COVER CROP IMPLICATIONS ON THE SOIL FAUNAL COMMUNITY

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Abstract

Many growers plant cover crops ahead of planting soybean. However, factors that accompany cover crop/soybean management can produce unexpected effects on agronomic traits, nematodes (plant parasites, fungivores, bacterivores, omnivores, predators), and other soil fauna (rotifers, tardigrades, mites, oligochaetes, Collembola). During the 2020-2021 season, a randomized factorial trial was conducted in Madison County, TN, USA consisting of three factors: 1) cover crop mixes (fallow, five-way mix without *Brassica spp.*, and six-way mix with *Brassica spp.*); 2) burndown timing (three weeks before planting and at planting); and 3) seed treatments (fungicide-only, insecticide-only, fungicide/insecticide, and fungicide/insecticide/nematicide). Soil samples were taken at four time points. Seedling emergence, biomass, yield, and the soil faunal community were analyzed. Soil samples taken when cover crops were sown and soybean was planted showed no effect of cover crop treatments on population densities of plant-parasitic nematodes or the soil faunal community. Conversely, the population densities of fungivores, bacterivores, rotifers, tardigrades, and oligochaetes were lower with late burndown. Seedling emergence and yield were also lower in late burndown treatments. Fallow treatments had greater emergence and yield than both cover crop treatments. These emergence and yield differences may be due to poor seed-to-soil contact resulting from one planting depth used across all treatments. Fungicide-only seed treatment had lower yield than combination seed treatments. Remaining soil samples from the trial will be processed and results presented at a later date.

Introduction

Of all soybeans grown in Tennessee, 80% are farmed in no-till conditions, meaning that crop debris is left over from the previous growing season (UT 2021). Using cover crops in conjunction with no-till practices can lead to long term soil health improvement (Hoorman et al. 2009). Because of this, cover crops are often utilized for their well-known soil health benefits (Sharma et al. 2018). However, there are many potential negatives to consider when planting cover crops as well (Haider et al. 2019) Therefore, to determine potential benefits/disadvantages of using cover crops in relation to soil faunal communities in TN soybean production systems, a 3-way factorial trial was conducted during the 2021 growing season in Madison County, TN. The factors were as follows: 1) cover crop mixes (fallow, five-way mix without *Brassica spp.*, and six-way mix with *Brassica spp.*); 2) burndown timing (three weeks before planting and at planting); and 3) seed treatments (fungicide-only, insecticide-only, fungicide/insecticide, and fungicide/insecticide/nematicide). The combined factors totaled 24 treatments. Treatments were replicated 4 times, resulting in a 96-plot trial.

Materials and Methods

Biomass samples were taken before and after each burn down timing. Samples were taken by throwing a 4x4 in PVC pipe square into each plot two times randomly. The green material that landed within the square was bagged and dried for 3 days at 60°C. The dried plant material was weighed in grams. Additionally, soil samples were taken at 4 different time periods: 1) at cover crop planting in the Fall; 2) at soybean planting in the Spring; 3) 45 days after soybean planting; and 4) at soybean harvest. Using an Oakfield soil tube, 10 soil cores were taken form the center two rows of each plot. Soil from each sample was sieved and split into 100 cm^3 subsamples. Soybean cyst nematode (SCN) populations were assessed via elutriation. Whereas the nematode community (plant parasites, bacterivores, fungivores, omnivores, and predators), and soil fauna (collembola, mites, oligochaetes, tardigrades, and rotifers) subjected to sucrose-centrifugation. All organisms were viewed and counted microscopically.

Cover mixes were planted in the Fall of 2020 at a targeted planting depth of 1 in across all plots. Soybean planting took place in the Spring of 2021. Planting depth of soybean varied between 1-1/4 in due to the difficulty of planting into substantial green material in the later burn down plots. Data was analyzed using Agricultural Resource

Management (ARM) statistical software. A factorial analysis was performed using an alpha level of 0.05.

Results and Discussion

As of January of 2022, only the soil samples from the cover crop planting in the Fall, and soybean planting in the Spring time points have been completely processed. Therefore, the following results are reflective of only those two time points. There were no significant differences in SCN, lance, spiral, omnivores, predators, mites, or collembola populations between or Fall and Spring sampling dates. However, there were significantly lower number of fungivores, bacterivores, rotifers, tardigrades, and oligochaetes in all burn down plots (Figure 1). This may be due to an increase in decomposing biomass from the early burndown plots, that we were not able to catch in the timepoint directly following the late burndown. Once all soil samples are processed from the remaining timepoints, it will be interesting to see if that negative trend continues throughout the season.

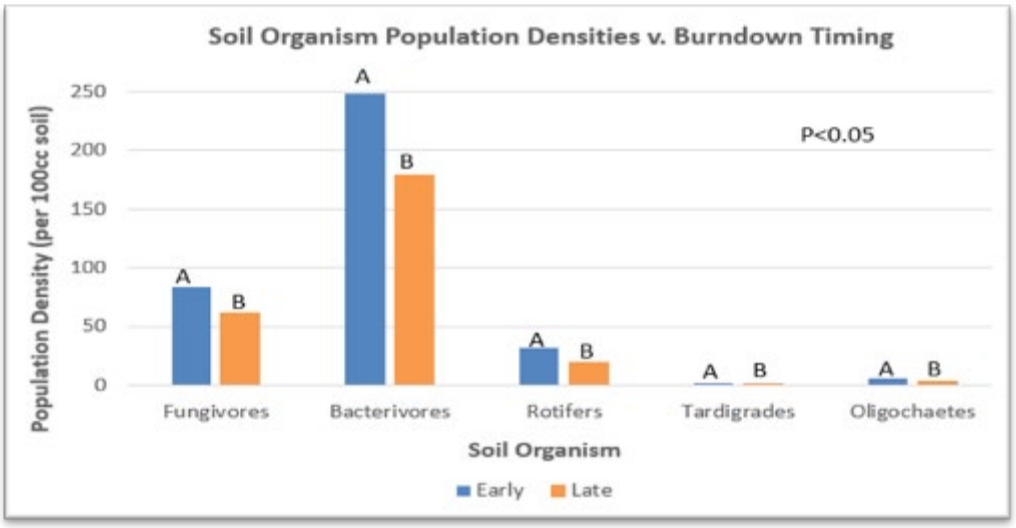

Figure 1. Soil organism response to burn down timing.

Both cover crop treatments had significantly greater biomass than the fallow (Figure 2). However, the biomass between the cover treatments did not significantly differ from each other. When looking at stand response, the fallow plots had significantly greater stand counts than both different cover crop mixes (Figure 3). Additionally, the treatment without the brassica had the lowest stand count overall. The random variations in planting depth used for the soybean most likely led to failed seed to soil contact in the cover crop plots. Moving forward, the planting depth of will be adjusted precisely for each cover crop and burn down treatment.

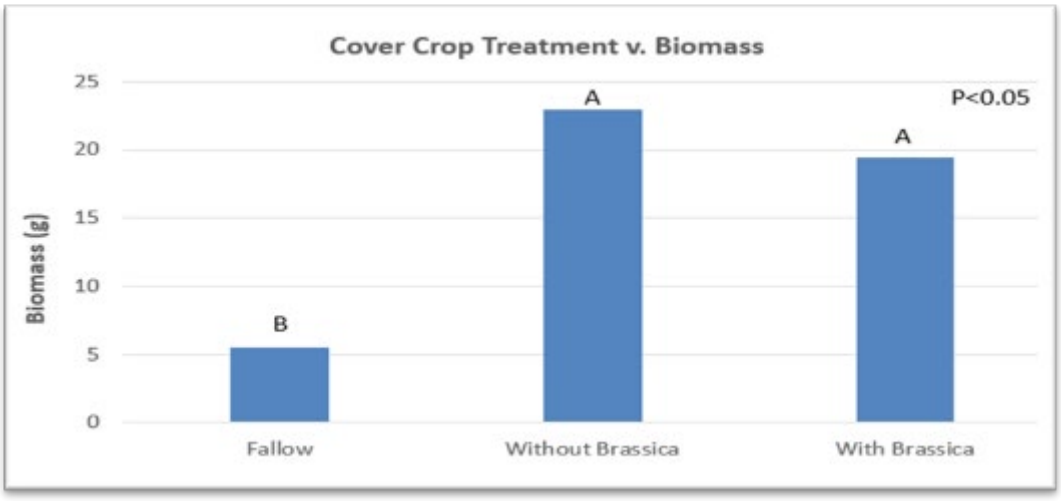

Figure 2. Biomass in relation to cover crop treatment.

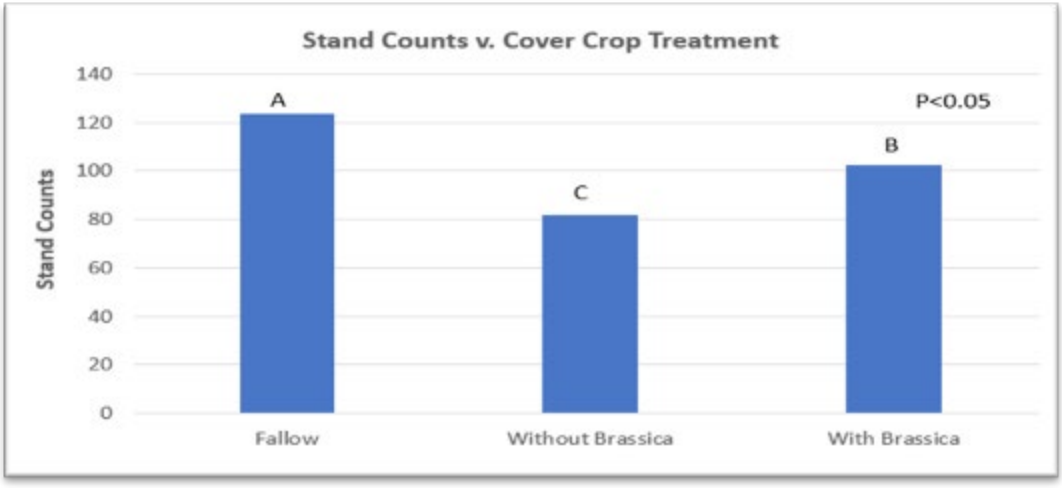

Figure 3. Stand count in relation to cover crop treatment.

The reduction in stand across the cover crop plots most likely influenced the significant difference in yield between the fallow and the cover treatments (Figure 4). Even though the stand counts between the cover treatments were significantly different, that difference was not enough to influence difference in yield. Natural variation in the field could have had some influence on the lack of significance between the two covers in yield compared to initial stand counts.

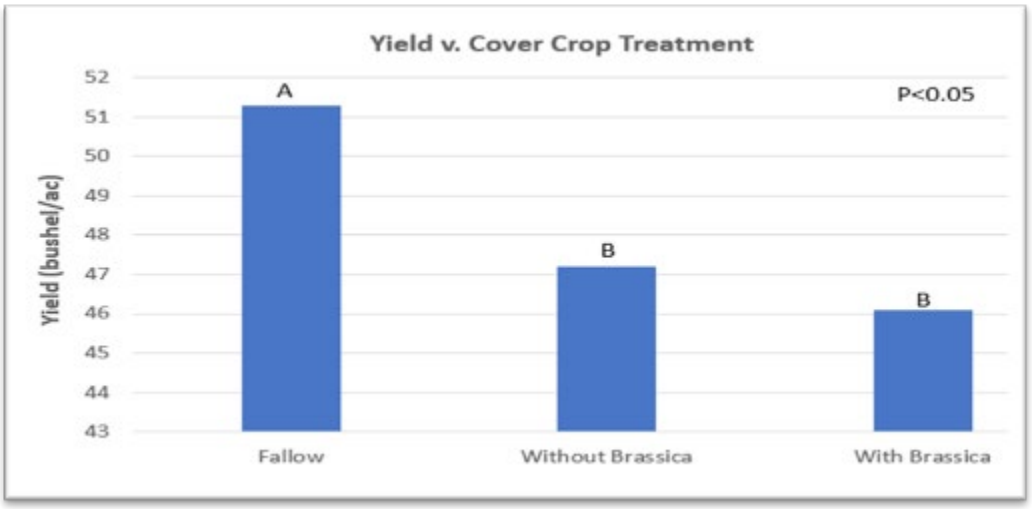

Figure 4. Yield in relation to cover crop treatment.

Looking at both yield and stand count response to cover crop treatments, there were significant interactions with burn down timings (Figure 5). Stand and yield were significantly lower across the late burndown plots. Again, this could be attributed to the difficulty of planting into green material in the late burn down, and the efficacy of our seed treatments against the green bridge formed from that green material. Finally, seed treatments had no significant impact on stand. However, there were significant impacts on yield (Figure 6). Overall, the combination treatments outperformed our stand-alone treatments. The stand-alone treatments were just not as strong in combatting pathogen and insect pests in the field. This loss was especially noticeable in the fungicide only treatment, meaning insecticides are an important component for seeds planted into cover crop residue.

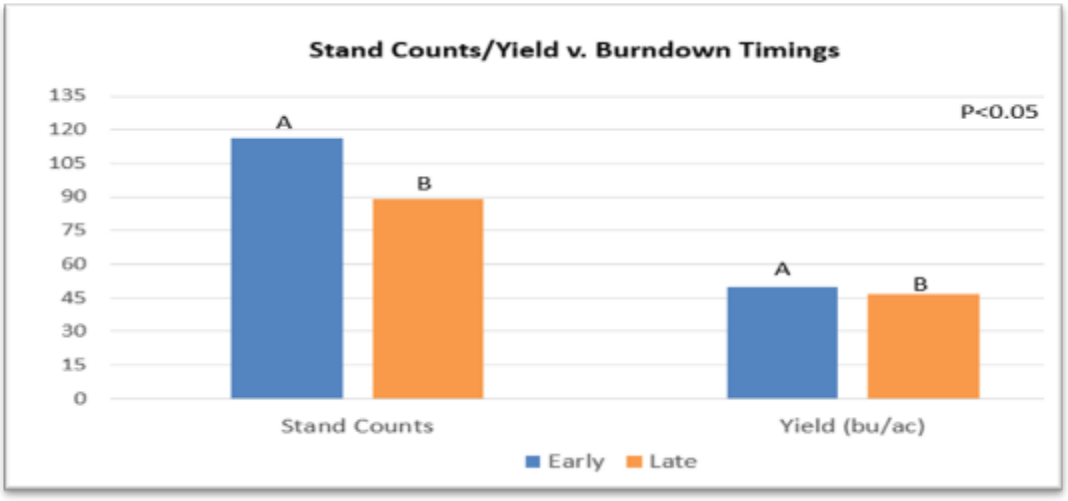

Figure 5. Stand/yield in relation to burn down timings.

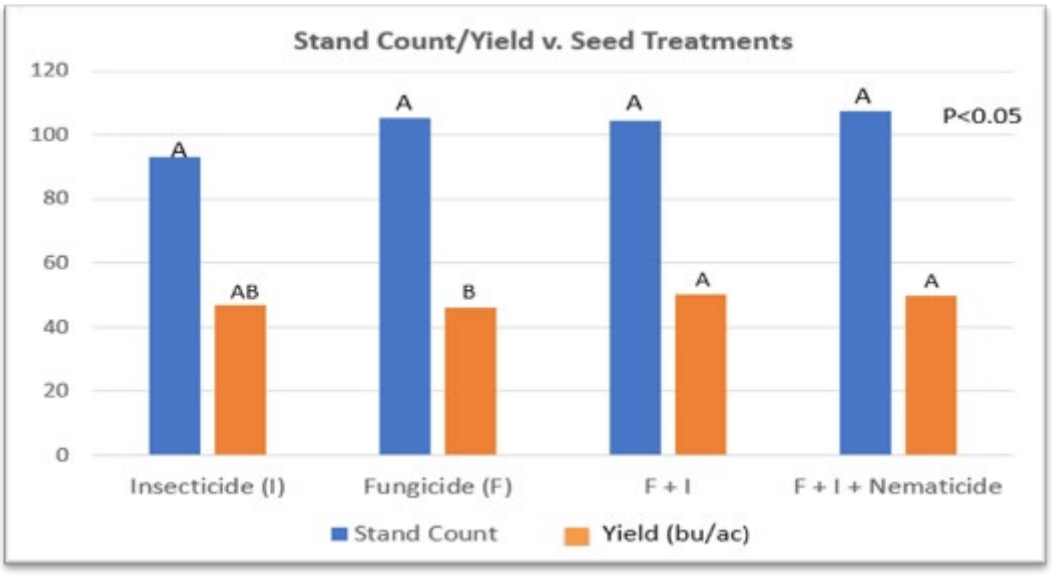

Figure 6. Stand/yield in relation to seed treatments.

Summary

In conclusion, there have been no significant effects on SCN, spiral, lance, omnivores, predators, mites, or collembola populations between or Fall and Spring sampling dates, there have been significantly negative effects of late burn down on fungivores, bacterivores, rotifers, tardigrades, and oligochaetes. Further analysis of soil samples is needed in order to uncover the true effect of burndown timings on season-long soil fauna. Accurate planting depths are essential to determining yield impact. Moving forward, the trial layout will be adjusted to account for accurate planting depths for individual cover mixes and burn down timings. This adjustment will give a more accurate view of stand and yield response in relation to all afore mentioned factors. Generally, this trial serves as a good example what could be investigated in other cropping systems such as corn and cotton and can be used to help growers and researchers understand underlying interactions which may impact soybean production, nematodes, and soil fauna.

Acknowledgements

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