

Supplemental Materials

Title: Grass-legume mixtures increase above and belowground biomass production in Andean forage-based fallows

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Table S1. Relative Yield Total (RYT) for bicultures based on total biomass, roots, and shoots. ANOVA results for each major factor (grasses, legume, and soil) with their corresponding interactions are presented at the bottom, with significant values in bold (p-value<0.05). Mean LER values are presented with their corresponding standard errors (SE) to the right of each mean.

Treatments ^a	RYT				Root RY				Shoot RY			
	Quilcas		Castillapata		Quilcas		Castillapata		Quilcas		Castillapata	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
OATS/VETCH	1.91	0.31	1.74	0.32	2.29	0.65	1.80	0.30	1.85	0.30	1.74	0.32
RYEG/VETCH	1.18	0.05	2.03	0.49	1.00	0.08	1.66	0.33	1.27	0.06	2.18	0.55
FELO/VETCH	1.89	0.37	2.75	0.53	1.18	0.10	2.10	0.43	2.04	0.46	3.05	0.79
BROM/VETCH	1.95	0.16	1.55	0.33	1.14	0.11	1.35	0.32	2.04	0.18	1.58	0.33
ORCH/VETCH	2.36	0.17	1.40	0.28	2.21	0.39	1.36	0.36	1.88	0.23	1.31	0.28
OATS/REDC	1.74	0.11	1.51	0.57	2.14	0.28	1.22	0.40	1.69	0.12	1.56	0.62
RYEG/REDC	1.38	0.37	1.55	0.22	1.27	0.26	1.16	0.10	1.46	0.44	1.68	0.38
FELO/REDC	1.25	0.34	1.05	0.20	1.52	0.43	0.86	0.14	1.12	0.30	0.97	0.11
BROM/REDC	1.00	0.33	0.72	0.13	1.15	0.34	0.75	0.20	0.97	0.33	0.75	0.10
ORCH/REDC	1.23	0.47	1.09	0.42	1.36	0.45	1.05	0.45	1.18	0.48	0.92	0.35
OATS/MELU	1.72	N/A	1.11	0.33	3.11	N/A	1.41	0.52	1.51	N/A	1.06	0.34
RYEG/MELU	1.09	0.16	1.07	0.19	0.84	0.03	1.15	0.13	1.26	0.28	1.06	0.23
FELO/MELU	0.78	0.12	1.64	0.42	0.54	0.12	1.42	0.21	0.89	0.19	1.87	0.52
BROM/MELU	2.57	1.62	2.24	0.51	2.28	1.21	2.51	1.04	2.65	1.73	2.22	0.42
ORCH/MELU	1.68	0.26	1.30	0.40	1.27	0.25	1.37	0.36	1.81	0.40	1.29	0.40
OATS/ALFA	1.48	0.44	1.40	0.25	1.61	0.54	1.73	0.52	1.47	0.42	1.35	0.21
RYEG/ALFA	1.23	0.16	0.83	0.17	0.89	0.13	0.90	0.20	1.46	0.20	0.81	0.15
FELO/ALFA	1.18	0.63	1.69	0.41	1.24	0.68	1.91	0.25	1.15	0.61	1.69	0.54
BROM/ALFA	0.73	0.08	1.02	0.37	0.85	0.16	1.84	0.91	0.71	0.07	0.90	0.31
ORCH/ALFA	0.84	0.54	0.91	0.17	0.67	0.44	1.58	0.54	0.94	0.61	0.76	0.12
All Mixtures ^b												
Legume	0.001				0.118				0.001			
Grass	0.629				0.049				0.579			
Soil	0.966				0.679				0.882			

Legume x Grass	0.169	0.465	0.137
Legume x Soil	0.898	0.057	0.968
Grass x Soil	0.145	0.15	0.131
Legume x Grass x Soil	0.813	0.766	0.865

Perennial Mixtures ^c

Legume	0.069	0.572	0.028
Grass	0.985	0.659	0.908
Soil	0.623	0.192	0.918
Legume x Grass	0.162	0.261	0.176
Legume x Soil	0.836	0.057	0.944
Grass x Soil	0.509	0.939	0.288
Legume x Grass x Soil	0.789	0.805	0.757

^a OATS=oats (*Avena sativa*; cv. Mantaro 15M), RYEG=ryegrass (*Lolium multiflorum*; cv. Tama), FELO=Festulolium (*Lolium x Festuca genera*), BROM=brome grass (*Bromus catharticus*), ORCH=orchardgrass (*Dactylis glomerata*), VETCH=vetch (*Vicia dasycarpa*), REDC = red clover (*Trifolium pratense*), MELU = black medic (*Medicago lupulina*), ALFA = alfalfa (*Medicago sativa*; cv. Ranger).

^b P_values based on treatments involving all species, whether annular/perennial (grasses and legume)

^c P_values based on treatments for perennial species only (grasses and legume).

Table S2. Root and shoot biomass of separate grass and legume components in each treatment.

Treatments ^a	Root dry biomass (g Pot ⁻¹)										Shoot dry biomass (g Pot ⁻¹)							
	Quilcas					Castillapata					Quilcas				Castillapata			
	n	Grass	SE	Legume	SE	Grass	SE	Legume	SE	Grass	SE	Legume	SE	Grass	SE	Legume	SE	
OATS/VETCH	4	4.39	1.31	0.28	0.09	0.83	0.35	0.57	0.23	19.81	2.16	3.85	0.34	6.43	2.40	5.18	0.24	
RYEG/VETCH	4	4.71	0.83	0.16	0.05	3.39	0.78	0.13	0.05	8.83	1.36	1.88	0.25	7.30	1.88	2.63	0.26	
FELO/VETCH	4	2.58	1.05	0.48	0.22	2.40	0.53	0.39	0.08	8.44	3.67	7.81	0.77	5.54	1.55	5.85	0.36	
BROM/VETCH	4	0.34	0.11	0.66	0.10	0.16	0.01	0.50	0.29	1.24	0.57	12.18	0.11	0.83	0.12	5.86	0.86	
ORCH/VETCH	3	4.51	0.76	0.34	0.06	0.65	0.29	0.50	0.06	4.93	0.93	7.37	0.09	0.67	0.29	7.00	0.19	
OATS/REDC	4	4.69	0.62	0.09	0.05	0.75	0.25	0.11	0.04	24.73	2.21	0.26	0.16	6.89	3.16	0.27	0.12	
RYEG/REDC	3	6.95	1.30	0.12	0.05	2.12	0.27	0.13	0.02	12.60	3.75	0.13	0.11	5.47	1.36	0.25	0.03	
FELO/REDC	3	2.60	1.12	0.93	0.62	0.97	0.16	0.13	0.04	4.90	2.19	1.27	0.44	1.79	0.37	0.26	0.05	
BROM/REDC	4	1.05	0.31	0.36	0.29	0.12	0.06	0.10	0.03	5.04	1.06	0.70	0.28	0.39	0.19	0.23	0.10	
ORCH/REDC	3	2.09	1.11	0.60	0.17	0.62	0.31	0.20	0.08	3.62	1.59	0.74	0.31	0.82	0.35	0.32	0.11	
OATS/MELU	1	5.71	N/A	0.12	N/A	0.75	0.23	0.03	0.02	14.90	N/A	0.41	N/A	5.30	1.91	0.06	0.03	

RYEG/MELU	2	4.61	0.25	0.02	0.01	1.48	0.34	0.04	0.02	10.49	3.21	0.07	0.12	2.54	0.53	0.20	0.15
FELO/MELU	3	2.37	0.58	0.01	0.00	1.62	0.47	0.02	0.01	8.32	1.98	0.04	0.06	4.09	1.22	0.06	0.03
BROM/MELU	3	0.86	0.50	0.32	0.29	0.17	0.03	0.13	0.08	4.95	2.71	1.48	0.64	1.04	0.11	0.53	0.18
ORCH/MELU	3	3.15	1.08	0.03	0.03	0.62	0.07	0.05	0.03	5.32	0.82	0.44	0.32	0.97	0.15	0.27	0.20
OATS/ALFA	4	3.50	1.19	0.06	0.04	0.98	0.24	0.06	0.05	21.42	6.73	0.13	0.10	7.13	0.88	0.08	0.10
RYEG/ALFA	4	4.52	1.24	0.09	0.08	1.85	0.44	0.01	0.00	11.10	2.96	0.27	0.22	3.06	0.58	0.02	0.03
FELO/ALFA	3	2.64	1.46	0.44	0.38	2.05	0.09	0.07	0.03	5.19	2.64	0.74	0.34	3.52	0.94	0.16	0.16
BROM/ALFA	4	1.01	0.25	0.07	0.04	0.10	0.05	0.19	0.13	5.01	0.66	0.10	0.09	0.46	0.22	0.36	0.16
ORCH/ALFA	2	1.74	1.35	0.05	0.01	0.64	0.06	0.11	0.07	3.70	3.00	0.13	0.12	0.81	0.10	0.14	0.07
OATS	4	2.29	0.68			0.74	0.28			15.79	3.63			5.65	1.36		
RYEG	4	6.08	1.36			2.24	0.82			9.01	1.58			3.89	1.36		
FELO	4	4.80	1.13			1.48	0.39			10.10	2.87			2.33	0.68		
BROM	3	1.35	0.18			0.22	0.07			8.06	1.27			0.92	0.35		
ORCH	4	2.88	0.64			0.85	0.33			4.44	0.83			1.33	0.35		
VETCH	4			0.74	0.11			0.83	0.20			9.80	0.73			8.63	0.08
REDC	4			0.95	0.30			0.50	0.22			2.02	0.30			0.72	0.18
MELU	4			0.20	0.08			0.08	0.03			0.73	0.30			0.49	0.26
ALFA	4			0.64	0.39			0.14	0.11			1.17	0.30			0.89	0.40

^a OATS=oats (*Avena sativa*; cv. Mantaro 15M), RYEG=ryegrass (*Lolium multiflorum*; cv. Tama), FELO= Festulolium (*Lolium* x *Festuca* genera), BROM=brome grass (*Bromus catharticus*), ORCH=orchardgrass (*Dactylis glomerata*), VETCH=vetch (*Vicia dasycarpa*), REDC = red clover (*Trifolium pratense*), MELU = black medic (*Medicago lupulina*), ALFA = alfalfa (*Medicago sativa*; cv. Ranger).

Figure S1. Mean total biomass production by treatment averaged across soil types. Error bars present the standard error of the mean and correspond to the original data (without transformation)

