WEED SUPPRESSION OF A BICULTURE COVER CROPPING SYSTEM IN FRESH MARKET TOMATOES

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INTRODUCTION

Fabacaceae (legume) and Brassicaceae are two families of cover crops that are often recommended in a sustainable production system because of their unique properties and benefits on the soil. The use of allelopathic legume cover crops is of great interest because of their ability to fix nitrogen (Hill et al 2006). Several studies have shown the allelopathic potential of legume cover crops (Njoujio & Mennan 2005; Teasdale 1996; Hutchinson & McGiffen 2000). One such group of legume cover crops that have shown strong allelopathic capabilities is the vetches (Njouajio & Mennan 2005, White et al 1989; Hill et al 2006). Vetches, which include hairy vetch, purple vetch, and lana vetch, perform well over a wide range of soils, can fix over 100 pounds of nitrogen per acre and release about half of it to the following cash crop (Schonbeck & Morse 2006). They also make soil phosphorus more available and provide habitats for beneficial insects.

Cover crops in the *brassica* family, which include daikon, oilseed, and fodder radishes, are often chosen as cover crops because they are deep rooted crops that can help open subsoil hardpan (Schonbeck & Morse 2006). This characteristic is especially important in areas where traditional tillage has left a layer of hard soil just under the disturbed soil area. Other advantages include conservation of soluble nitrogen and rapid canopy closure to help prevent weed seed germination (Schonbeck & Morse 2006). These cover crops are also known to have strongly allelopathic root exudates, which can leave behind a weed-free seedbed after winterkill.

Planting a *brassica* and legume cover crop as a biculture could be very beneficial. In areas where traditional agricultural practices, such as mold-board plowing, have left a hardpan under the soil, the *brassica* cover crop could help break-up this layer. Incorporating a legume cover crop, that will help fix nitrogen, could prove to be very beneficial, especially in areas where the soil contains very low organic matter. Weed suppression could also be increased by incorporating the two families, instead of planting a monoculture cover crop system. However, it is important to understand how these crops will not only affect one another, but the cash crops that would follow behind this system. If increased weed suppression occurred from the biculture system, it is possible cash crops could be negatively affected, as well. Field studies are necessary to examine this system before it can be recommended to growers. Therefore, the objectives of this study were to determine: 1. compatibility of a *brassica* and legume cover crop

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in a biculture production system, 2. weed suppression when *brassica* and legume cover crops are planted as a mono-and biculture, and 3. effects on a cash crop when *brassica* and legume cover crops are planted as a mono- and biculture.

MATERIALS AND METHODS

For this study, oilseed radish (*Raphanus sativus*) and purple vetch (*Vicia atropurpurea*) were chosen because both have similar planting dates and should be winterkilled when temperatures drop below 20° F. Field design was a randomized complete block design with four replications. Individual plots measured 15 feet by 6 feet and consisted of four treatments: 1. Bare-ground control, 2. Purple vetch monoculture, 3. Oilseed radish monoculture, and 4. Purple vetch/oilseed radish biculture. Two locations were chosen for this study, one at the Tidewater Agricultural Research and Extension Center in Suffolk, VA and one in Dinwiddie County, VA. Plots were planted in Dinwiddie on 13 August 2007 and in Suffolk on 11 September 2007. Prior to planting, soil samples were taken from each treatment plot and evaluated for basic soil nutrient levels and percent organic matter. The cover crop seed was planted at the recommended rated with an Earthway® "EV-N-SPRED" broadcast seed spreader. After broadcasting, the seed were incorporated into the top two inches of the soil with a hard garden rake. Approximately two weeks after planting, data were collected from each plot based on percent ground coverage of the cover crops and weed coverage. Ground coverage percentages were subjected to ANOVA and the means were separated using Fisher's Protected LSD test.

The following spring, the treatments were incorporated into the soil with a garden tiller and soil samples were again taken from each plot. Approximately two weeks after cultivation, 'Crista' tomatoes were transplanted into the treatment plots and maintained according the Virginia Vegetable Production Recommendations Guide (Kuhar et al 2008). Weed data were taken on a weekly basis for approximately eight weeks. A 20- by 20- inch quadrat was placed randomly within the plot and the numbers of weeds were counted within the quadrat. Two quadrat samples were taken per treatment each week. Weed data were placed into one of the following categories: 1. < 2 inches, 2. 2-4 inches, and 3. ≥ 5 inches. Weed counts were totaled and subjected to ANOVA and the means were separated using Fisher's Protected LSD test. Weed data were also analyzed to determine if weed suppression properties of the cover crops diminished over time.

Yield data was also collected in late summer of 2008 from the transplanted tomatoes. Data were collected for total number of plants that survived to harvest, total fruit weight, and marketable fruit weight. These data were subjected to ANOVA and the means were separated using Fisher's Protected LSD test.

RESULTS AND DISCUSSION

When purple vetch was planted in a monoculture, percent coverage totaled 32.50%, which is significantly higher than 11.88% coverage when planted in the biculture system with oilseed radish (Figure 1). Subsequently, percent coverage of oilseed radish in a monoculture compared to the biculture with purple vetch was not significantly different, totaling 78.13% and 75.00%, respectively (Figure 2).

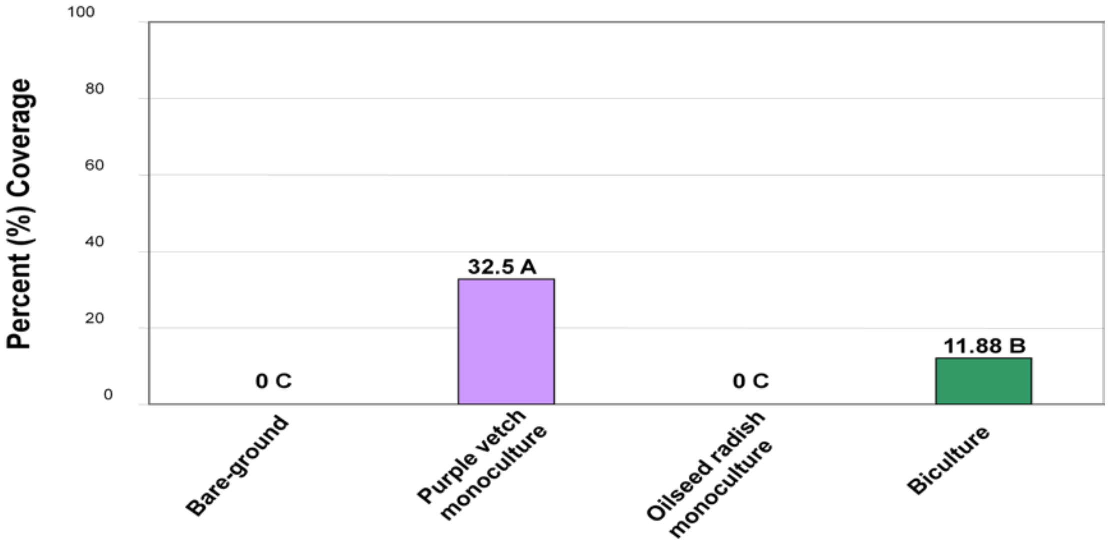


Figure 1. Percent coverage of purple vetch. Treatments with the same letter are not significantly different (α=0.05).

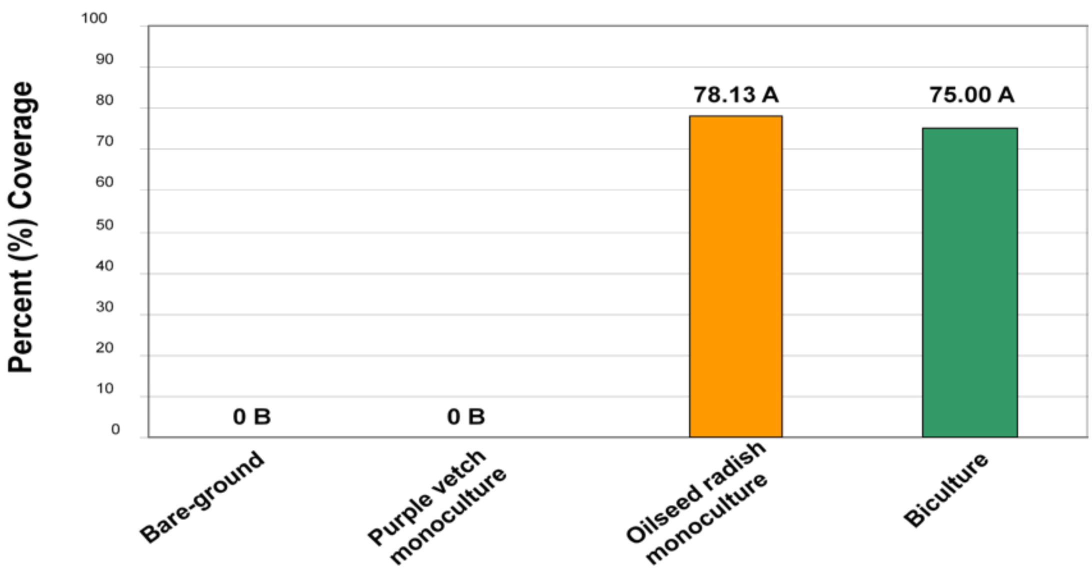
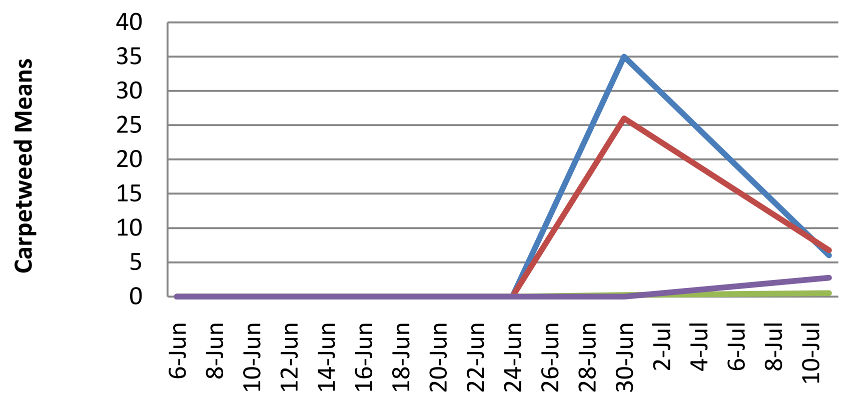


Figure 2. Percent coverage of oilseed radish. Treatments with the same letter are not significantly different (α=0.05).

In 2008, there were significant differences in total weed counts when individual species of weeds were compared from the Suffolk location, however, there were no significant differences in total weed counts for individual species of weeds from the Dinwiddie location (Figure 2). In Suffolk, there were three predominant species of weeds present: carpetweed (*Mollugo verticillata*), yellow nutsedge (*Cyperus esculentus*), and a variety of grass species. Carpetweed counts between the untreated control (41.00) and the vetch monoculture (32.75) were not significantly different from one another. Likewise, carpetweed counts in the oilseed radish monoculture (0.75) and the biculture (2.75) were not significantly different. However, when carpetweed counts for the untreated control and the purple vetch monoculture were compared to weed totals in the oilseed radish monoculture and the biculture, the treatments that contained oilseed radish had significantly lower carpetweed counts. Significant differences in total weed counts did not occur with any of the other predominate weed species at the Suffolk location.

At the Suffolk location, carpetweed counts were significantly higher approximately one month after the initial counts in both the untreated control and the purple vetch monoculture (Figure 3). There were no significant differences in weed numbers at different days in the oilseed radish monoculture and the biculture, suggesting carpetweed suppression up to eight weeks after incorporation of the cover crop. There were no other significant differences in weed counts over time at the Suffolk location. As with total weed counts, there were no significant differences in weed species as a function of time at the Dinwiddie location.



	6-Jun	24-Jun	30-Jun	11-Jul
Bare-ground	0	0	35	6
Purple vetch monoculture	0	0	26	6.75
Oilseed radish monoculture	0	0	0.25	0.5
Biculture	0	0	0	2.75

Figure 3. Carpetweed means over time at the Suffolk location (p<0.0001).

There were no significant differences in yield data from either location.

CONCLUSIONS

Early results from this study suggest that a biculture production system involving a brassica (oilseed radish) and a legume (purple vetch) cover crop may not be a viable system for Southeast Virginia. Purple vetch coverage was significantly lower when planted in a biculture system with oilseed radish versus a purple vetch monoculture. However, this situation only occurred at one of the two locations used in this study, so it is difficult to say for certainty if this would occur each time these two cover crops were planted together or if there were other factors contributing to these differences. Likewise, differences in weed counts only occurred at the Suffolk location, and then only with carpetweed. Carpetweed also showed significant differences as a function of time. Total carpetweed counts steadily increased in both the bare-ground control and the purple vetch monoculture, but remained significantly lower in the oilseed radish up to eight weeks after incorporation of the cover crop into the soil. While it is possible that carpetweed totals were significantly lower in treatments containing oilseed radish because of allelopathy, it may actually be a result of shading. The Suffolk location experienced very warm temperatures in early spring, which caused the oilseed radish to bolt and ultimately seed out before the cover crop was incorporated into the soil. High numbers of “volunteer” oilseed radish germinated in all treatment plots that contained this cover crop. Early in its development, carpetweed is a very low growing weed and may have been shaded by the oilseed radish plants and was therefore unable to grow as well in the treatment plots that did not have an oilseed radish problem.

There does not appear to be any negative effects on tomato growth and yield as a result of allelopathy from either of the two cover crops. However, as with weed counts and ground coverage percentages from these treatments, further data needs to be collected.

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