

Cover Crop Mix Demonstrations

Alabama USDA–NRCS

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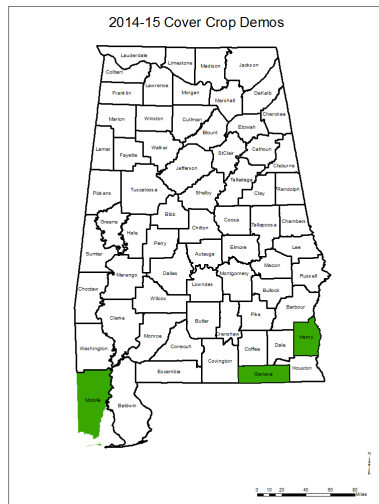
There is growing interest in cover crop mixes among farmers, but most farmers have little experience in planting, managing, and terminating mixtures of species. We also want to compare cover crop mixes to mono crops in terms of biomass production, other benefits and challenges, and profitability.

We asked Alabama farmers with experience growing cover crops to try mixtures to determine their applicability in Alabama systems and to compare the mixtures with their own cover crops.

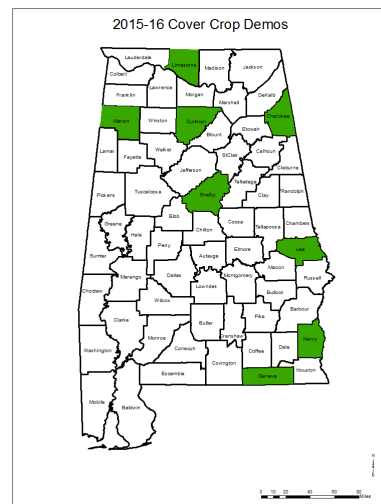
Each farmer was provided seeds for a three-species mix (oat, crimson clover, radish). The fields were visited several times during the growing season to monitor plant growth, and biomass samples were collected at termination. Biomass carbon and nitrogen were determined by the USDA–ARS National Soil Dynamics Lab in Auburn. Funds for seeds were provided by Alabama Chapter SWCS and Alabama USDA–NRCS. Seeds were provided by Petcher Seeds of Fruitdale, AL.

The recommended seeding rate for the mix was: 30 lb./A Cosaque oat; 10 lb./A Dixie crimson clover; and 3 lb./A Sodbuster radish. Farmers were free to modify the rate and to include any comparison cover crops.

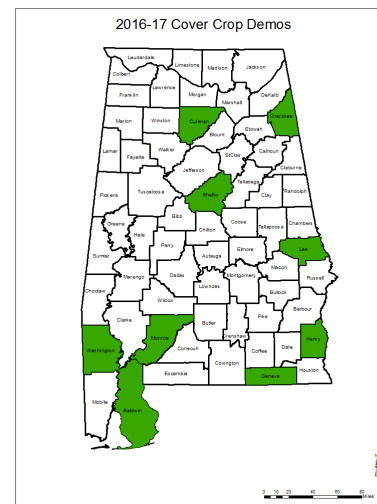
2014–15



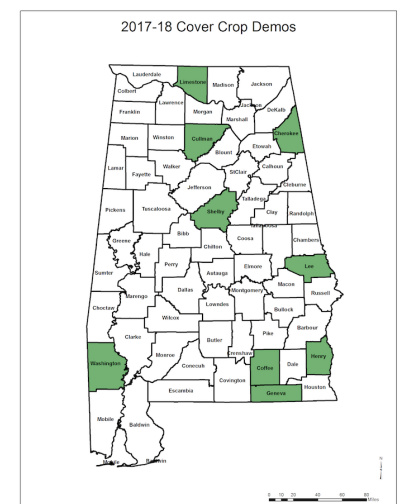
2015–16



2016–17



2017–18



What we learned

We had a number of questions about growing cover crop mixes vs. single species. After four years, we have some answers.

Can a mix of species with different seed sizes and optimum planting depths be planted successfully?

Seed distribution was not perfect, but it seemed reasonable. In no-till drills with two boxes, oats were always put in the big box, clover in the small box, and radishes in one or the other. In one case, radish seeds got hung up in the tube of the small box. That was adjusted and worked okay afterwards. Species distribution seemed acceptable. In at least one case, clover population was relatively greater in the mix vs. in a mono crop stand. It seemed the larger seeded species broke through some crusting and helped the clover emerge.

What equipment was best for seeding?

Several options were used over the four years. All seemed to work. No-till drills had the best success. No big differences between two-boxed and one-boxed types. Broadcasting was often successful, but best results came when rainfall followed soon thereafter. Running cotton stalk pullers after broadcasting helped improve seed-soil contact. In one case, turbo-tilling after broadcasting buried clover seeds too deep for successful emergence. Broadcasting before cotton defoliation, followed by stalk-pulling, worked well in the Lee County #2 field in 2017/18 season.

How does above-ground biomass production of mixes compare to single-species cereal crops?

Production varied by field and year, but, in general, above-ground biomass was about the same overall. More important was early planting, late termination, and fertilization, regardless of the crop. Figure 1 (page 4) shows three years of cover crop comparisons on the field in Henry County. Each year the field had several cover crop species and the mix, with several replications. Biomass production of the mix was comparable to the single-species strips. Yields of the following cash crops were also comparable each year. Several growers commented that cash crop yields following the mix were equal or better than fields following single-species cover crops.

Because the radish matured and often died before the cover crop mix was terminated, many radish leaves were already on the ground and decomposing before biomass samples were collected. In these cases, total biomass produced would be greater than what we measured.

Do radishes cause problems with cotton planting?

There were no problems planting cotton into residue of mixes that included radishes.

Do radishes winter–kill as they do in more northern states?

No. The only winter kill of radishes occurred when young seedlings were exposed to extreme cold, usually several days–worth. In the 2017-18 winter, several nights of extreme cold severely damaged mature radishes, but most of them recovered later. Establishing radishes was often a problem in northern Alabama, where planting them early enough to avoid killing of seedlings is a challenge. In central Alabama, the only problems occurred with late-planting or unusually early frosts.

Do radishes going to seed before termination cause problems in following crops?

Radishes often produced seed before the mixes were terminated. This did not seem to be much of a problem in most cases. When followed by cotton, the cotton herbicide programs controlled volunteer radishes pretty well. Herbicide programs for peanuts did not completely control the volunteer radishes. We did not see any extreme problems, but in a well-managed peanut field, the occasional radish plants were noticeable. They did not seem to affect peanut yield, however. In Cullman, winter cover crops were followed by vegetables planted at various times. Weed radishes were not a problem.

Planting early and terminating late had big effects on biomass production.

This is nothing new but we really saw the effects. The greatest biomass production each year usually came on fields planted early. Later termination also had a big effect. When temperatures are warming up in the early spring, extra weeks of growth can really accumulate biomass. In 2018 on Lee #2, we measured biomass twice (page 14). An extra 16 days of growth produced nearly one extra ton of biomass.

Were mixes more expensive than mono–crops?

Not much. At the recommended seeding rate (30 lb. oat, 10 lb. clover, 3 lb. radish) the seed cost of the mix was about \$27/acre; slightly higher than some single–species cereal crops and similar to others.

The mixes provided longer periods of soil coverage and erosion control.

Fast–growing species (radish) covered the soil early while the cereal and legume species were still getting started. Late in the season, the cereals and legumes provided good soil coverage while the radishes were senescing. This extended the time period that the soil was covered by plant matter, intercepting rain drops and reducing erosion potential.

Multiple species in the mixes extended flowering periods.

Beneficial insects were observed as soon as the first flowers opened and until termination. Multiple species extended the flowering season.

**Figure 1. Henry County Biomass Production
2015-16 / 2016-17 / 2017-18**

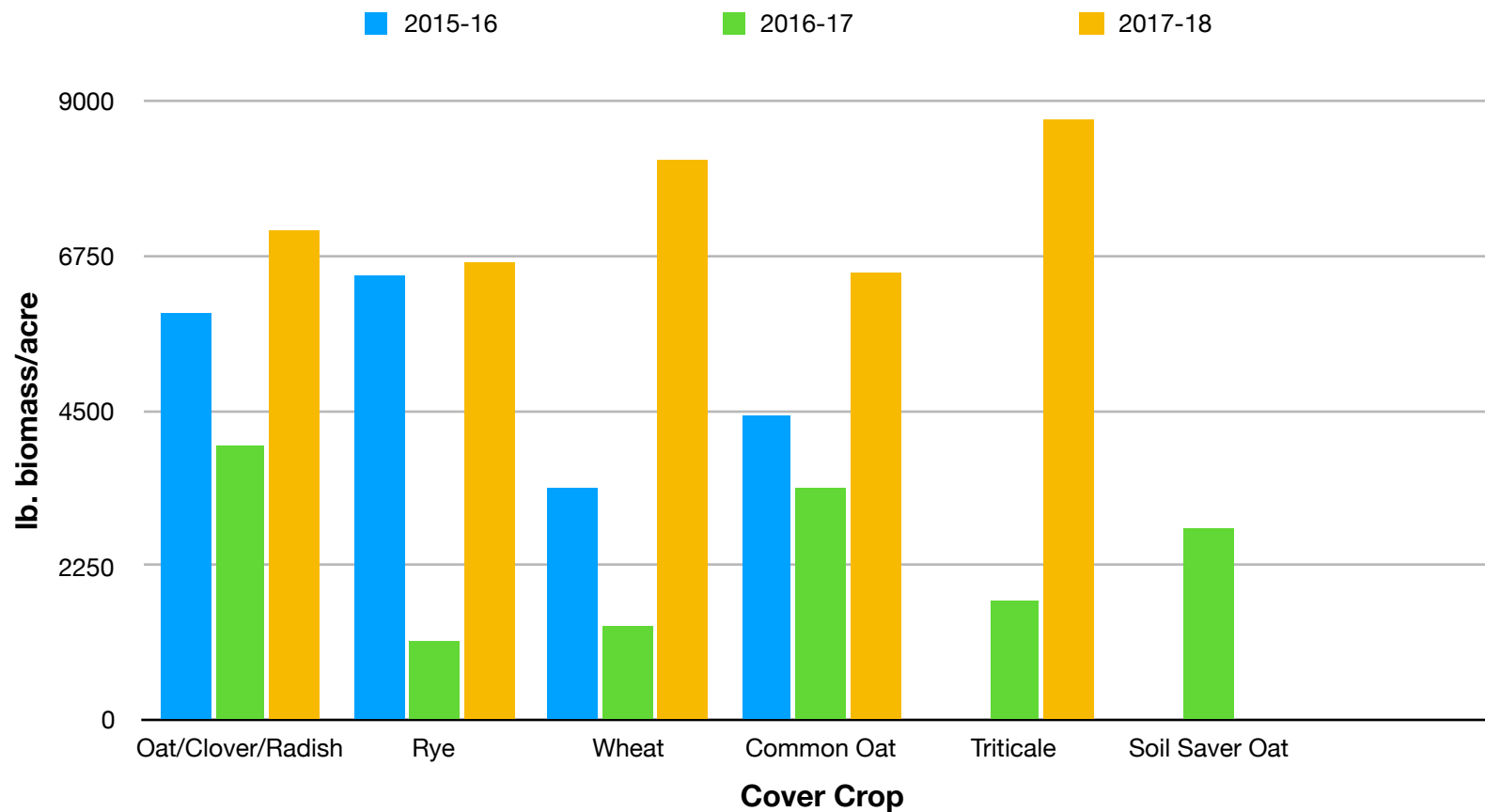


Table 1. 2015/16 Cover Crop Demonstrations

County	Crop / Mix	Seeding Rate	Seed Cost ¹	Plant Pop.	Plant Date	Fertilizer or Litter	Final Ht. ⁵	Max Cover	Biomass ²				
		lb./A	\$/A	#/A		Y/N	inches	%	DAP	lb./A	lb. N/A	lb.C/A	
Cherokee	Cosaque oat	37.5		326700	Oct 12, 2015	Y	43/48	95	197	9,421	103	4,038	
	Crimson clover	12.5	\$29.50	315810			37						
Sodbuster radish	3.75		87120	25/35									
	Rye	30	\$28.00	250,470	Oct 12, 2015	Y	42/73	95	197	7,002	106	3,074	
	Crimson clover	10		152460			33						
	Tillage radish	1.5		98010			24/33						
Cullman	Cosaque oat	30	\$28.80	392040	Oct 12, 2015	N	42	98	196	8,320	95	3,716	
	Crimson clover	10		244030			33						
	Sodbuster radish	5		163350			20/39						
		Rye	30	\$42.90	424710	Oct 12, 2015	N	45/71	95	196	6,347	51	2,885
		Crimson clover	15		196020			27					
	Hairy vetch	5	n/a		51								
	Triticale	30	\$54.90	272250	Oct 12, 2015	N	54	95	196	6,880	108	3,036	
	Crimson clover	15		87120			34						
	Hairy vetch	5		n/a			47						
	Clover	20	\$30.20	348480	Oct 12, 2015	N	32	100	196	8,537	179	3,729	
	Vol. rye			108900			41/66						
	Vol. vetch			n/a			47						
	Vol. ryegrass			n/a			53						
Geneva³	Cosaque oat	30	\$25.60	544500	Dec 5, 2015	N	14	50	133	1,876	39	791	
	Crimson clover	10		392040			12						
	Sodbuster radish	3		206910			14/22						

County	Crop / Mix	Seeding Rate	Seed Cost ¹	Plant Pop.	Plant Date	Fertilizer or Litter	Final Ht. ⁵	Max Cover	Biomass ²			
		lb./A	\$/A	#/A		Y/N	inches	%	DAP	lb./A	lb. N/A	lb.C/A
Geneva	Cosaque oat	50	\$18.00	860,310	Dec 5, 2015	N	14	30	133	663	6	292
	Crimson clover	8-10	\$9.00	762,300	Dec 5, 2015	N	12	60	133	2,582	72	1,091
	Sodbuster radish	15-20	\$28.00	294,030	Dec 5, 2015	N	16/23	50	133	2,819	39	1,208
Henry	Cosaque oat	67	\$45.52	1,001,880	Dec 9, 2015	Y	31	90	139	5,938	94	2,464
	Crimson clover	11		566,280			20					
	Sodbuster radish	6.5		87,120			24/32					
	Rye	100	\$35.00	914,760	Dec 9, 2015	Y	42/54	55	139	6,459	54	2,954
	Wheat	100	\$32.00	1,001,880	Dec 9, 2015	Y	27	36	139	3,373	45	1,985
	Common oat	120	\$44.40	1,089,000	Dec 9, 2015	Y	28	38	139	4,416	38	1,519
Lee	Cosaque oat	30	\$25.60	239,580	Dec 22, 2015	Y	37	75	119	4,638	106	1,983
	Crimson clover	10		228,690			14					
Sodbuster radish	3	21,780		17/25								
	Wheat	60	\$19.20	n/a	Dec 22, 2015	Y	22	50	119	2,979	35	1,335
Lee CCS	Triticale	39	\$41.28	116,160	Oct 1, 2015	Y	38/46	95	207	8,058	160	3,428
	Crimson clover	5		87,120			34					
	Tillage radish	4		58,080			33					
Limestone	Cosaque oat	30	\$25.60	479,160	Oct 30, 2015	N	14	90	158	2,784	79	1,215
	Crimson clover	10		490,050			12					
	Sodbuster radish	3		32,670			8					
		Fallow	n/a	\$0.00	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a

County	Crop / Mix	Seeding Rate	Seed Cost ¹	Plant Pop.	Plant Date	Fertilizer or Litter	Final Ht. ⁵	Max Cover	Biomass ²			
		lb./A	\$/A	#/A		Y/N	inches	%	DAP	lb./A	lb. N/A	lb.C/A
Marion	Cosaque oat	30	\$25.60	402,930	Nov 17, 2015	N	12	70	153	1,954	35	857
	Crimson clover	10		217,800			12					
	Sodbuster radish	3		4,350			12					
	Wheat	60	\$19.20	304,920	Nov 17, 2015	N	15	33	153	1,007	14	444
	Wheat	90	\$28.80	577,170	Nov 17, 2015	N	16	43	153	1,739	21	771
	Wheat	120	\$38.40	751,410	Nov 17, 2015	N	16	50	153	1,429	19	636
Shelby⁴	Cosaque oat	30	\$25.60	272,250	Oct 16, 2016	Y	na	77	158	1,864	26	764
	Crimson clover	10		228,690								
Sodbuster radish	3	108,900										
	Wheat	65	\$20.80	446,490	Oct 16, 2016	Y	n/a	27	158	n/a	n/a	n/a

1. Prices used for seed costs:
 - A. NRCS mix purchased from Petcher Seeds, Fruitdale, AL: Cosaque black oat: \$0.36; Crimson clover: \$1.00; Sodbuster radish: \$1.60.
 - B. CCS (Cover Crop Solutions Charlotte mix; 82% triticale, 11% crimson clover, 8% radish): \$43/50 lb. bag.
 - C. Other seed prices from regional surveys by Dr. Leah M. Duzy, USDA-ARS, Auburn, AL.: Rye: \$0.35; Wheat: \$0.32; Oat: \$0.37; Triticale: \$0.75; Crimson clover: \$1.51; Hairy vetch: \$1.95.
2. Biomass nitrogen and carbon were determined by Dr. Kip S. Balkcom, USDA-ARS, Auburn, AL
3. Geneva site had significant weed pressure.
4. Shelby site was terminated and cotton was planted and emerging before biomass could be sampled. No residue was collected from the wheat. The mix was sampled but residue was scattered and amounts were lower than they would have been at termination.
5. Height measured to top of lush canopy growth. If two numbers reported (x/x), first number is height to lush canopy, second number is to top of seed head.

Table 2. 2016/17 Cover Crop Demonstrations

County	Crop / Mix	Seeding Rate	Seed Cost ¹	Plant Pop.	Plant Date	Fertilizer or Litter	Final Ht.	Max Cover	Biomass ²			
		lb./A	\$/A	#/A		Y/N	inches	%	DAP	lb./A	lb. C/A	lb. N/A
Baldwin	Cosaque oat	30		213,444	Dec 23, 2016	Y	20	85	102	3,971	1,692	79
	Crimson clover	10	\$26.60	169,884			10					
	Sodbuster radish	3		82,764			39					
	Cosaque oat	39	\$13.86	300,564	Dec 23, 2016	Y	17	67	102	2,497	1,115	70
	Crimson clover	6	\$6.88	104,544	Dec 23, 2016	Y	7	88	102	1,877	829	65
	Persian clover	5	\$15.00	69,696	Dec 23, 2016	Y	7	64	102	1,454	630	43
Cherokee	Cosaque oat	50		527,076	Oct 29, 2016	N	23	88	151	4,469	2,036	67
	Crimson clover	5	\$28.30	217,800			19					
	Sodbuster radish	3		26,136			26					
	Soil Saver oat	50		527,076	Oct 29, 2016	N	18	76	151	2,551	1,160	44
Crimson clover	5	\$35.30	230,868	17								
Sodbuster radish	3		8,712	23								
	Cosaque oat	50	\$23.50	553,212	Oct 29, 2016	N	24	87	151	3,663	1,656	69
	Crimson clover	5		213,444			18					
	Rye	50	\$20.50	853,776	Oct 29, 2016	N	66	94	151	6,100	2,842	93
	Crimson clover	5		148,104			17					
Cullman	Cosaque oat	30		320,710	Nov 20, 2016	N	36	95	151	5,106	2,302	70
	Crimson clover	10	\$29.80	274,156			32					
	Sodbuster radish	5		0			35					
Geneva	Cosaque oat	43		788,920	Nov 29, 2016	N	30	95	119	4,871	2,143	92
	Crimson clover	14	\$38.00	459,800			17					
	Sodbuster radish	4		125,840			48					
	Cosaque oat	50	\$18.00	706,640	Nov 29, 2016	N	18	50	119	2,679	1,209	44

County	Crop / Mix	Seeding Rate	Seed Cost ¹	Plant Pop.	Plant Date	Fertilizer or Litter	Final Ht.	Max Cover	Biomass ²			
		lb./A	\$/A	#/A		Y/N	inches	%	DAP	lb./A	lb. C/A	lb. N/A
Henry	Cosaque oat	60		574,992	Jan 18, 2017	Y	21	60	89	3,978	1,765	71
	Crimson clover	25	\$73.10	121,968			7					
	Sodbuster radish	15		87,120			45					
	Oat	100	\$30.00	798,600	Jan 18, 2017	Y	20	40	89	3,369	1,562	53
	Soil Saver oat	100	\$60.00	466,092	Jan 18, 2017	Y	40	50	89	2,779	1,271	38
	Triticale	100	\$38.00	1,045,440	Jan 18, 2017	Y	33	50	89	1,736	810	26
	Rye	100	\$25.00	838,530	Jan 18, 2017	Y	10	50	89	1,144	534	32
Wheat	100	\$26.00	762,300	Jan 18, 2017	Y	23	30	89	1,357	629	28	
	Fallow (mostly henbit)	0	\$0.00	n/a	Jan 18, 2017	Y	12	20	n/a	1,114	479	19
Lee	Cosaque oat	30		213,444	Nov 30, 2016	Y	30	95	132	6,006	2,732	106
	Crimson clover	10	\$26.60	217,800			25					
	Sodbuster radish	3		60,984			37					
Monroe³	Cosaque oat	75	\$54.50	701,316	Dec 28, 2016	Y	18	95	n/a	-	-	-
	Crimson clover	25		0			-					
	Wheat	?	?	309,276	Dec 28, 2016	Y	8	70	n/a	-	-	-
Shelby	Cosaque oat	30		278,784	Nov 30, 2016	Y	29	90	133	4,961	2,213	67
	Crimson clover	10	\$26.60	100,188			36					
	Sodbuster radish	3		74,052			14					
Washington⁴	Cosaque oat	30		213,444	Nov 28, 2016	N	20	90	133	4,138	1,863	46
	Crimson clover	10	\$26.60	182,952			10					
	Sodbuster radish	3		69,696			40					
	Fallow (grasses and henbit)	0	\$0.00	n/a	Nov 28, 2016	N	4 6	50	133	-	-	-

1. Prices used for seed costs:
 - D. NRCS mix purchased from Petcher Seeds, Fruitdale, AL: Cosaque oat: \$0.36; Crimson clover: \$1.10; Sodbuster radish: \$1.60.
 - E. Other seed prices from regional surveys by Dr. Leah M. Duzy, USDA-ARS, Auburn, AL.: Wrens Abruzzi rye: \$0.25; Wheat: \$0.26; Oat: \$0.30; Triticale: \$0.38; Soil Saver oat: \$0.60; Persian clover: \$3.00.
2. Biomass nitrogen and carbon were determined by Dr. Kip S. Balkcom, USDA-ARS, Auburn, AL
3. Monroe crops were mowed before biomass could be collected. Wheat seeding rate was unavailable. Clover in the mix was smothered by the oat and none was apparent by the end of the season.
4. Washington crops were terminated and brown before biomass could be collected. A strip of the mix was available to sample (brown but upright). The fallow strip was completely strip-tilled and unavailable for biomass collection.

Table 3. 2017/18 Cover Crop Demonstrations

County	Crop / Mix	Seeding Rate	Seed Cost ¹	Plant Pop.	Plant Date	Fertilizer or Litter	Final Ht.	Max Cover	Biomass ²			
		lb./A	\$/A	#/A			inches	%	DAP	lb./A	lb. C/A	lb. N/A
Cherokee	Rye	50	\$55.85	849,420	Nov 2, 2017	N	27	78	146	2,196	1,004	30
	Sunrise clover	15		261,360			11					
	Cosaque oat	13	\$48.65	784,080	Nov 2, 2017	N	10	74	146	1,873	846	29
	Rye	39		(oat/rye)			25					
Sunrise clover	11	250,470		10								
Sodbuster radish	1.3	21,780		12								
	Cosaque oat	17	\$27.96	740,520	Nov 2, 2017	N	13	87	146	2,163	961	45
	Sunrise clover	8		337,590			12					
	Sodbuster radish	1.7		21,780			14					
	Cosaque oat	17	\$17.64	500,940	Nov 2, 2017	N	15	95	146	2,271	987	47
	Dixie clover	8		468,270			12					
	Sodbuster radish	1.7		98,010			12					
Coffee	Cosaque oat	30	\$26.60	362,548	Sep 25, 2017	Y	36	94	189	9,213	4,064	73
	Crimson clover	10		135,036			27					
	Sodbuster radish	3		60,984			37					
Coffee	Coker oat	40	\$34.45	365,904	Sep 25, 2017	Y	51	92	189	8,840	4,008	86
	Rye	10		(cereals)			62					
	Vetch	5		74,052			34					
Cullman	Cosaque oat	50	\$39.30	326,700	Oct 3, 2017	N	30	100	198	6,069	2,847	101
	Crimson clover	15		191,664			23					
	Sodbuster radish	3		104,544			-					
	(Vol. rye)	0		n/a			58					
	(Vol. vetch)	0		n/a			32					

County	Crop / Mix	Seeding Rate	Seed Cost ¹	Plant Pop.	Plant Date	Fertilizer or Litter	Final Ht.	Max Cover	Biomass ²			
		lb./A	\$/A	#/A			inches	%	DAP	lb./A	lb. C/A	lb. N/A
Geneva	Cosaque oat	30	\$26.60	500,940	Nov 27, 2017	N	27	70	133	5,038	2,281	80
	Crimson clover	10		196,020			17					
	Sodbuster radish	3		94,380			32					
Geneva	Cosaque oat	50	\$18.00	888,624	Nov 27, 2017	N	31	59	133	3,346	1,547	38
Geneva	Coker oat	90	\$42.30	n/a	Nov 27, 2017	N	26	60	133	3,380	1,534	47
Geneva	Wheat	75	\$27.75	419,265	Nov 27, 2017	N	25	49	133	1,399	633	20
Henry	Cosaque oat	60	\$73.10	784,080	Oct 25, 2017	Y	35	100	152	7,115	3,216	116
	Crimson clover	25		696,960			24					
	Sodbuster radish	15		239,580			31					
	Common oat	100		1,132,560			37					
	Rye	100		1,074,480			62					
	Triticale	100		784,080			48					
Wheat	100	1,089,000	36	78	152	8,154	3,782	127				
	Fallow	n/a	\$0.00	n/a	Oct 25, 2017	Y	n/a	n/a	n/a	3,236	1,462	51
Lee #1	Triticale	30	\$37.70	146,362	Sep 28, 2017	N	12	82	180	1,281	561	26
	Cowpea	20		55,321			12					
	Sodbuster radish	2		11,064			23					
	(Vol. corn)	0		–			24					
Lee #2³	Cosaque oat	30	\$26.60	278,784	Oct 31, 2017	N	27	97	147 ^a 163 ^b	3,779 ^a 5,505 ^b	1,697 ^a 2,503 ^b	76 ^a 113 ^b
	Crimson clover	10		178,596			24					
	Sodbuster radish	3		60,984			28					

County	Crop / Mix	Seeding Rate	Seed Cost ¹	Plant Pop.	Plant Date	Fertilizer or Litter	Final Ht.	Max Cover	Biomass ²			
		lb./A	\$/A	#/A			inches	%	DAP	lb./A	lb. C/A	lb. N/A
Limestone	Cosaque oat	38	\$34.38	379,594	Oct 31, 2017	N	10	59	150	1,213	547	22
	Crimson clover	13		336,034			5					
	Sodbuster radish	4		0			–					
Shelby	Cosaque oat	30	\$26.60	505,296	Nov 18, 2017	N	12	62	145	1,433	649	21
	Crimson clover	10		235,224			5					
	Sodbuster radish	3		43,560			16					
Washington	Cosaque oat	30	\$26.60	641,520	Nov 18, 2017	N	43	91	150	7,597	3,520	79
	Crimson clover	10		665,280			5					
	Sodbuster radish	3		95,040			n/a					
	Coker oat	90	\$42.30	745,965	Nov 18, 2017	N	45	90	150	7,831	3,619	72

1. Prices used for seed costs:
 - F. NRCS mix purchased from Petcher Seeds, Fruitdale, AL: Cosaque oat: \$0.36; Crimson clover: \$1.10; Sodbuster radish: \$1.60.
 - G. Other seed prices from regional surveys : Wrens Abruzzi rye: \$.40; Wheat: \$0.37; Oat: \$0.47; Triticale: \$0.53; Soil Saver oat: \$0.60; Crimson clover: AU Robin: \$1.67; AU Sunrise: \$2.39; Iron Clay cowpea: \$0.93; Hairy vetch: \$2.33.
2. Biomass nitrogen and carbon were determined by Dr. Kip S. Balkcom, USDA-ARS, Auburn, AL.
3. Field sampled for biomass twice.
 - a - March 27 (147 DAP).
 - b - April 12 (163 DAP).

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Kathy Gotcher	Mark Grimes	Mike Gunn	Bob Helms
Rod Higdon	Wade Hill	Tibor Horvath	Ken Howell
Kirk Iversen	Myron Johnson	Randy Kerr	Joey Koptis
Joyce Lane	Mitch Lazenby	Steve Lloyd	Thomas McDaniel
Nick McGee	Joyce Nicholas	Richard Petcher	Dustin Potter
David Richardson	Patrick Rohling	Steve Rohrer	Adam Sconyers
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