Issue 1, September, 2004

Organic Research Matters

A publication of the USDA-ARS Organic Research Program in Salinas, California.

New Newsletter!

This is the first issue of this new newsletter. The goals of *Organic Research Matters* are to communicate research results from the Organic Research Program at the USDA Agriculture Research Service (ARS) in Salinas, and update you on program developments, future field days and presentations. As you may know, this research program is unique because it is the first and only USDA-ARS research program in the country that focuses exclusively on organic issues. My previous work as an extension agent with the Peace Corps in Thailand, and my observations and experiences since then have sensitized me to the need for and challenges of getting research information from research stations, laboratories, and academic publications into the hands of farmers. During recent discussions on this issue with Nathan Boyd, the post-doctoral researcher in my program, Nathan suggested that we create a newsletter. Hence, the birth of *Organic Research Matters.*

Although, you may be aware of some aspects of this new research program from interactions with me, presentations, and articles in other "farmer-friendly" publications (*UCCE Crop Notes*, *CAFF Farmer to Farmer*), I believe that *Organic Research Matters* will help to fill the gaps and facilitate transfer of our research results to the field. In the future, *Organic Research Matters* may also be available online. To request additional subscriptions or to give input on the newsletter or the research program, please don't hesitate to contact me by phone, mail or email (p.4). Thanks for supporting organic researchers by supporting organic farmers!

Sincerely,

Eric Brennan, Ph.D. (Research Horticulturist)

Cover Crop Seeding Rate and Planting Orientation Trial

Eric Brennan, Nathan Boyd and Richard Smith

Fall is fast approaching and soon many organic growers will begin to plant their winter cover crops. Cover crops are an important component of ecologically based farming systems and affect soil quality, nutrient cycling, pests, diseases, and weed populations. Their use helps mitigate the negative impacts of intensive vegetable production such as nitrate leaching and soil compaction. In the last few years the acreage dedicated to winter cover crops has grown on the central coast of California and we hope that this trend continues.

There are many basic aspects of cover crop management that need to be addressed to optimize cover crop performance. Cover crop seeding rate and cover crop planting orientation (i.e. one-way versus crisscross planting patterns) are two important aspects that we are studying. We began two on-farm trials last winter to examine the effects of seeding rate and planting orientation on cover crop biomass production and weed suppression. The cover crops included 'Merced' rye (*Secale cereale)*, and a legume/oats mixture (35% bell beans, *Vicia faba*; 15% common vetch, *V. sativa*; 15% purple vetch, *V. benghalensis*; 25% 'Magnus' peas, *Pisum sativum;* 10% 'Cayuse' oats, *Avena sativa*). The collaborating organic farmers are Ron Yokota (Tanamura and Antle) and Phil Foster. This study is supported by a grant from the Organic Farming Research Foundation. The objectives of this 2 year study are (1) to determine if increasing the cover crop seeding rate or planting a cover crop in a crisscross versus a one-way planting pattern will affect the canopy growth of the cover crop and its ability to compete with winter weeds and (2) to determine if any benefits obtained by increasing the seeding rate or altering the planting pattern are worth the increased cost of the alternative practice.

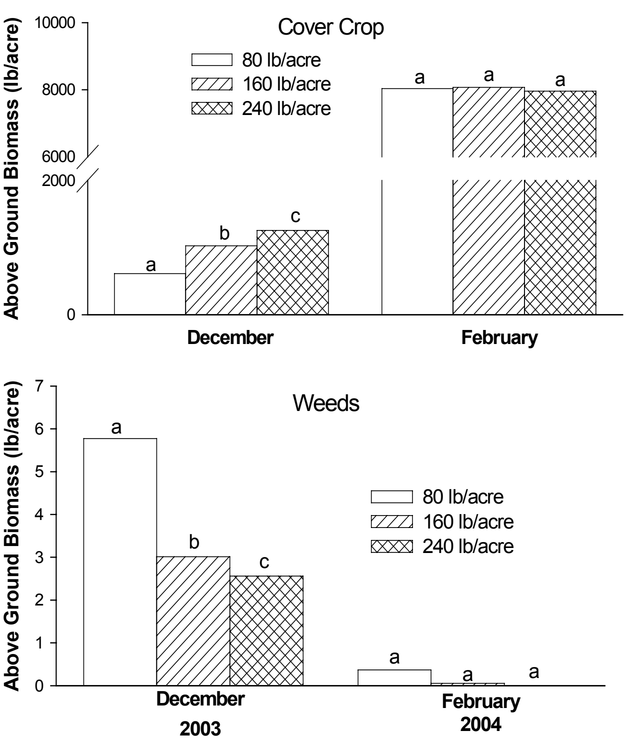
On October 22, 2003, 'Merced' rye was planted at 3 seeding rates (80, 160, and 240 lbs/acre) in two planting arrangements (one-way versus crisscross) at a Tanamura and Antle organic farm along Foster Road in Salinas. On November 3, 2003, the legume/oats mix was planted at Phil Foster's organic farm in Hollister, at three rates (100, 200, and 300 lbs/acre) and the two planting orientations. The cover crops were planted with a Great Plains grain drill with double disk openers and press wheel following seed lines that are spaced 6" apart. Cover crop and weed growth were monitored throughout the season at both sites.

We found that increasing the seeding rate increased cover crop biomass production early in the winter (December) with both cover crops, but did not affect biomass production by the end of the season (Figures 1 and 2). Seeding rate and planting arrangement did not effect the number of weeds that emerged in either cover crop (data not shown). With both cover crops, increasing the seeding rate did, however, reduce early season weed growth, and with the legume/oat mix this trend continued to the end of the season. Increasing the seeding rate also affected the rate of canopy development with higher seeding rates reducing the amount of time that the ground remained bare. There appears to be a strong relationship between the ability to cover the ground quickly and the growth of weeds and their ability to survive and produce seeds.

Seeding rate also influenced the productivity of the legume component of the legume/oat cover crop mix (Table 1). At the beginning of the season across all seeding rates and planting arrangements, the legumes comprised 85% of the cover crop biomass. But as the season progressed, the legume portion of the total cover crop biomass declined, especially in the higher seeding rates (200 and 300 lbs/acre). By the end of the cover cropping period (April), the amount of legume biomass produced in the 100 lb/acre seeding rate was more than double the legume biomass produced in the 300 lb/acre seeding rate.

The effect of planting arrangement on cover crop biomass production differed between the rye and legume/oat mix. Biomass production by rye averaged across all seeding rates, was equivalent in the crisscross and one-way patterns for most of the season except in January when there was 10% more biomass in the crisscross pattern. However, the rate of the rye canopy development was faster in the crisscross than in the one-way planting pattern (Figure 3). With the legume/oats mix, there was no difference in cover crop biomass production until the end of the season when the crisscross planting yielded 19% more than the one-way planting averaged across all seeding rates. Planting arrangement did not affect weed suppression by rye or the legume/oats mix.

The results reported in this article are preliminary but show that increasing the seeding rate does not affect total cover crop biomass production but does affect the rate of canopy development early in the season. This is important because maximizing early season growth may maximize nitrate scavenging and weed suppression. Our previous studies have shown that early season weed suppression can result in less weed seed production in some situations. We did not measure weed seed production in these cover crops. However, weed seed production data from another of our ongoing studies at the USDA organic research plots found that an 80 lb/acre seeding rate in rye reduced chickweed seed production as well as a 240 lb/acre planting. Thus, although a higher seeding rate for rye provides additional “insurance” against weed seed production, it may not be necessary. Improving early season ground cover appears more important with the legume/oats mix than with rye because the former is less competitive with weeds. Although increasing the seeding rate of the legume/oat mix increases its competitiveness with weeds, it also suppresses the legume component and hence it’s potential to fix nitrogen.



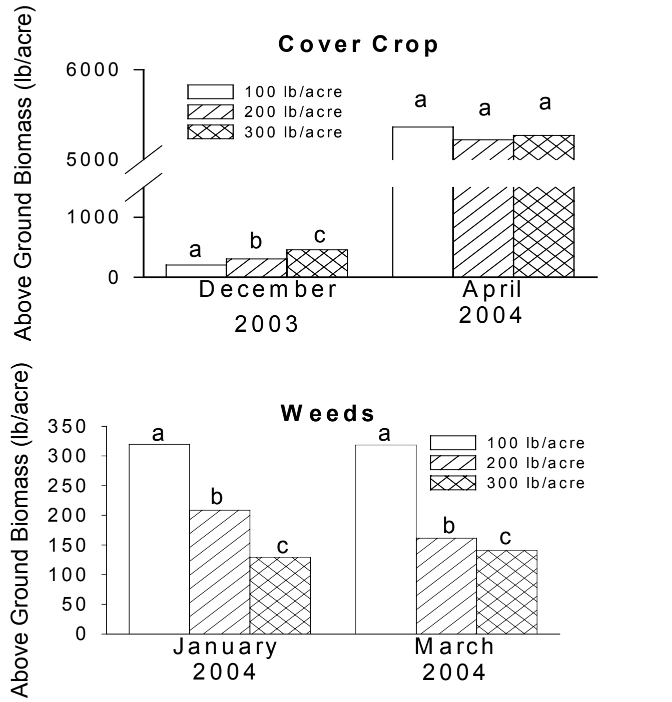


Figure 2. *Effect of 3 seeding rates on cover crop and weed biomass production in the 90% legume/10% oats mixture at the Foster Ranch. Bars topped with different letters are significantly different at the p<0.05 level.*

Seeding Rate	Dec. 15	Jan. 20	Mar. 5	April 5
	---Legume Biomass Production (lbs/acre)---			
100	165 a (82%)	1688 b (55%)	2170 a (42%)	3322 a (62%)
200	262 b (86%)	2015 ab (55%)	1931 b (39%)	1699 b (33%)
300	412 c (91%)	2317 a (54%)	1533 b (34%)	1763b (33%)

Table 1. *Effect of seeding rate on dry above ground legume biomass production in the 90% legume/10% oats mixture at the Foster Ranch. These data are averaged across the one-way and crisscross planting arrangements. Numbers within the same date followed by different letters are significantly different at the p<0.05 level. Numbers in ( ) are the legume percentage of the total above ground cover crop biomass.*

The results do not show any clear advantage of increasing cover crop seeding rate or planting in a crisscross pattern. They do suggest, however, that their may be some benefits in regards to weed suppression. Seeding rate issues are more complex with a legume/oats mix than a rye cover crop because higher rates suppress the legume component as well as the weeds. A more promising practice for reducing weeds in cover crops is discussed in the following article.

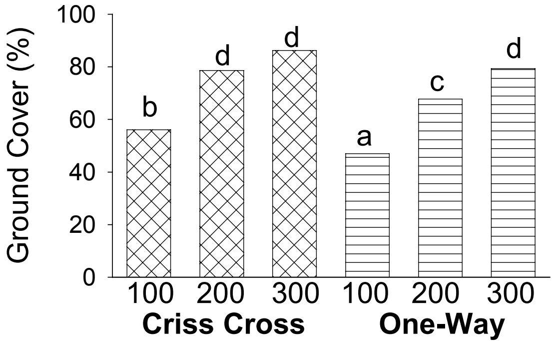


Figure 3. Canopy development of a rye cover crop at 3 seeding rates (100, 200, 300 lb/acre) and 2 planting arrangements (crisscross and one-way) 29 days after planting at the Tanamura and Antle site. Bars topped with different letters are significantly different at the p<0.05 error rate.

Weed Survival and Seed Production Following Rotary Hoeing in a Mixed Cover Crop

Nathan Boyd and Eric Brennan

Weed seed production during cover crop growth can be substantial and may cause future weed problems. Legume/cereal mixes are widely used on organic farms in the central coast of California and have relatively poor weed suppressive abilities due to their slow early season canopy development (Brennan and Smith 2003). The rotary hoe is one implement that may be used for weed control following cover crop emergence. It has been used to control weeds effectively in a variety of monocultures, but to our knowledge, has never been evaluated in mixed cover crop plantings. The objective of this study was to evaluate the impact of the rotary hoe on cover crop density and biomass, weed density and biomass, and weed seed production.

An experiment was conducted on a 10 acre transitional organic block of the 22 acre organic research land at the USDA-ARS in Salinas, California in 2003-2004. A mixed cover crop consisting of 10% ‘merced’ rye, 15% common vetch (*Vicia sativa* L.), 15% purple vetch (*Vicia benghalensis* L.), 25% ‘magnus’ peas (*Pisum sativum* L.) and 35% bell bean (*Vicia faba* L.), was planted in November, 2003. Three treatments were tested; no rotary hoeing, 1 pass with the rotary hoe 14 days after planting (DAP), and 2 passes with the rotary hoe with the first occurring at 14 DAP and the second at 28 DAP. A 15’ wide Yetter rotary hoe (Colchester, IL) was used at speeds of 8-10 mph.

15’ wide Yetter Rotary Hoe. Cost ≈ $2,500

During the first pass with the rotary hoe, cover crop growth stages were rye (2 leaves), common and purple vetch (1st true leaves just emerging), peas (1st true leaf) and bell bean (first true leaves emerging from soil). During the second pass with the rotary hoe, cover crop growth stages were rye (1-2 tillers), purple vetch (4-6 nodes with the bottom 1 branching), common vetch (4-5 nodes with the bottom 2 branching), peas (3-4 true leaves) and bell beans (2-3 true leaves).

Neither 1 nor 2 passes with the rotary hoe affected cover crop stand density or the proportions of the various components within the cover crop mix. The rotary hoe also did not affect cover crop biomass production. One pass with the rotary hoe reduced the number of chickweed, common groundsel, henbit, and shepherd’s purse seedlings but did not significantly reduce hairy nightshade seedlings. The two predominate weed species were chickweed and shepherd’s purse. One rotary hoe pass reduced the number of chickweed and shepherd’s purse seedlings by 64% and 91%, respectively. A single pass with the rotary hoe reduced total weed density by 69%, from 44 to 13.7 weeds/ft^2. A second pass with the rotary hoe did not further reduce weed density.

Dry weed biomass 105 days after planting was 648 lbs/acre where no rotary hoeing occurred (Figure 4). A single pass with the rotary reduced weed biomass by 77% to 149 lbs/acre.

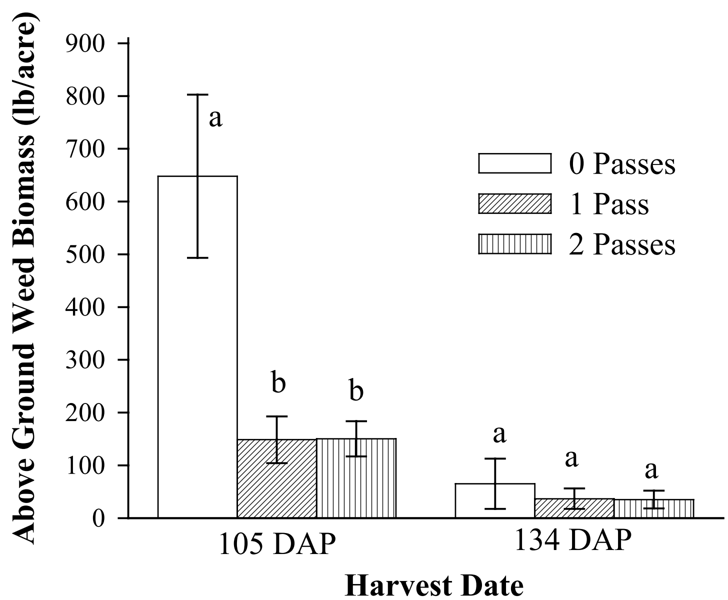


Figure 4. *Dry weed biomass in the cover crop at 105 and 134 DAP (days after planting) following 0, 1, or 2 passes with the rotary hoe. Bars are mean ± 1 standard error. Bars topped with different letters within each harvest date are significantly different at the p<0.05 level.*

A second pass did not further reduce weed biomass. Most weeds were dying by 134 days after planting and the effect of rotary hoeing on weed biomass was no longer significant.

Rotary hoeing also reduced weed seed production. One pass with the rotary hoe reduced seed production by 81% for chickweed and 93% for shepherd's purse (Figure 5). A second pass with the rotary hoe had no additional affect on weed seed production.

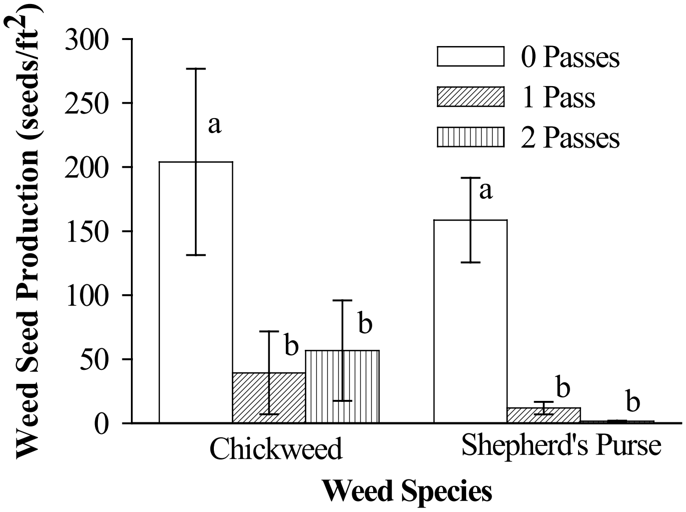


Figure 5. *Weed seed production by chickweed and shepherd's purse 134 days after plating following 0, 1, or 2 passes with the rotary hoe. Bars are mean ± 1 standard error. Bars topped with different letters within each weed species are significantly different at the $p<0.05$ level.*

These preliminary results illustrate the ability of the rotary hoe to reduce weed populations and weed seed production without significantly affecting cover crop plant stand density or biomass. These results are consistent with the results of other studies that found that the rotary hoe could be used multiple times at various growth stages without affecting the yield of the crop. Our study is unique because the crop is composed of multiple species at various growth stages. Despite this variability, 1 or 2 passes with the rotary hoe did not affect survival of the various cover crop species or their biomass production. The rotary hoe may be an effective and relatively inexpensive implement for managing weed populations in poorly competitive legume-cereal cover crops. To obtain sufficient weed control, proper timing in relation to weed emergence and weather patterns is critical. Rotary hoeing is generally recommended when weeds seedlings are most vulnerable in the white thread stage just before they emerge from the soil, or soon thereafter.

Rotary hoeing an emerged cover crop at 8-10 mph

References

Brennan, E.B., Smith, R. 2003. Cover crop cultivar and planting density impacts on cover crop productivity, and weed biomass and seed production in an organic system in the Central Coast of California. p. 80-88. Proceedings of the California Chapter of the American Society of Agronomy, Modesto, California.

Up Coming Events

Dr. Nathan Boyd, a post doctoral researcher with the USDA-ARS organic research program will give a presentation entitled **"Stale Seed Bed Studies for Organic Vegetable Production"** at the UCCE Salinas Valley Weed School 2004 (1432 Abbot Street) at 11 am on November 18, 2004.

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