THE OHIO STATE UNIVERSITY
COLLEGE OF FOOD, AGRICULTURAL, AND ENVIRONMENTAL SCIENCES

Paul C. and Edna H. Warner Endowment Fund for Sustainable Agriculture
Interdisciplinary Grant Program for On-Farm Research

Report Form

Project Title: Summer Annual Double Crop Organic Forage Production

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Summary (Describe your project, its objectives and results in one or two sentences)

In an organic cropping system that includes wheat, there are currently 9 months when an agronomic crop is not usually grown after wheat harvest and before corn when weeds must be controlled. Our local producers typically plant frost seeded or interseeded red clover for this weed control and mow the clover to control weeds. As they look for ways to diversify their operations, they are looking to grow a crop during part of this non-profitable time that can be sold as an organic forage or feed into a diversified livestock operation. This project was aimed at utilizing these existing clover stands as well as other alternative forages to discover what species might blend well with clover, and what additional, if any, nitrogen must be supplied to grow a sufficient amount of forage to cover costs. In addition to tonnage, the forages were analyzed for nutritional quality to help determine value. We discovered that all of the species we interseeded into clover plots, including oats, brown mid-rib sorghum, and sorghum sudan, complemented the clover forage to provide added tonnage over just the clover stand in the portion of the trial that was tilled prior to companion crop seeding. In the no-till establishment, yields were similar in both the control plots with just clover and the plots with an added companion crop, but overall total yields of dry matter were significantly higher on average in the no-tilled portion, regardless of crop. The no-tilled crops also tested with higher protein content and higher TDN (total digestible nutrients), likely due to the extra tonnage provided by the visibly thicker clover stand that was mowed prior to companion crop establishment versus the tillage of the clover in the tilled plots. Weed control looked to be more effective in the no-till plots, as the canopy from desirable crops was thicker and scored higher on the canapeo app measurements.

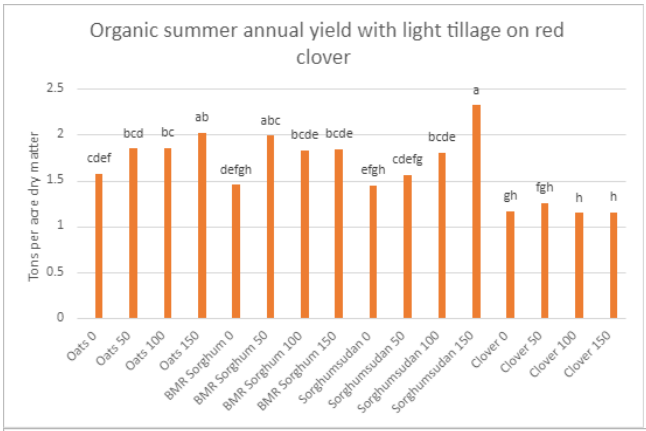
What was done? (One paragraph describing the goals, experiments and how they were performed)

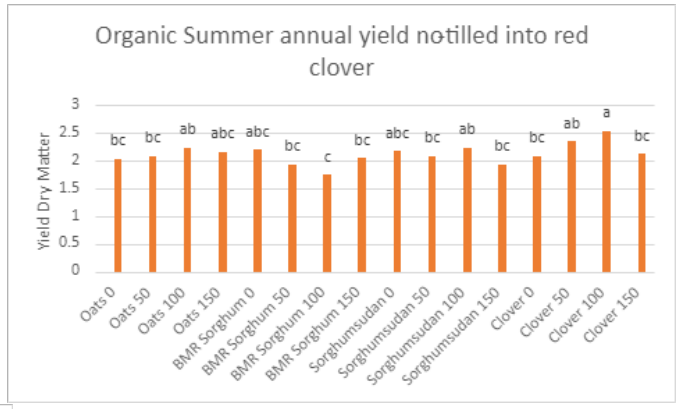
Work in this project aims to build on work from conventional systems to provide answers to organic grower's questions: What species will grow the best when planted into frost-seeded red clover after wheat harvest? How much nitrogen is needed to maximize forage yield and quality but still be economical? Lastly, how will these forage species assist with weed control?
On August 10, the researchers established the trial, seeding oats, sorghum, and sorghum-sudan into existing clover stands, with one half of the clover stand tilled prior to planting, and the other half mowed to a height of 3 inches. A control rep of just clover was included, and each half of the trial was performed in random block design with each species having 4 different nitrogen rates of 0, 50, 100, and 150 pounds of pelleted, organic nitrogen applied prior to planting. On October 9th, at the targeted window of 60-70 days post planting, the RCI forage plot harvester was used to harvest plots

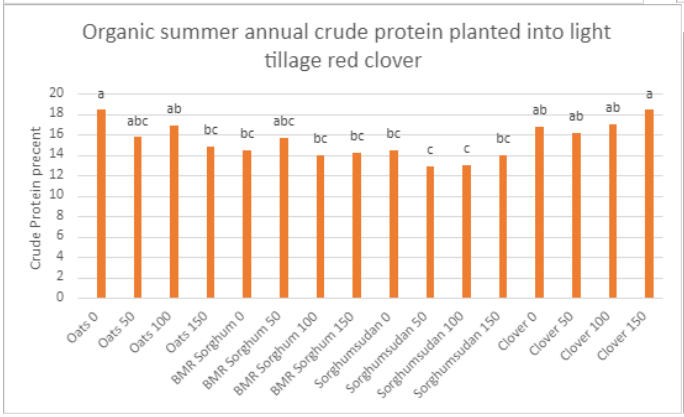
and record tonnage for each rep of each variable. The Canapeo app was also used to evaluate the percentage of ground cover at the time of harvest, giving indicators of weed control status and stand health. Dry down of the harvested forage was performed in the seed drying apparatus at the North Central Agricultural Research Station of the Ohio State University, and following dry down and yield calculations, samples were submitted to Cumberland Valley Analytical for forage nutrient analysis.

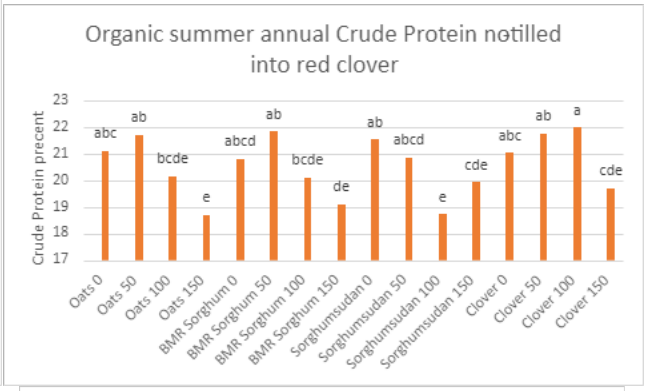
What were the results? (One paragraph on the outcome of the experiments, what was learned from them)

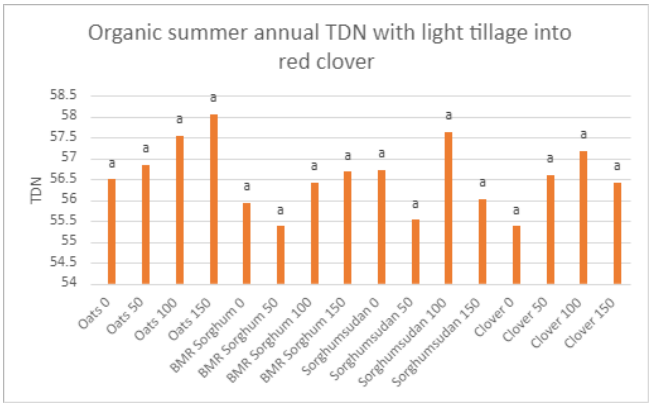
As seen in the charts below, overall tonnage was the greatest across all species in the trial in the no-tilled half of the plots, but observation here was that a majority of the tonnage in the no-tilled plots was clover forage, as the other species did not germinate quickly and compete with the rapidly re-growing clover. In the tilled plots, the clover came back much slower, and the other species were able to establish themselves and compete with the clover. From a weed control perspective, however, the tilled plots were less desirable, as their canopy scored lower than the no-tilled plots on average, and the noticeable bare spots where clover did not re-grow became filled with weeds, mainly foxtail, and some lambsquarter. From a nitrogen efficiency standpoint, there were significant differences noted in the tilled plots, which comes as no surprise that nitrogen mattered more when the companion crop was growing more vigorously. The highest rate of nitrogen at 150 pounds per acre yielded the best for both oats and sorghum-sudan, while the 50 pound rate was best for sorghum. There were very few statistical differences in the no-tilled plots between nitrogen rates. The nutrient content was highly variable across all of the trials, with protein content in the tilled plots reading significantly lower on average than the no-till plots, but with much more consistency in readings. This is most likely due to the no-till plots being mostly clover, which would be expected to test with higher protein and TDN values than the other crops in the trial. While nitrogen use efficiency was not calculated on this trial, it would appear in studying the data that due to the lack of growth of companion crops in the no-till plots, the addition of nitrogen was not economical, but it certainly was up to or slightly over the 100 pound rate in the tilled plots. In the tilled plots as nitrogen rates increased crude protein decreased but TDN and tonnage increased showing a correlation between nitrogen rate and summer annual grass forage percentage. The main takeaway for farmers on the use of these specific crops in addition to their clover stands is that if they want a mixed forage, it will be necessary to perform some type of tillage of the clover prior to seeding the companion crops. Added nitrogen is beneficial in that instance, and nutrient content will still be acceptable for most species of livestock, but for anyone feeding dairy cows, pure clover stands will more likely accomplish nutritional goals. From the weed control perspective, the tillage necessary to have success with companion crops may allow for more weed pressure than the clover stands that were not tilled, so growers would need to decide whether mixed forages and additional nitrogen costs outweigh the weed control benefits. The weather in 2023 was an anomaly with above average rain fall in July delaying planting and below average temperatures and rainfall in August, which both may have slowed the growth of the summer annuals that were planted into the clover. The researchers certainly recommend continued studies for long term data compilation not justify these claims.

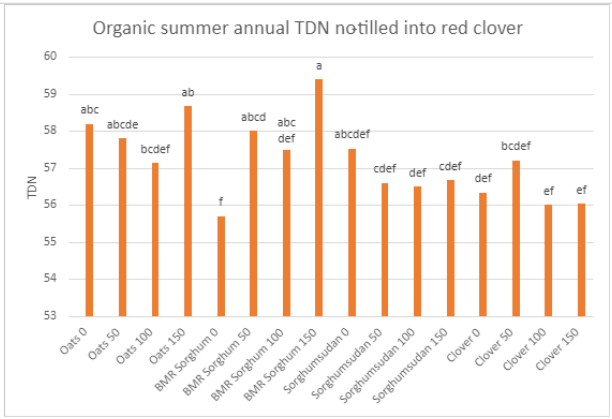












How have the results contributed or will they contribute to sustainable agriculture? (One paragraph on how will farmers use this research information and what difference will it make on their farm?

These results will improve sustainability through improved land usage and forage production to meet livestock needs. One of the challenges in pure red clover stands is that the forage provides more crude protein than the animal needs but not enough energy, TDN. Adding oats to a clover stand increased

TDN by 2%. While not a lot this small increase brings the forage closer to what lactating beef cows or sheep would need. The additional 2 tons of forage produced on this ground would provide producers with an additional $400/acre of income or feed value for their livestock. The ability to slow clover growth with tillage and then grow summer annual grass forage provides an additional value. Some producers want clover as an overwintering crop to produce spring nitrogen but need a grass based forage for feed. Our preliminary work shows that frost seeded red clover growth can be slowed with tillage and allow summer annual grass to establish. The Red clover will regrow both after tillage and after forage harvest to provide winter cover and spring nitrogen fixation.