



How Legume and Grass Systems Actually Work

By John McGregor, MFGA Extension Support

When it comes to adding nitrogen to mixed stands of legumes and grasses there are two schools of thought:

- legumes provide all the nitrogen that the accompanying plants need, so additional nitrogen fertilizer is not needed.
- to produce top yields, nitrogen must be added to mixed stands, with the amount of nitrogen decreasing with more legumes in the stand.

We plant alfalfa or clover with grasses normally for two reasons. First, we are hoping in some way to capitalize on the ability of legumes to convert atmospheric nitrogen gas into a form that is usable as a plant nutrient and reduce the need for nitrogen fertilizer. Secondly, by planting a legume, we want to take advantage of the higher protein levels in legume forage for livestock.

As we think about how this system works, there are some key facts that we need to keep in mind and some misconceptions to clear up. In biology class we learned that it is actually the bacteria living in the root nodules that do the work of nitrogen fixation. In this symbiotic relationship, the bacteria are given sugars for energy by the host plant and in return, the plant is given nitrogen it can use for growth.

Nothing about nitrogen fixation is free to the plants or bacteria! At peak growth, many legumes **direct 50 percent of their total energy** derived by photosynthesis to the nodules to fuel nitrogen fixation.

Legume plants don't freely give all of this nitrogen to their neighbors. The truth is that 60 to 70 percent of the nitrogen in legumes is in the leaves and stems of the top growth. Also, 30 to 40 percent or so of the nitrogen that is in the roots and crowns is being saved as a reserve for later plant growth.

If you are like me – I didn't have the right picture of how this legume system. However, taking a step back, the system does work and has for thousands of years in agriculture all over the world.

How nitrogen from legumes gets transferred to neighboring plants requires us to stress the legume. Consider a grass-alfalfa hayfield with the alfalfa at bud stage. The alfalfa plant is devoting half its energy from photosynthesis to the nodules at that point. If we

come along with a mower and cut the plants off, they can no longer conduct the photosynthesis to feed all those nodules and roots, so some of them die. The dead roots and nodules decompose and then the nitrogen from the legume is available to neighboring grass plants. The same thing would be true of a cow grazing off a grass-clover pasture.

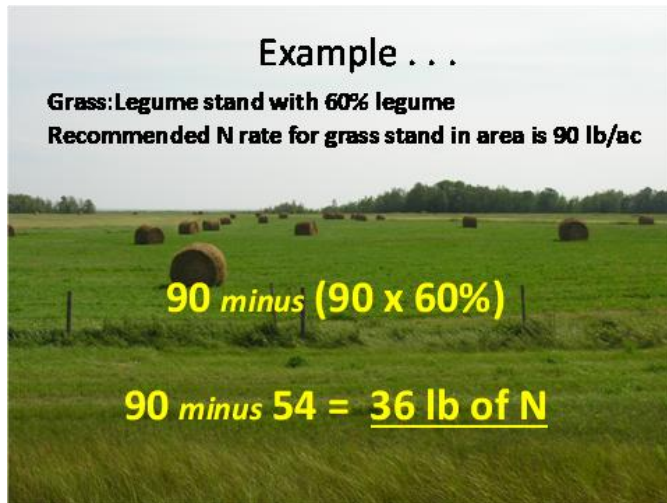


1The affect of stressing a forage has on root die-back

So do we need to add nitrogen to mixed stands or not? The biggest factor is our harvest management. If the vast majority of the nitrogen in a legume is in the leaves and stems, following where the forage goes will tell us where our legume-based nitrogen is going. If I mow the field and sell the hay, I just sold the majority of my legume nitrogen.

If I graze the pasture, some of that nitrogen is leaving the field as meat or milk, but the amount is minuscule. Nearly all that nitrogen is going back onto the pasture in feces and urine. As a middle ground, hay that is fed back onto the field returns some of that legume nitrogen back to the field.

John Heard, with MAFRD uses a formula to help calculate the contribution of N by legumes to a mixed stand. **Nitrogen rate for a mixed stand is: Recommended N rate for pure grass MINUS (% legume x N rate).**



2 Source: John Heard

In conclusion, you will likely always see a response to additional nitrogen. Whether it is economical or not depends on costs and response. MAFRD recommends the following:

- For stands that are more than 50% legume, they do not require a lot, if any, nitrogen fertilizers.
- For stands that are less than 30% legume, responses to nitrogen fertilizer can be expected as for a pure grass stand.

Mixed hay fields where the forage is removed may be candidates for adding N depending on the % of legume in the mix. Pastures where most of the nutrients are recycled likely won't need additional N, providing there are legumes in the mix.

Just a word of caution: the addition of N to a grass/legume mix can increase the competitiveness of the grass at the expense of the legume.

Experiment on your own operation and conduct soil testing to evaluate what you need to do, but don't just assume having a legume present will eliminate the need for extra nitrogen inputs.

Adapted from:

<http://www.progressiveforage.com/forage-production/management/how-legume-and-grass-systems-actually-work>

<http://www.gov.mb.ca/agriculture/crops/production/forages/print,fertilizing-forage-stands.html>