Spring Carbon and Nitrogen Pools of Wheat and Cereal Rye Following Corn Silage

Shona B. Ort[1], Quirine M. Ketterings[1], Sheryl N. Swink[1], Greg S. Godwin[1], Sanjay Gami[1], and Karl J. Czymmek[1,2], [1]Nutrient Management Spear Program, and [2]PRODAIRY, Department of Animal Science, Cornell University

Nutrient Management

Introduction

The practice of seeding an overwintering cover crop such as cereal rye or winter wheat after corn silage harvest is becoming increasingly popular in New York State. Based on cover crop biomass sampling of New York farm fields in the fall of 2010 and 2011, fall accumulation of nitrogen (N) is typically 20 to 30 lbs of N/acre independent of species (Ketterings et al., 2011; Ort et al. 2013). However, the contribution of cover crops to N dynamics is not determined by fall growth only. In spring 2012, 13 cereal rye and 15 wheat fields seeded after corn silage harvest in the fall of 2011 were sampled to determine total biomass, carbon (C) and N. The biomass was determined by using a sampling frame of 8 by 38.5 inches at a total of four locations per field. Within the sampling area, plants were uprooted to assess both the above and below ground biomass. Samples were washed to remove soil, and roots and shoots were separated prior to drying in an oven. Dried samples were weighed, ground, and analyzed for C and N content.

Results

Total biomass accumulation averaged 0.64 tons DM/acre for wheat and 0.75 tons of DM/acre for cereal rye (Table 1). The total C accumulation averaged 529 lbs C/acre for wheat and 632 lbs C/acre for cereal rye (Table 1), while N accumulation averaged 37 lbs N/acre for wheat and 45 lbs/acre for cereal rye. However, as Table 1 shows, there was a wide range in total biomass, C, and N accumulation across fields within each species. All fields in the study were planted between 9/12/2011 and 10/12/2011, and stands were terminated and sampled between 3/13/2012 and 4/9/2012. Among wheat fields, those fields that were planted the earliest and received an application of manure in the fall tended to have the highest C and N accumulation. Cereal rye fields that accumulated the most biomass, C, and N also tended to be the ones planted the earliest in the fall. Thus, planting date plays a major role in determining total C and N pools accumulated by these overwintering cover crops.

The shoot portion of the cover crop represented 86% and 83% of the total biomass, 85% and 83% of the total C pool, and 92% and 91% of the total N pool for wheat and cereal rye, respectively. These results were very similar to the 82 to 84% C and 92 to 93% N pools seen for the same species in the fall (Ort et al., 2013).

Average C:N ratios were 13:1 for the shoots of both species in the spring (Table 1), similar to what was measured in the fall 2011 sampling round of these fields (Ort et al., 2013). Root C:N ratios in the spring averaged 25:1 and 26:1, also consistent with the fall sampling (Ort et al., 2013). When spring C:N ratios fall below 25:1, N mineralization of the

Table 1: Spring biomass on a dry matter (DM) basis, percent carbon (C) and nitrogen (N) content, C:N ratio, and total C and N pools for various cover crop species following corn silage in the rotation.*

Species (fields)		DM	C	N	C: N	Total C	Total N
		tons/acre	%	%		lbs/acre	
----------Total (above and below ground) ----------							
Cereal rye (13)	Mean	0.75	.	.	.	632	45
	Min	0.08	.	.	.	71	7
	Max	1.61	.	.	.	1295	94
Wheat (15)	Mean	0.64	.	.	.	529	37
	Min	0.07	.	.	.	62	6
	Max	1.32	.	.	.	1088	83
----------Shoots----------							
Cereal rye (13)	Mean	0.62	42.88	3.69	13:1	526	41
	Min	0.07	40.00	1.62	9:1	60	7
	Max	1.32	44.87	4.98	26:1	1067	86
Wheat (15)	Mean	0.55	41.86	3.47	13:1	452	34
	Min	0.06	39.60	2.29	9:1	51	5
	Max	1.15	43.30	4.88	18:1	956	77
----------Roots----------							
Cereal rye (13)	Mean	0.13	40.36	1.75	25:1	106	4
	Min	0.01	37.95	0.88	19:1	11	0
	Max	0.29	42.27	2.26	46:1	228	9
Wheat (15)	Mean	0.10	40.60	1.73	26:1	77	3
	Min	0.01	38.69	1.06	17:1	9	0
	Max	0.21	41.96	2.39	39:1	166	7

*Cover crop planting dates ranged from 9/12/2011 to 10/12/2011 and spring sampling dates ranged from 3/13/2012 to 4/9/2012.

cover crop biomass can occur rapidly assuming good mineralization conditions following termination of the stand.

Summary, conclusions, and implications

Spring total biomass accumulation of cover crops planted after corn silage and terminated early to allow for timely corn planting averaged 0.64 and 0.75 tons DM/acre for wheat and cereal rye, respectively. Total C accumulation averaged 529 lbs C/acre for wheat and 632 lbs C/acre for cereal rye. Spring N accumulation for cereal rye fields averaged 45 lbs N/acre, while for wheat this accumulation was 37 lbs N/acre. The C:N ratio of the shoots and roots in the spring (typically around 13:1 for shoots and 25:1 for roots) suggested that the total N pool in the cover crop could become available to the corn crop planted after cover crop termination and somewhat reduce the amount of N fertilizer needed. Assuming an uptake efficiency of 60–75%, the estimated N credit from winter cereals seeded after corn silage harvest and terminated between mid-March and mid-April, amounts to 20–30 lbs N/acre. However, fall planting date, fall manure application, and spring harvest date may impact the spring accumulation and expected N credits of a field.

Research in New York supports use of a 20-30 lbs N/acre N credit from overwintering cereals seeded as a cover crop after corn silage.

Literature Cited

- Ketterings, Q.M., J. Kingston, S. McIlvennie, E. Long, G. Godwin, S. Gami, M. Stanyard, and K. Czymmek. 2011. Cover crop carbon and nitrogen content: fall 2011 sampling. What's Cropping Up? 21(3): 1-4.
- Ort, S.B., Q.M. Ketterings, K.J. Czymmek, G.S. Godwin, S.N. Swink, and S.K. Gami. 2013. Carbon and nitrogen uptake of cereal cover crops following corn silage. What's Cropping Up? 23(2): 5-6.
- Sustainable Agriculture Research and Education (SARE). 1998. Managing cover crops profitably. Sustainable Agriculture Network, Beltsville, MD.

Acknowledgments

This work was supported by Federal Formula Funds, a grant from the Northern New York Agricultural Development Program (NNYADP), and a USDA-conservation innovation grant. We thank Cornell Cooperative Extension educators Joe Lawrence (Lewis County), Mike Hunter (Jefferson County), consultants Pete Barney (Barney Agronomic Services) and Dave DeGolyer (Western New York Crop Management Association, WNYCMA), and the eleven dairy farmers who were part of the project. Thanks also to Gordana Jacimovski and Sara Orlowski for help with sampling and/or sample processing. For questions about these results contact Quirine M. Ketterings at 607-255-3061 or qmk2@cornell.edu, and/or visit the Cornell Nutrient Management Spear Program website at: http://nmsp.cals.cornell.edu/.