



# Fall Cover Crop Selection and Planting Dates in Tennessee

*Mary A. Rogers, Former Postdoctoral Research Associate*

*Annette L. Wszelaki, Associate Professor and Commercial Vegetable Extension Specialist*

*David M. Butler, Assistant Professor*

*Sarah Eichler Inwood, Research Associate*

*Jennifer L. C. Moore, Research Associate*

*Department of Plant Sciences*

Cover crops are a valuable management tool for conventional and organic vegetable growers alike. Cover crops can improve soil quality by preventing erosion and nitrate leaching, by providing nitrogen and organic matter to the soil for the subsequent growing season, and by reducing weed, disease and insect pressure. Interest in cover crops is growing in Tennessee, partly due to cost-sharing programs offered by various agencies, which help growers cover a portion of the seed cost.

One challenge to successfully using cover crops is timely planting. Fall cover crops are usually planted following the primary vegetable growing season. Timing is important for proper establishment of cover crops, and mid-September through mid-October is the ideal time to sow these crops in Tennessee. However, the fall cover crop planting timeline overlaps with a productive season for many vegetables, and sowing during this window may be difficult depending on fall precipitation and temperature.

In addition to timely planting, cover crop choice is important because different species provide different benefits. For example, small grains such as barley, oat, rye, triticale and winter wheat may provide biomass for building soil organic matter and weed suppression. Some crops may also have allelopathic effects, where chemicals produced by the cover crop inhibit growth of other plants. This can be beneficial for weed control, but may be detrimental to small seeded vegetable crops that are direct sown within two weeks after cover crop kill. Legumes such as crimson clover, ladino white clover, red clover, hairy vetch and winter pea do not generally produce as

much biomass as small grains, but are able to fix nitrogen that may be available for the vegetable crop during the growing season. A biculture, which is a combination of two cover crop species — usually a grain and a legume — can optimize the benefits of both crop types. This experiment tested the performance of cover crops sown at three planting dates (mid-September, mid-October and mid-November) and two years, in either monoculture or in grain-legume biculture, for an organic production system in East Tennessee.

This study was planted in fall of 2008 and 2009 at the East Tennessee AgResearch and Education Center — Organic Crops Unit of the University of Tennessee Institute of Agriculture in Knoxville. Soft red winter wheat, winter rye, winter barley, winter triticale, spring common oat, crimson clover, medium red clover, ladino white clover, winter pea and hairy vetch were the cover crops tested (Table 1). The 36 treatments included all legumes and small grains grown in monoculture, all possible grain-legume combinations in biculture, and a no-crop check plot. A 1.3-acre field (160 feet by 305 feet) was spaded with an Imants Spader (Imants, Reusel, The Netherlands) and cultipacked with a Brillion seed cultipacker (Brillion, WI) to prepare a firm seedbed. Plots were 64 inches by 20 feet and seeds were planted ½- to 1-inch deep with a 64-inch-wide light duty grain drill (ALMACO, Nevada, IA). The recommended seeding depth for clovers is a quarter to half an inch and for grains is 1 to 2 inches.

Legumes must be colonized with the proper bacteria in order to fix nitrogen. Prior to planting, legume seed was separated and inoculated. Vetch inoculant was N-Dure

(*Rhizobium leguminosarum* biovar *viceae*); clover inoculant was N-Dure (*Sinorhizobium meliloti* and *Rhizobium leguminosarum* biovar *trifolii*); and Austrian winter pea inoculant was Guard-N (*Bradyrhizobium* sp. and *Rhizobium leguminosarum*). All inoculants were from INTX Microbials, LLC (Kentland, IN). A 10 percent sugar water solution was sprayed on the seed as a sticker, and inoculant was applied generously. The seed was allowed to dry prior to planting.

Cover crops were planted in 2008 on September 16, October 13 and November 19, and in 2009, they were planted on September 25, October 21 and November 12. In mid-April of the following spring (2009 and 2010), the percent ground cover for each plot (by cover crop or weeds) was measured by collecting 10 samples per plot on a diagonal transect (one sample every 2 feet). A 1-square-foot quadrat was tossed at random into each plot, and plants were cut to the soil surface to collect biomass. After all measurements were taken, the cover crops were flail mowed before flowering to avoid self-seeding in the following season. To determine the best performing crops, all monocultures and bicultures were ranked by biomass, weed suppression and percent soil coverage. These three rankings were averaged to determine the best overall performing crops.

As expected, cover crops planted in September and October had greater soil cover than those planted in November. Since many growers still have profitable crops in the ground in September, and November planting is risky due to the potential for weather that is unfavorable to establishment, we focused on the October results to determine the best overall performing bicultures (Table 2) and monocultures (Table 3). Triticale, rye and barley combined with winter pea, crimson clover, hairy vetch and red clover were the best-performing bicultures. When grown singly, these crops (except for winter pea and triticale) were also the best-performing monocultures. Nine of the 10 lowest ranked October planted bicultures contained oat or ladino clover, which were also the lowest-ranked monocultures (data not shown).

For September planted crops, nine of the top 10 performing crops were bicultures (Table 4), most including rye, triticale, barley, wheat, crimson clover, winter pea and hairy vetch. Seven of the 10 lowest-ranked crops were monocultures (data not shown). For crops planted in November, bicultures again outperformed monocultures with eight of the top 10 crops being bicultures. Rye-containing covers were better ranked at the November planting, while plots containing crimson

clover ranked lower in the November planting compared to the September planting. Also, November was the only month during which barley was not in the top 10 and ladino clover was in the top 10. For September, five of the 10 lowest-ranked crops, and for November, six of the 10 lowest-ranked crops contained oat or ladino clover (data not shown).

This study showed greater soil coverage with bicultures over monocultures. Overall, red clover, ladino white clover and common oat did not perform as well as the other crops in this study. Soil cover in the spring was generally increased when cover crops were planted earlier in the fall, and this study confirms that mid-September through mid-October planting dates are more consistently suitable for cover crop establishment than a mid-November sowing date in East Tennessee, although this will vary by year, temperature and rainfall. The months of September and October 2008 were drier than normal while September and October 2009 were wetter than normal (compared to 30-year averages). Both years were drier than normal for February, March and April. Maximum and minimum daily temperatures were near normal for both seasons. These variations are representative of what can be expected in East Tennessee.

Growers should choose the appropriate cover crop and planting date according to individual needs. For example, if weed suppression is a concern, rye, triticale or wheat planted in September will provide the most biomass and more soil cover in the fall to suppress weeds. If weed suppression and nitrogen are desired, a grain/legume biculture would be suitable, or a monoculture of hairy vetch, winter pea or crimson clover seeded during the early part of the planting window. If cover crop planting is delayed until November, rye or wheat with vetch are good combinations. The extensive research in this area indicates that, despite challenges in management, cover crops are still a vital tool for organic producers because of their many benefits.

## Resources for Additional Information

Cover Crops and Green Manures. UT Extension W235-G. A. Wszelaki and S. Broughton. <https://utextension.tennessee.edu/publications/Documents/W235-G.pdf>

Cover Crops for Organic Farms. Center for Environmental Farming Systems. K.R. Baldwin and N.G. Creamer. [www.cefs.ncsu.edu](http://www.cefs.ncsu.edu)

Cover Crop Decision Tool at Cornell University: <http://covercrops.cals.cornell.edu/decision-tool.php>

Managing Cover Crops Profitably. 3rd edition. 2007. Sustainable Agriculture Network. Beltsville, MD. <http://www.sare.org/Learning-Center/Books/Managing-Cover-Crops-Profitably-3rd-Edition>

Midwest Cover Crops Council: [www.mccc.msu.edu](http://www.mccc.msu.edu)

National Resources Conservation Service: Financial Assistance Programs: <http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/>

Reduced Tillage and Cover Cropping Systems for Organic Vegetable Production. M. Schonbeck and R. Morse. Virginia Association for Biological Farming Information Sheet. <http://www.vabf.org/pubs.php>

Table 1.

Cover crops tested, planting rates and seed sources. Other than the winter wheat and winter pea, all seeds were “variety not stated.” All seeds were certified organic, with the exception of the spring oat, which was untreated.

Cover crop	Planting rate (lbs./acre) (monoculture/biculture)	Seed source
Winter wheat, ‘Arapahoe’	120 / 60	Albert Lea Seed House <sub>1</sub>
Winter rye	120 / 60	Albert Lea Seed House
Winter barley	120 / 60	Albert Lea Seed House
Winter triticale	120 / 60	Albert Lea Seed House
Spring common oat	120 / 60	Knox Seed and Greenhouse <sub>2</sub>
Crimson clover	30 / 15	Seven Springs Farm <sub>3</sub>
Medium red clover	10 / 5	Seven Springs Farm
Ladino white clover	4 / 2	Seven Springs Farm
Winter pea, ‘Austrian winter’	120 / 60	Seven Springs Farm
Hairy vetch	40 / 20	Seven Springs Farm

1 Albert Lea, MN. 2 Knoxville, TN. 3 Check, VA.

**Table 2.**

**Top bicultures for cover crops planted in October 2008 and 2009 combined.**

<b>Cover crop</b>	<b>Biomass (lbs A<sup>-1</sup>)</b>	<b>Biomass rank</b>	<b>% Soil covered by cover crop</b>	<b>Cover crop rank</b>	<b>Avg rank<sub>1</sub></b>
Triticale/Winter pea	5306	1	100	1	1.0
Triticale/Crimson clover	3531	2	98	2	1.7
Triticale/Hairy vetch	3377	3	96	3	2.3
Rye/Crimson clover	3186	5	98	2	2.7
Rye/Winter pea	3153	7	98	2	3.3
Rye/Red clover	3172	6	90	6	4.3
Barley/Crimson clover	2961	12	100	1	4.7
Rye/Hairy vetch	3044	10	96	3	4.7
Triticale/Red clover	3194	4	82	10	5.0
Barley/Winter pea	2942	13	94	4	6.0

<sup>1</sup>Each category was ranked independently then all three rankings (biomass, % soil covered by weeds, and % soil covered by cover crops) were averaged to determine the top 10 cover crop combinations for October bicultures. NOTE: Weed pressure was very low for the October planting. All crops in the table were equally free of weeds and received a rank of 1, so this category is not shown.

**Table 3.**

**Top performing monocultures for cover crops planted in October 2008 and 2009 combined.**

<b>Cover crop</b>	<b>Biomass (lbs A<sup>-1</sup>)</b>	<b>Biomass rank</b>	<b>% Soil covered by weeds</b>	<b>Weed rank</b>	<b>% Soil covered by cover crop</b>	<b>Cover crop rank</b>	<b>Avg rank<sub>1</sub></b>
Barley	3127	8	0	1	74	13	7.3
Crimson clover	2508	18	0	1	92	5	8.0
Rye	2329	22	0	1	88	7	10.0
Hairy vetch	1805	28	2	2	98	2	10.7
Wheat	2482	19	0	1	76	12	10.7

<sup>1</sup>Each category was ranked independently then all three rankings were averaged to determine the top five cover crops for October monocultures.

Table 4.

Top performing cover crops (monoculture or biculture) for September and November planting dates, 2008 and 2009 combined.

Cover crop	Biomass (lbs A <sup>-1</sup> )	Biomass rank	% Soil covered by weeds	Weed rank	% Soil covered by cover crop	Cover crop rank	Avg rank <sub>1</sub>
September							
Triticale/Crimson clover	5198	1	0	1	100	1	1.0
Wheat/Crimson clover	4942	2	0	1	100	1	1.3
Rye/Crimson clover	4557	3	0	1	100	1	1.7
Triticale/Winter pea	4087	5	0	1	98	2	2.7
Barley/Crimson clover	4316	4	2	2	97	3	3.0
Crimson clover	3918	7	0	1	100	1	3.0
Common oat/Crimson clover	3824	8	0	1	100	1	3.3
Barley/Winter pea	3718	9	0	1	95	4	4.7
Triticale/Red clover	4081	6	5	5	93	5	5.3
Wheat/Hairy vetch	3266	13	0	1	97	3	5.7
November							
Rye/Ladino white clover	2195	1	0	1	87	3	1.7
Triticale	2003	2	0	1	92	2	1.7
Wheat/Crimson clover	1829	3	0	1	84	5	3.0
Rye/Hairy vetch	1431	11	0	1	97	1	4.3
Wheat	1797	4	2	2	78	7	4.3
Triticale/Winter pea	1533	9	0	1	85	4	4.7
Rye/Crimson clover	1701	6	0	1	77	8	5.0
Wheat/Hairy vetch	1243	13	2	2	85	4	6.3
Rye/Winter pea	1608	8	7	6	78	7	7.0
Triticale/Red clover	1714	5	2	2	62	14	7.0

<sup>1</sup>Each category was ranked independently then all three rankings were averaged to determine the top 10 for September and November for all crops tested.

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