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The benefits of clover are frequently extolled. We have all heard the sermons (or preached them). “Less need for N fertilizer because of biological N fixation! Yields equal to grass fertilized with moderate levels of N! Higher quality forage! Increased animal performance!” are the common exclamations. But, do the facts support these claims?

I was recently asked to speak at the American Forage and Grassland Council’s annual meeting and was charged to re-read and review the basis for these claims. In addition, if these claims about clover are true, I was to determine if this leads to a higher profit potential. In essence, I was asked to settle the question of “Are clovers worth it?”

What Does the Research Data Say?

Numerous plot and grazing studies have been conducted over the years, the majority of which were in the 1950s-1970s. There have been some additional trials in the years since that have confirmed some aspects or

addressed knowledge gaps. The benefits and limitations of using clovers are among the most well-researched aspects of forage agronomy. In fact, I found and examined over 130 research reports addressing this topic.

One of the best summaries of the benefits of clover in grass pastures was presented 33 years ago by Drs. Joe Burns and J.E. Standaert at a joint meeting between researchers from the U.S., Australia, and New Zealand at an international workshop. Dr. Burns, a forage agronomist with USDA's Agricultural Research Service based in Raleigh, NC, and Dr. Standaert, an economist at NC State University, summarized the research from 38 different research reports across 19 states. In those reports, there were 42 experiments where there was a straight comparison of beef cattle weight gains between a grass + legume pasture and the same grass given N fertilizer. Of those trials, 90% reported an increase in average daily gain (ADG) for the beef cattle. The average increase in ADG was 18%.

In the 38 studies reporting total gain per acre, the grass + clover pastures also produced 18% more beef per acre on average (after removing an outlier). However, the increase in gain per acre was much more variable and not reliable. Only half of the studies resulted in a real increase in beef productivity per acre, 27% resulted in no difference, and 23% resulted in a significant decrease in gain per acre.

Grass + Clover = Variable Results

The lack of a reliable improvement in gain per acre is a reflection of the variability in how much contribution the selected legume makes to forage production in a pasture. For every research trial that shows grass + clover out-yields or yields the same as a grass + N, there is a trial that shows less total forage production in a grass + clover field. Some grasses are more sensitive than others to competition from the clover component.

Choosing the right combination of grass and clover improves the odds of success, but grass + clover tends to be riskier in areas with less consistent rainfall, poorer soil conditions, and hotter and more subtropical weather. In fact, recent long-term research at both Texas A&M University and the Noble Research Institute in Oklahoma has shown that mixing legumes in their warm season grass-based pastures frequently reduces forage production, the length of the grazing season, and net returns per acre, despite reducing the need for N fertilizer. Cool season grass-based pastures are more reliably improved by the addition of clover, especially when that clover has the added benefit of offsetting some of the poor performance associated with toxic tall fescue.

The Cost of N

Further, one needs to consider the alternative to growing clover: N fertilizer addition. Well-timed N fertilization generally provides a substantial increase in the amount of forage produced from that pasture. Certainly, that N addition comes at an economic and, in some situations, environmental cost. But, establishing clover is not without costs, too. There is a cost to N, whether it comes from clover or out of a spreader.

To compare the costs of grass + N and grass + clover, I created a spreadsheet that performs a partial budget analysis. It examines the impact of N fertilizer prices and the longevity of the clover stand (Table 1). The latest version of this spreadsheet is available at http://bit.ly/grasscloverN, if one would like to download it and make comparisons using their own costs and rates of fertilization.

This comparison demonstrates the sensitivity of the costs to stand longevity and N price. One really needs a stand of clover to last at least 3 years at current N prices to breakeven. If it lasts only 2 years, N fertilizer prices would have to increase from about $0.45/lb of N today to over $0.60/lb for the clover to be worth it. Of course, these conclusions all assume there is no loss in forage or animal production on a per acre basis. This is likely a safe assumption where cool season grass pastures dominate, but it is a risky or false assumption in more drought-prone or stressful locations.

Table 1. The expected variable costs for pastures consisting of grass and clover mixtures (grass + clover) compared to grass stands fertilized with N (grass + N).[1]

		Clover stand life, years				
		1	2	3	4	5
		Annualized cost of clover establishment				
	Expected Variable Costs for Grass + N	$168.78	$87.44	$60.37	$46.88	$38.80
N price	Pastures	Expected Variable Costs for Grass + Clover Pastures				
($/lb)	($/acre)	($/acre)				
$0.40	$162.30	$274.78	$193.44	$166.37	$152.88	$144.80
$0.50	$177.30	$274.78	$193.44	$166.37	$152.88	$144.80
$0.60	$192.30	$274.78	$193.44	$166.37	$152.88	$144.80
$0.70	$207.30	$274.78	$193.44	$166.37	$152.88	$144.80
$0.80	$222.30	$274.78	$193.44	$166.37	$152.88	$144.80

[1] A spreadsheet containing the input costs and rates of fertilization is available at (http://bit.ly/grasscloverN). The cost of clover establishment ($157) was annualized assuming a 7.5% interest rate.

This is not to say that clovers are not useful even in these more challenging pastures. Low cost methods of establishment, such as frost seeding, can substantially improve the economic potential of their use. Clovers can fill gaps in the grass stand otherwise filled by weeds. Legumes managed for natural reseeding may also be a strategy that is advantageous. Additionally, using clovers strategically within the grazing system can have a major impact on reproductive efficiency. For example, there were 5 studies reviewed in the aforementioned paper by Burns and Standaert were the ADG of the cow was measured. All 5 measured a significant and reliable increase in the cows' ADG, averaging 0.5 lbs/hd/d more than the grass + N co-horts. Some studies since that review have shown that such an increase in cow weight gain translated to greater pregnancy and calving rates. This is encouraging, as even marginal increases in reproductive efficiency in a brood herd can make major profitability improvements.

In summary, mixtures of grass and clover generally increase individual animal performance and usually sustain animal productivity per acre at levels that are similar to or slightly better than grass pastures fertilized with N. The economics of using grass + clover pastures varies from site to site, but the chances of profitable clover use are greatest when grown in cool season grass pastures, a stand life of 3 or more years is expected, and N prices are moderate to high. Even in less than ideal conditions, clovers can provide additional benefits to the system that make them economically viable. Thus, the answer to the question "are clovers worth it?" is "usually, but not always."