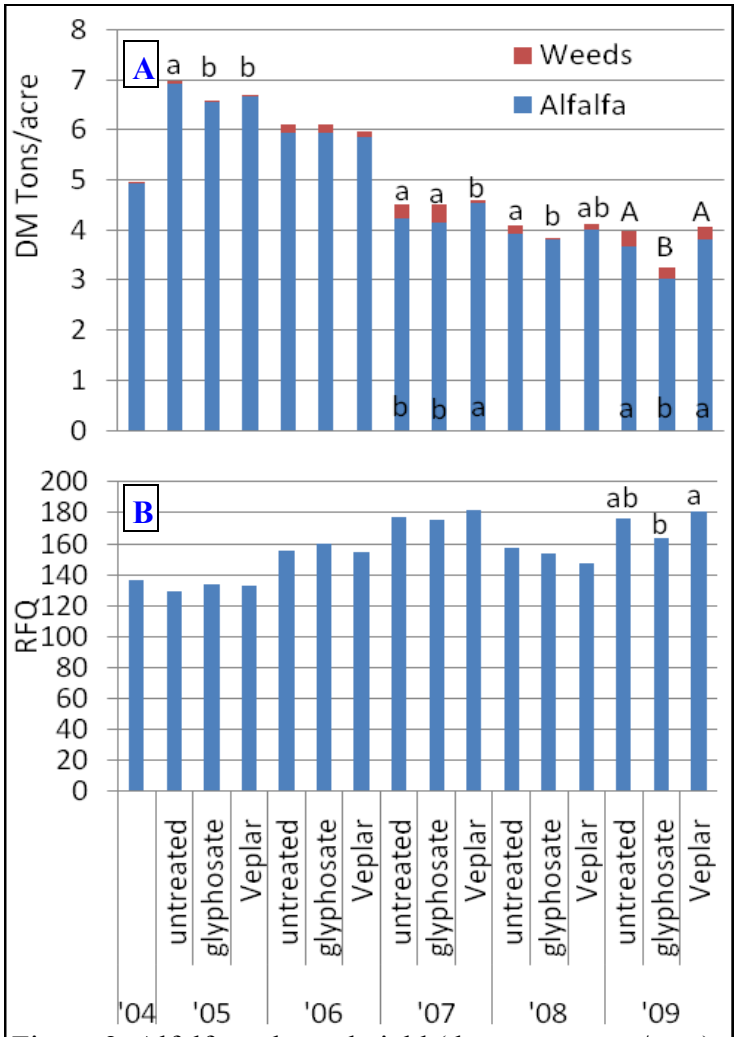

Figure 2. Alfalfa and weed yield (dry matter tons/acre) (A) and Relative Forage Quality (RFQ) (B) of Roundup Ready alfalfa under three weed control treatments (untreated, glyphosate, and Velpar) at East Lansing, MI. [1]

[1] The lowercase letters at the base of the bars represent significant differences for the alfalfa yield at $P<0.05$. The lower case letters at the top of the bars are for weed yield and the upper case letters are for the total (alfalfa + weed) yield.

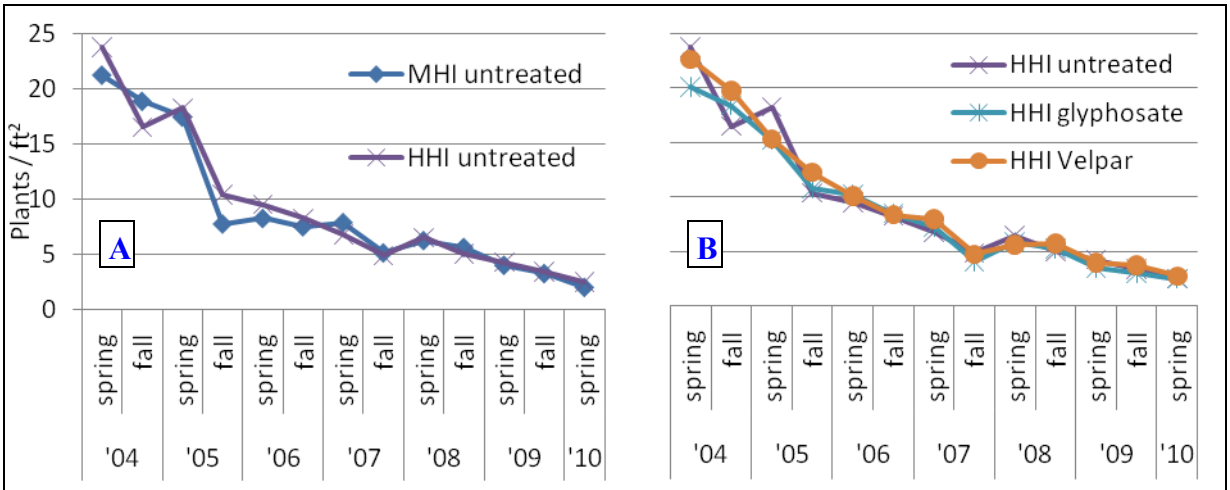

Figure 3. Stand density (plants/ft^2) of Roundup Ready alfalfa under two harvest frequencies [moderate harvest intensity (MHI) and high harvest intensity (HHI)] (A) and three weed control treatments (untreated, glyphosate, Velpar) (B) at East Lansing, MI.

Conclusions

Roundup Ready alfalfa provides additional options for weed management during alfalfa establishment or in established alfalfa. Previous studies have demonstrated the effectiveness of glyphosate for weed control during Roundup Ready alfalfa establishment. This study confirmed that glyphosate can effectively remove weeds from established alfalfa. However, weed removal had little effect on forage yield or quality. In addition, weed removal in established alfalfa had no effect on stand persistence. These results indicate that weed removal in established RR alfalfa will likely not extend the productive life of the stand. This does not diminish the value of RR alfalfa for those desiring weed-free hay.