

## LRTF Research Funding Request for Summer 2010

### **Impact of Roadside Prairie Plantings on Plant and Insect Communities**

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#### **Introduction**

In October 2008, the Iowa DOT began roadside prairie establishment in the right-of-way (ROW) along US-52 from the Decorah city limits to the Minnesota state line using Smith Seeding of Eldridge, IA as contractors. The timing and proximity of this IDOT project to the Luther campus (site of the Gateway Prairie planting, Projects 90-00-LRTF-512 & 90-00-LRTF-610) has created a unique opportunity to study the impact of this roadside prairie planting on the plant and insect communities inhabiting this roadside area before, during, and after the establishment of this planting.

During the summer of 2008, Luther College established 9 monitoring sites (3 control, 3 “organic” and 3 “spray” sites) and began baseline monitoring of plant, ground beetle and butterfly communities in the US-52 roadside. The untreated control sites are outside the project area located along US-52 south of Decorah. The “spray” sites are areas that were planted using the standard roadside planting protocol including mowing, spraying with herbicides, and disking. The “organic” sites are located in an area of the project where an adjacent organic farmer has requested IDOT not use herbicides and use mowing and disking only during the planting and establishment phase. Our goal is to monitor changes to both plant and insect roadside communities over a 5-year period as this project progresses: to obtain baseline data during 2008 (Project 90-00-LRTF-800), initial establishment during 2009 (Project 90-00-LRTF-910) after the spraying and planting during heavy weed management (primarily by mowing), during 2010 (this proposal) which likely will be the first year without heavy mowing, and then additional follow up as the planting becomes more established in 2011 and 2012. We hypothesize that as this diverse native prairie roadside planting becomes established, there will be increased plant species richness, plant productivity, insect abundance, and insect species richness.

We are using butterflies (Lepidoptera) and ground beetles (Coleoptera: Carabidae) as indicators of general impacts of this roadside prairie establishment on herbivore and predator insect groups. Butterflies have been monitored previously in Iowa roadsides by Ries *et al.* (2001). The butterfly and ground beetle communities of the Decorah area are well known (Larsen & Bovee 2002, Larsen *et al.* 2003). Ground beetles are known to be excellent indicators of habitat disturbance and change (Evans 1983, Eyre *et al.* 1989).

*The specific objectives of the proposed project in 2010 will be to study the impact of this roadside planting on plant species richness, above-ground plant productivity, butterfly abundance and species richness, and ground beetle abundance and species richness. One Luther College undergraduate biology student will work as a research assistant with Dr. Larsen*

during the summer and fall of 2010. For 2010, we request \$9,253.17 to follow up our 2008 baseline and 2009 sampling which took place during the 1<sup>st</sup> season after planting during active weed management by mowing. We anticipate requesting additional funding for 2011 and 2012 to follow up with additional monitoring at these same sites as the planting becomes established.

## **Research Methodology**

**Research Locations.** In conjunction with IDOT personnel (Ole Skaar), we established nine research monitoring sites in the ROW along US-52 and Iowa Hwy 9 from approx 3 miles south of Decorah to 5 miles north of Decorah (Figure 1). There are three replicate sites for each of the following treatments: “control” sites outside of the roadside planting area (south of Decorah along US-52), three sites in an area near organic farms that will have a special “organic” planting protocol that does not use herbicides, and three “spray” sites planted with the standard IDOT roadside planting protocol including the use of mowing, disking, and herbicides during establishment and for weed treatment. At each of the nine monitoring sites, a 100-m long transect has been established and located using GPS, and south end of each transect marked with a sign located along the fence line at the edge of the ROW (Figure 2). The transect is located half way between the fence line and the edge of the highway shoulder. All plant and insect monitoring occurs along these nine transects once a month in June, July, August, and September each year 2008 through 2012. Digital photographs of each transect site (taken from the south end of each site) are being taken for annual comparisons several times each summer (e.g. Figure 3).

**Plant Diversity and Productivity.** Plant diversity is being recorded at each site during early-June, mid-July, and late-August. We are identifying and recording each species of plant found along each transect and collecting voucher specimens for each species which will be housed in the herbarium collection of the Hoslett Museum of Natural History at Luther College. Percent cover is calculated with four subsamples taken at randomized locations along each transect. At each subsample, plants (or bare ground or litter) below 25 points in a 0.25 m<sup>2</sup> grid are identified. Any additional plant species observed within 2 m of each transect is assigned one “contact point” in the nearest percent cover subsample. The cumulative species list will be used to determine plant species richness at each site. These species are being identified as native or non-native, and categorized to functional group (forb, grass, woody, litter, or bare ground).

To measure above-ground plant productivity, at the end of the growing season in early September, all standing plants are clipped and surface litter removed from four random 0.25 m<sup>2</sup> quadrat locations along the transect at each site, dried at 55°C in a drying oven, and weighed to determine biomass (in g/m<sup>2</sup>) for grasses, forbs, and surface litter.

**Butterfly Monitoring.** At each site, butterfly surveys involve walking the 100 m transect at each site at a slow steady pace during both a morning and an afternoon visit once each month (eight visits total: June through September), counting and identifying all butterflies observed. The order sites are surveyed, and scheduling of morning and afternoon visits are randomized each month. To ensure good flight activity, all surveys must occur between 1000 and 1500 h CDT at temperatures between 24°C and 35°C, with wind speeds less than 24 kph. Cloud coverage must be less than 90% (i.e., some blue sky is visible). Weather conditions, time

spent walking the transect, and numbers of each species of butterfly seen in a 5 m wide band in front of the observers are recorded.

Any butterflies not identified “on the wing” are collected in a butterfly net, identified and released, or stored in a glassine butterfly envelopes and returned to the laboratory for identification and vouchering. Butterflies are identified using Schlict et al. (2007) and Opler et al. (2009). Voucher specimens for each species are housed in the research insect collection of the Hoslett Museum of Natural History at Luther College.

**Ground Beetle Sampling.** Ground beetles are collected using pitfall traps during four 7-day periods, once each month from June through September. Each pitfall trap is constructed from one 473 mL (16 oz) plastic cup (9 cm dia) placed into the ground so the lip of the cup is at or slightly below the ground surface. In each cup is placed approximately 50 mL of propylene glycol preservative diluted at a 1:1 ratio with water. A funnel constructed from a 207 mL casual cup insert prevents beetle escape. Four traps are placed at 10 m intervals along the transect at each site.

Following processing and mounting of the samples, all ground beetles are identified to species using keys presented in Lindroth (1961-1969) and Noonan (1991). Names are standardized using Bousquet & Laroche (1993). Species richness and beetle abundance (beetles/trap/day) will be calculated for each treatment. Voucher specimens are being housed in the reference insect collection in the Hoslett Museum of Natural History, Luther College, Decorah, Iowa.

**IDOT Permit Required.** An “Application to Perform Work within State Highway Right-of-Way” has been submitted and permit approved by the local IDOT office (Kathie Rustad, 2305 US Highway 52 South, Decorah) for this monitoring work to proceed. A copy of this permit that expires 15 October 2012 is available from the PI.

### **Brief Summary of Results from Previous Work**

**Plant Diversity and Productivity.** To date, a total of 39 species of plants have been identified in the roadside of US-52 at these 9 sites. The greatest average plant species richness has been found in the control sites (Figure 4), although with establishment of the native forbs and grasses not yet seen, this is expected to shift dramatically.

Percent cover indicates that grasses currently dominate the roadsides (Figure 5), although there has been a significant shift from bare ground in 2008 to litter in 2009, primarily due to the new seeding and frequent mowing that occurred in 2009.

There was a significant reduction in overall net primary productivity ( $\text{g/m}^2$ ) of vegetation from 2008 (Figure 6) to 2009 ( $F=41.924$ ;  $df=1,12$ ;  $p<0.001$ ) and between treatments ( $F=10.883$ ;  $df=2,12$ ;  $p=0.002$ ) due to the mowing of the organic and sprayed plots. Mowing in the organic and spray treatments significantly reduced grass net primary productivity in 2009 which also decreased litter accumulation (Figure 7).

**Butterfly Survey Results.** A total of 289 butterflies representing 23 species have been collected from these 9 sites along US-52 in 2008 and 2009. These are relatively low numbers,

but considering the small roadside strips between corn or soybean fields and the highway and lack of native forbs are to be expected. With the frequent mowing of organic and spray treatments in 2009, there were fewer butterflies collected (Figure 8), although species richness only seemed to be reduced in 2009 in the organic treatment (Figure 9).

**Ground Beetle Survey Results.** Overall, 1,331 carabids representing 53 species of ground beetles were collected from the roadside of US-52 in 2008 and 2009. Overall species richness was lower in 2009, which was a colder (by almost 5°F) and wetter year than 2008 (Figure 10). Species richness was slightly greater in 2008 than 2009, but there was no significant difference in years ( $F=2.20$ ;  $df=1,12$ ;  $p=0.164$ ) or between treatments ( $F=0.535$ ;  $df=2,12$ ;  $p=0.599$ ) to date. Evenness was higher in 2009, and as a result Shannon diversity indices ( $H'$ ) were greater higher in 2009.

Overall beetle abundance (beetles/trap/day) was greater in 2008 than 2009 (Figure 11), but there was no significant difference in years ( $F=1.62$ ;  $df=1,12$ ;  $p=0.23$ ) or between treatments ( $F=0.229$ ;  $df=2,12$ ;  $p=0.799$ ) at this point. Beetle abundance (square root transformed beetles/trap/day) is related to the average temperatures (Figure 12) during the sampling periods ( $r=0.66$ ,  $p=0.053$ ). At higher average temperatures during sampling, significantly more beetles were captured ( $R^2=0.573$ ;  $p=0.018$ ).

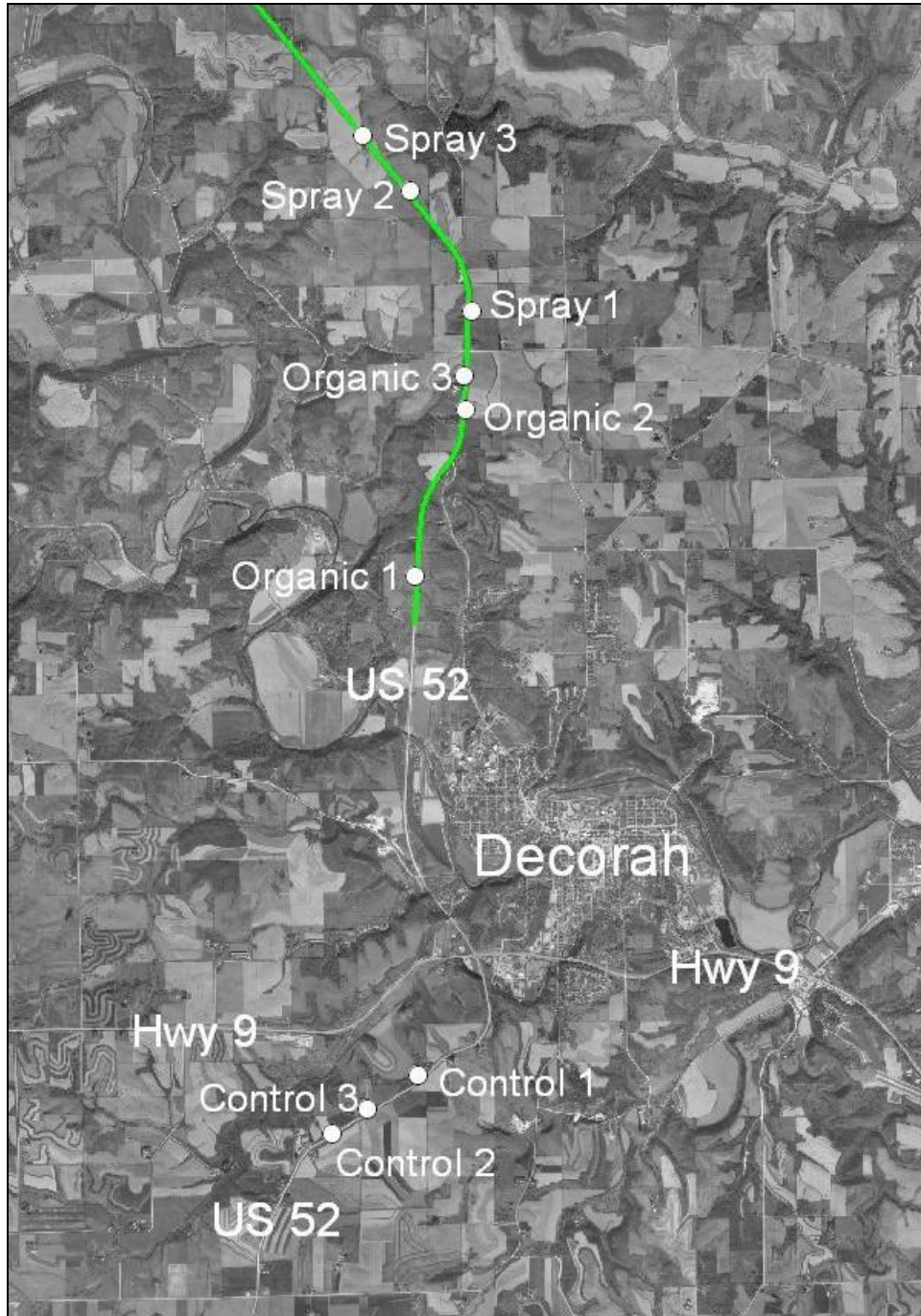
At this point, there has been no effect of this new roadside prairie planting (organic or spray planting treatments) on carabid species richness or abundance. However, as this diverse roadside prairie planting becomes established and mowing is reduced in future years, increased carabid abundance and species richness is expected.

**Budget Request for Summer 2010 Work**

|  |                   |
|--|-------------------|
| Direct Costs   |                   |
| Principle Investigator salary                        | \$2,500.00        |
| Benefits (PI @ 32%)                                  | \$800.00          |
| Undergraduate Student stipend and hourly             | \$3,500.00        |
| Benefits (student FICA @7.65%)                       | \$267.75          |
| Summer Housing on campus                             | \$500.00          |
| Travel (mileage to sites, presentations at meetings) | \$500.00          |
| Supplies and Equipment                               | <u>\$500.00</u>   |
| Total Direct Costs                                   | \$8,567.75        |
| Indirect Costs (8%)                                  | \$685.42          |
| Total Request for 2010                               | <b>\$9,253.17</b> |

## Literature Cited

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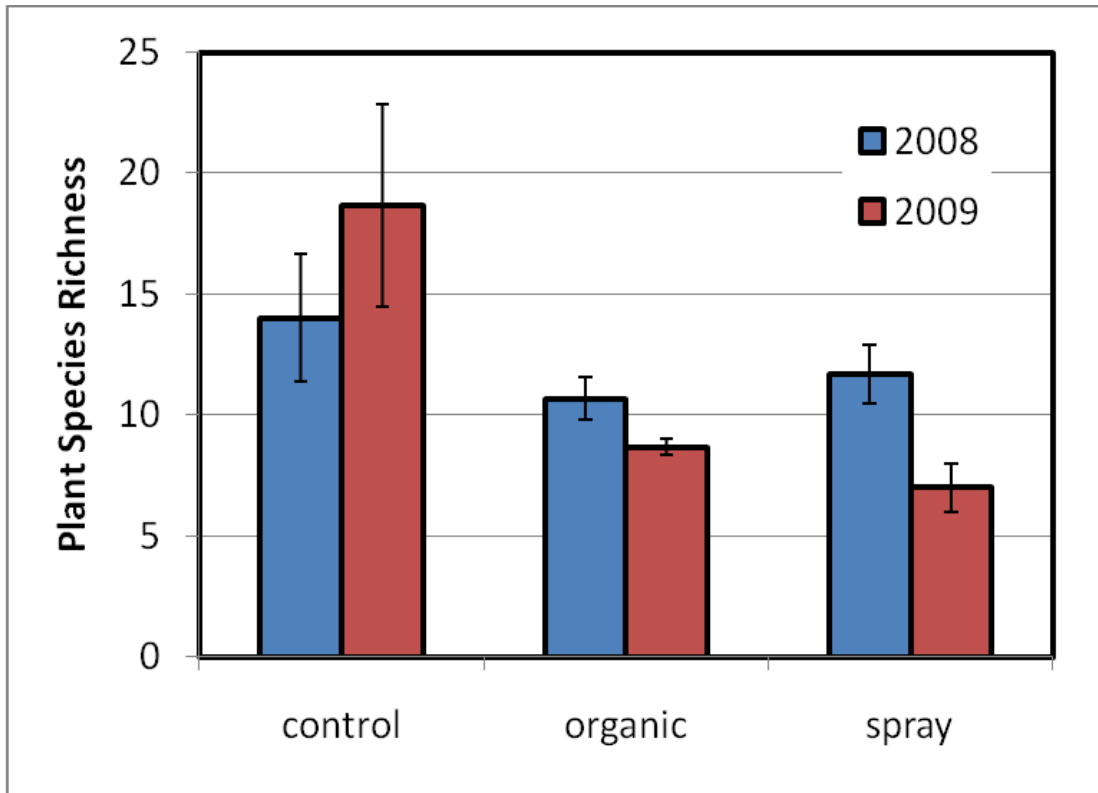
**Figure 1.** Location of nine biodiversity monitoring sites along US-52 in Winneshiek County, with area of US-52 roadside planting project highlighted in green.



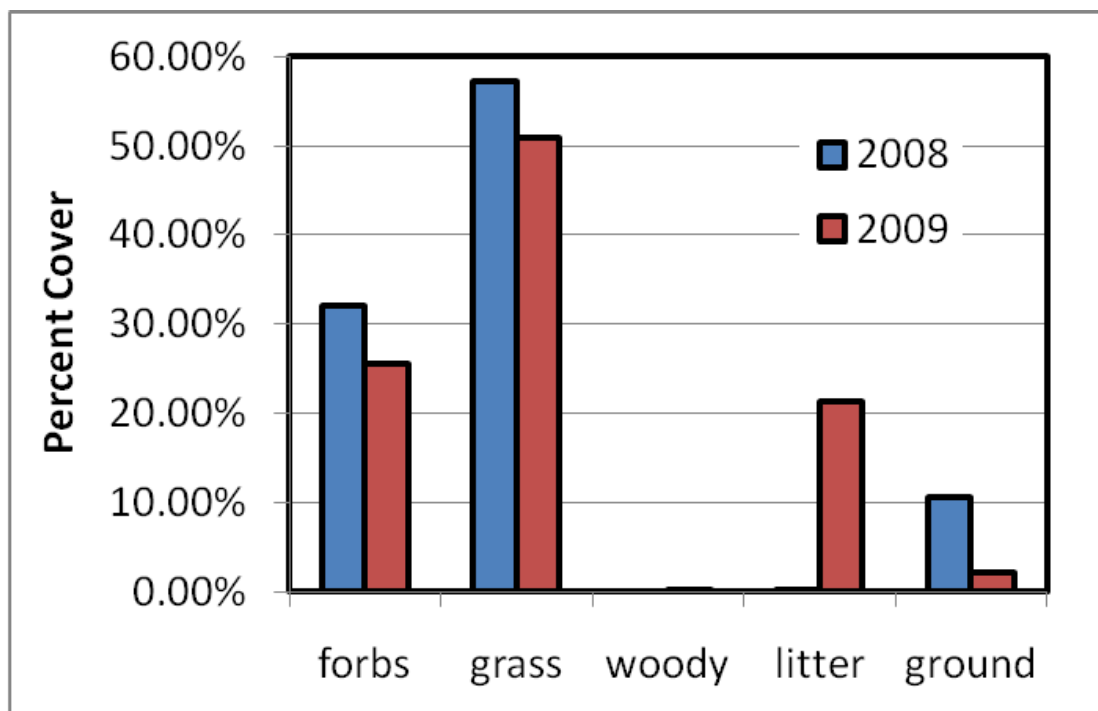
**Figure 2.** Sign posted along fence at south end of each monitoring site along US-52.



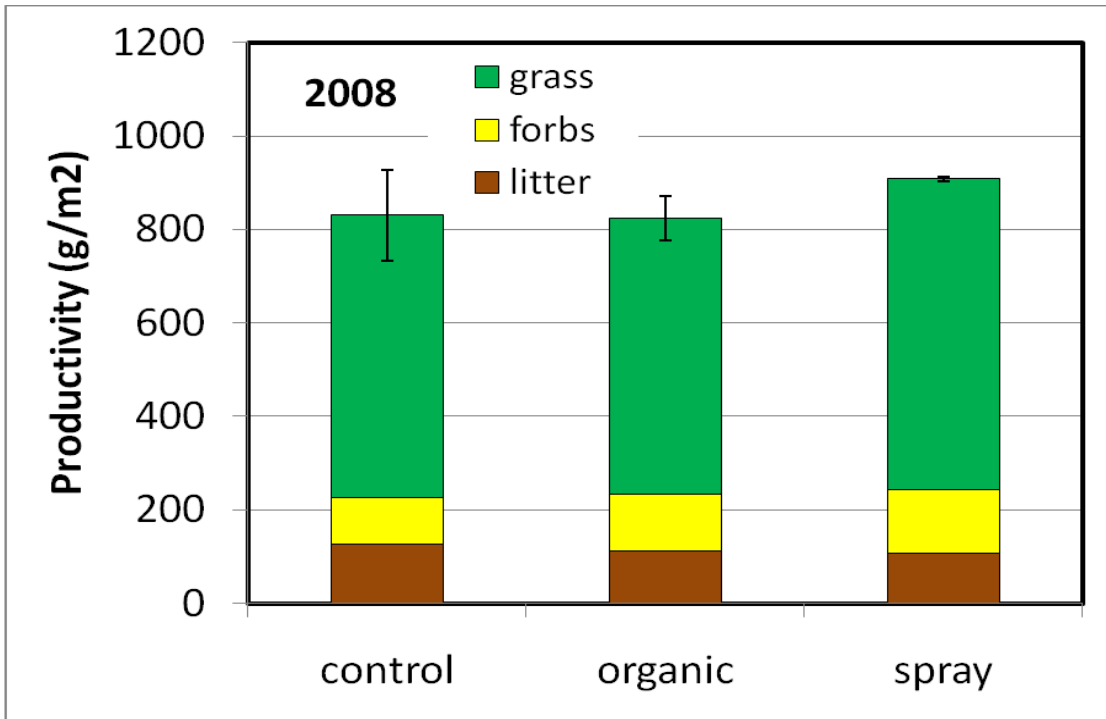
**Figure 3.** North view of the “Spray 3” site transect on the west side of US-52 in 2008 prior to the native prairie roadside project.



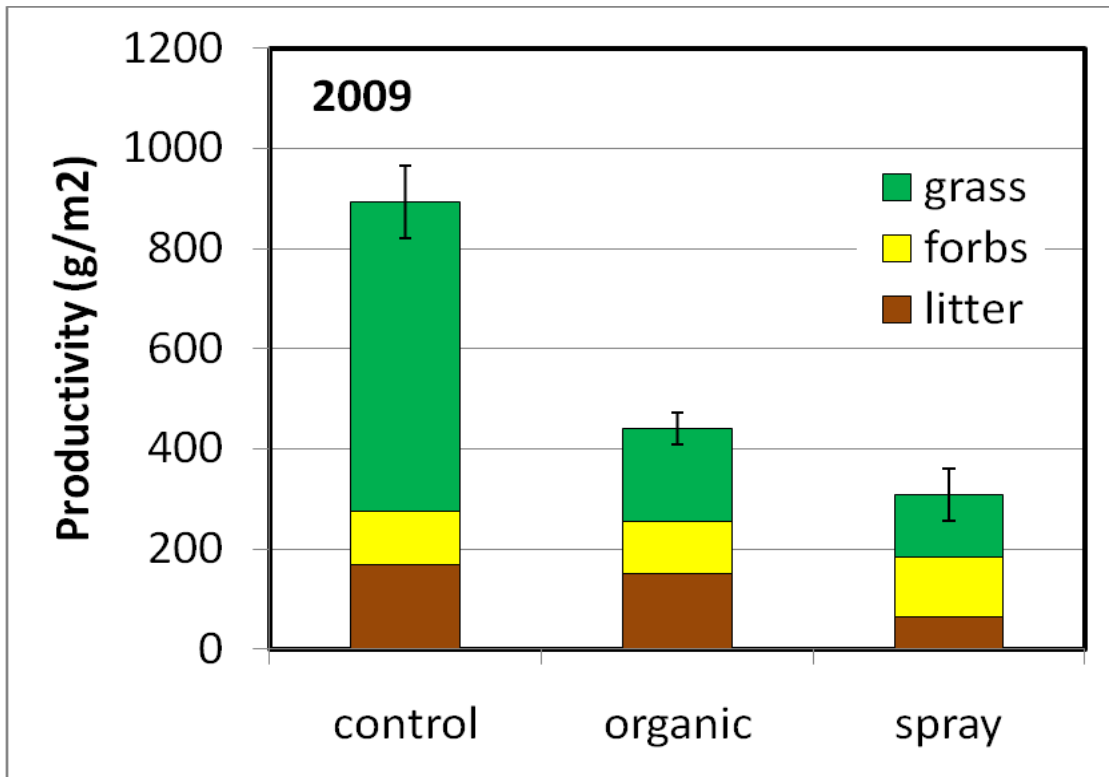
**Figure 4.** Average ( $\pm$  SE) plant species richness in the three treatments along US-52 during 2008 (baseline) and 2009 (planting establishment).



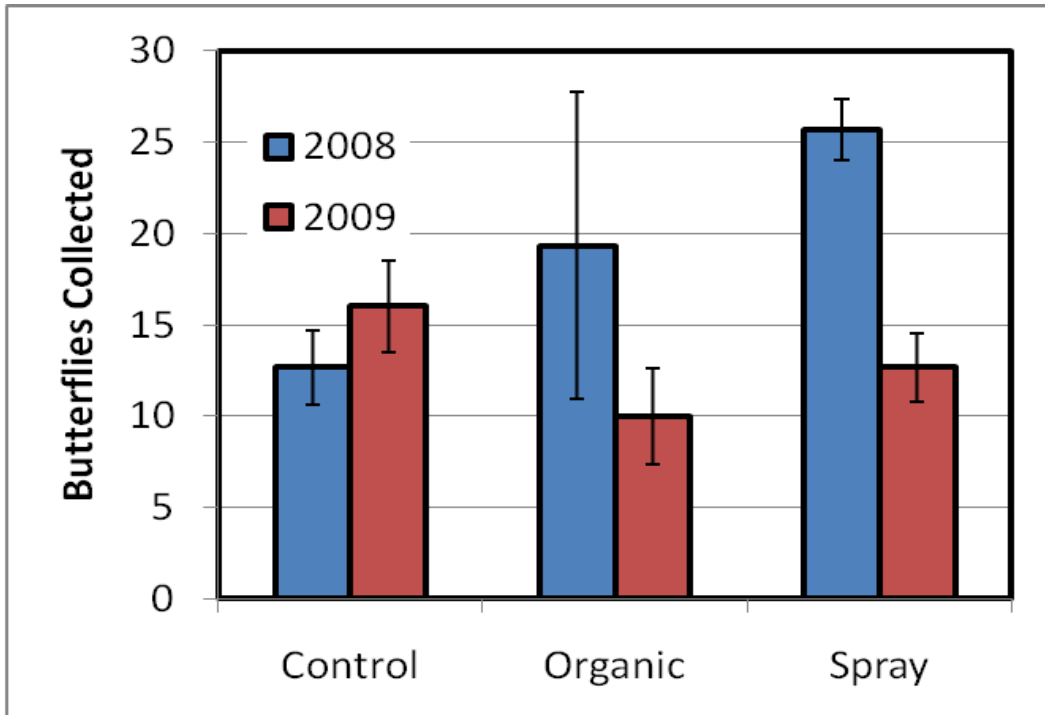
**Figure 5.** Total percent cover by plant functional groups along US-52 during 2008 (baseline) and 2009 (planting establishment).



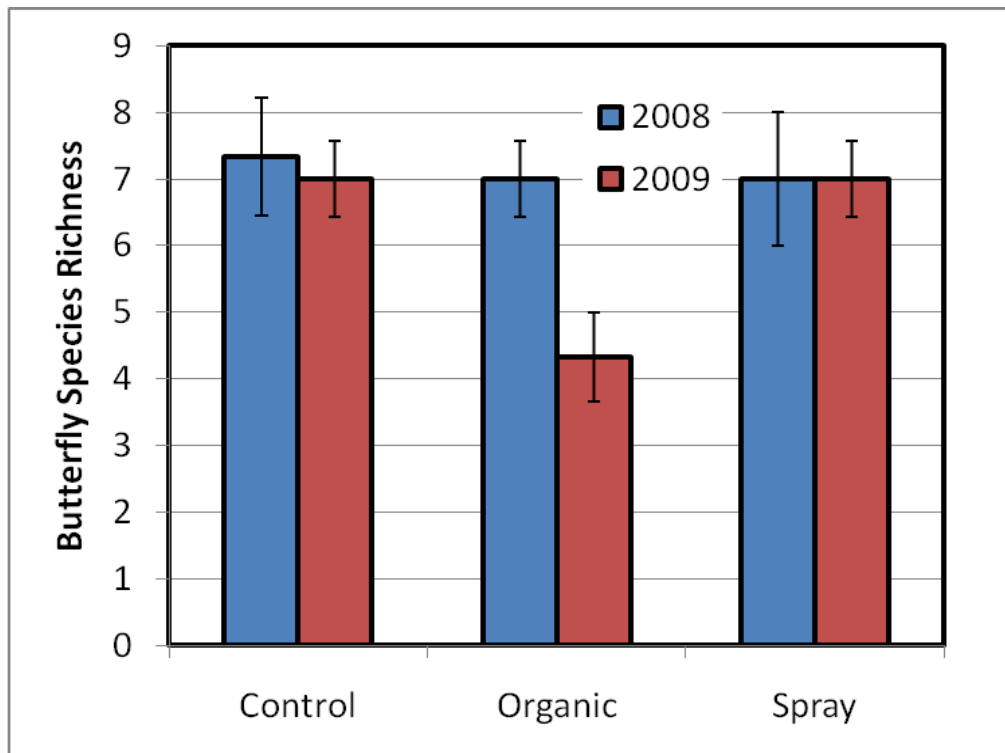
**Figure 6.** Average ( $\pm$  SE) productivity ( $\text{g/m}^2$ ) of grasses, forbs, and leaf litter in the three treatments along US-52 during 2008 (baseline).



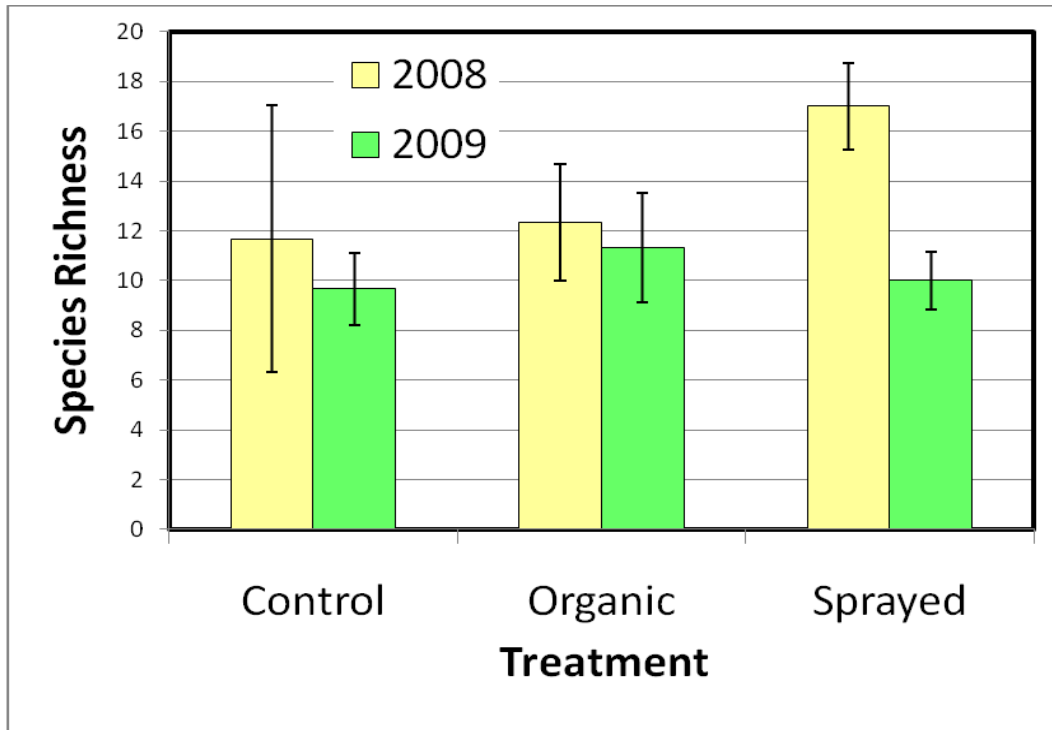
**Figure 7.** Average ( $\pm$  SE) productivity ( $\text{g/m}^2$ ) of grasses, forbs, and leaf litter in the three treatments along US-52 during 2009 (planting establishment).



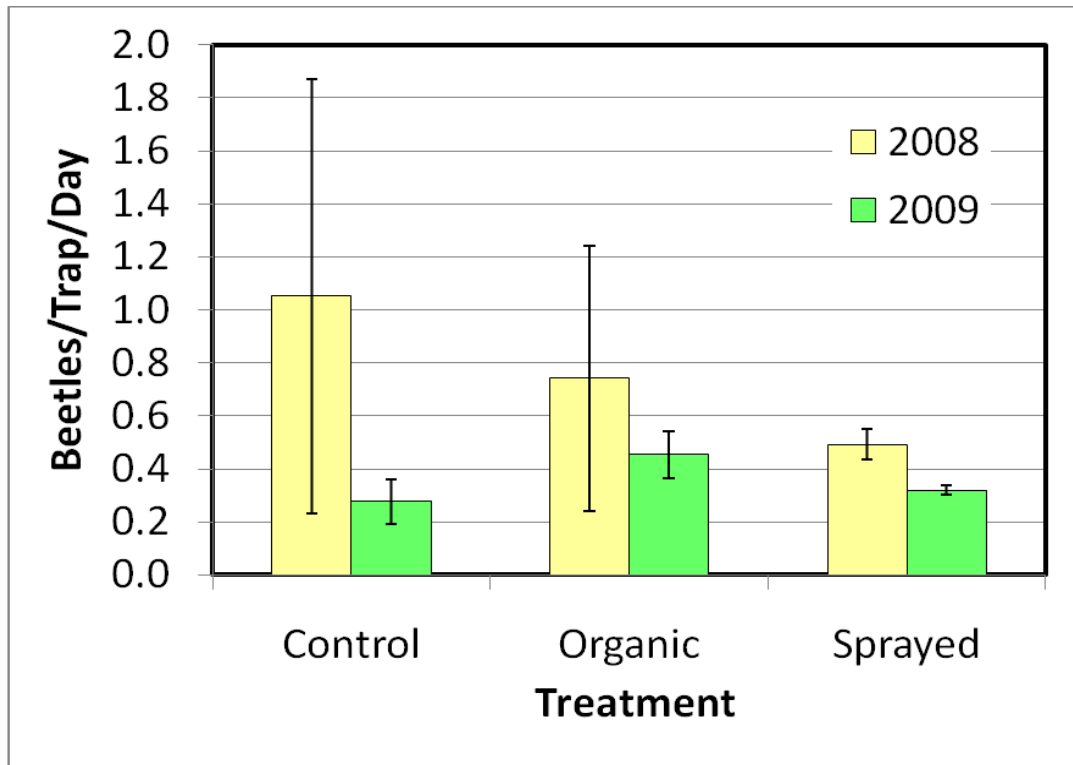
**Figure 8.** Average ( $\pm$  SE) butterflies observed in the three treatments along US-52 during 2008 (baseline) and 2009 (planting establishment).



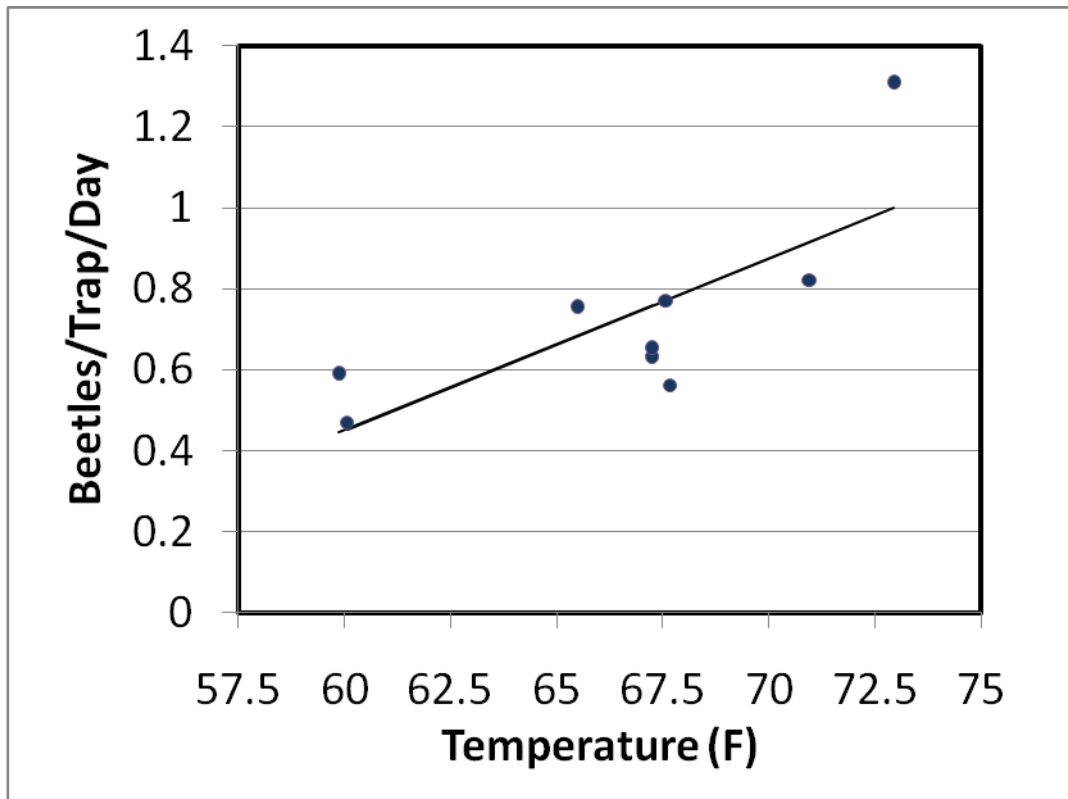
**Figure 8.** Average ( $\pm$  SE) butterfly species richness observed in the three treatments along US-52 during 2008 (baseline) and 2009 (planting establishment).



**Figure 10.** Average ( $\pm$  SE) ground beetle species richness in the three treatments along US-52 during 2008 (baseline) and 2009 (planting establishment).



**Figure 11.** Average ( $\pm$  SE) relative ground beetle abundance (beetles/trap/day) in the three treatments along US-52 during 2008 (baseline) and 2009 (planting establishment).



**Figure 12.** Relative ground beetle abundance (beetles/trap/day) collected in pitfall traps relative to average temperatures during the trapping period in the three treatments along US-52 during 2008 (baseline) and 2009 (planting establishment).