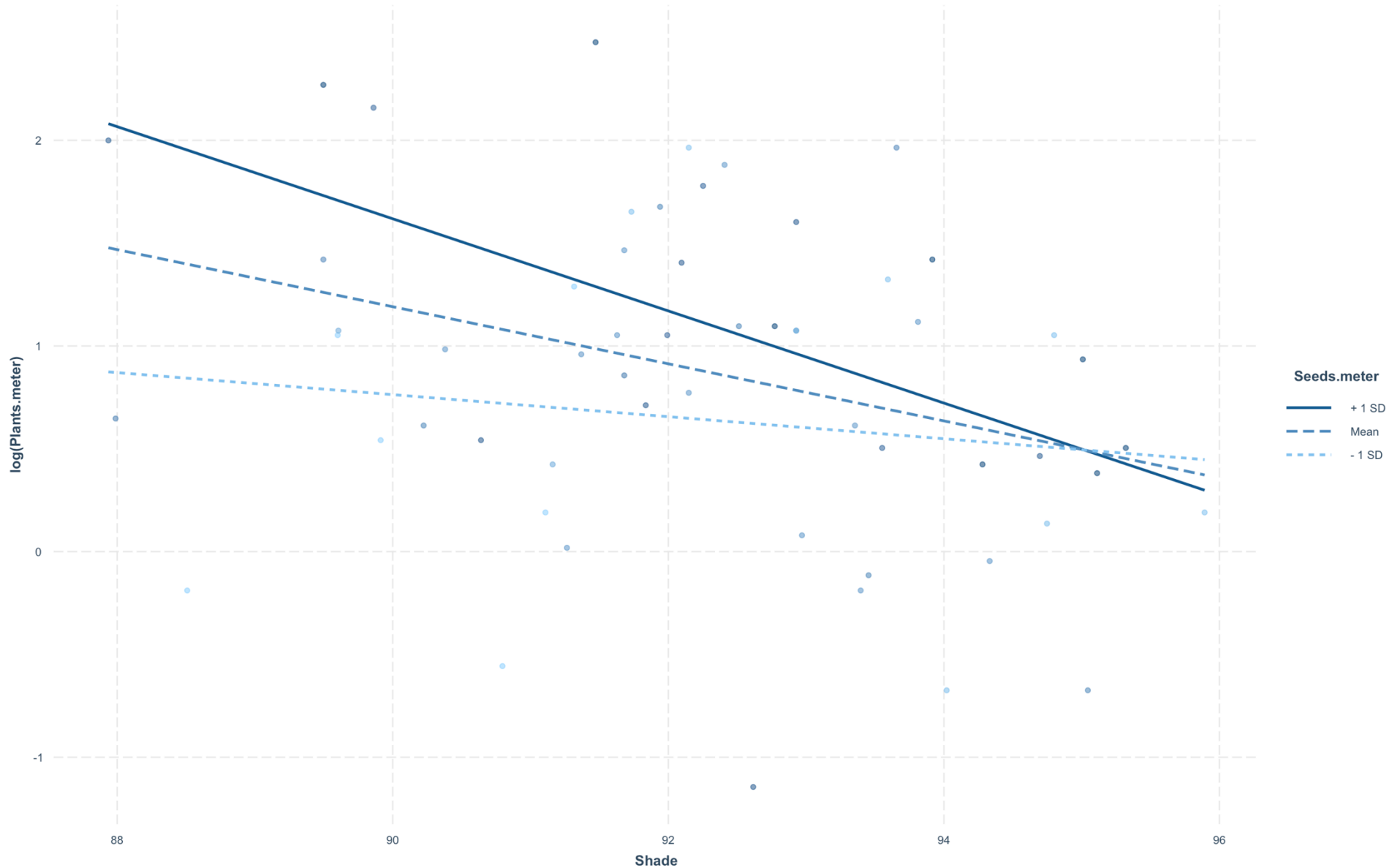
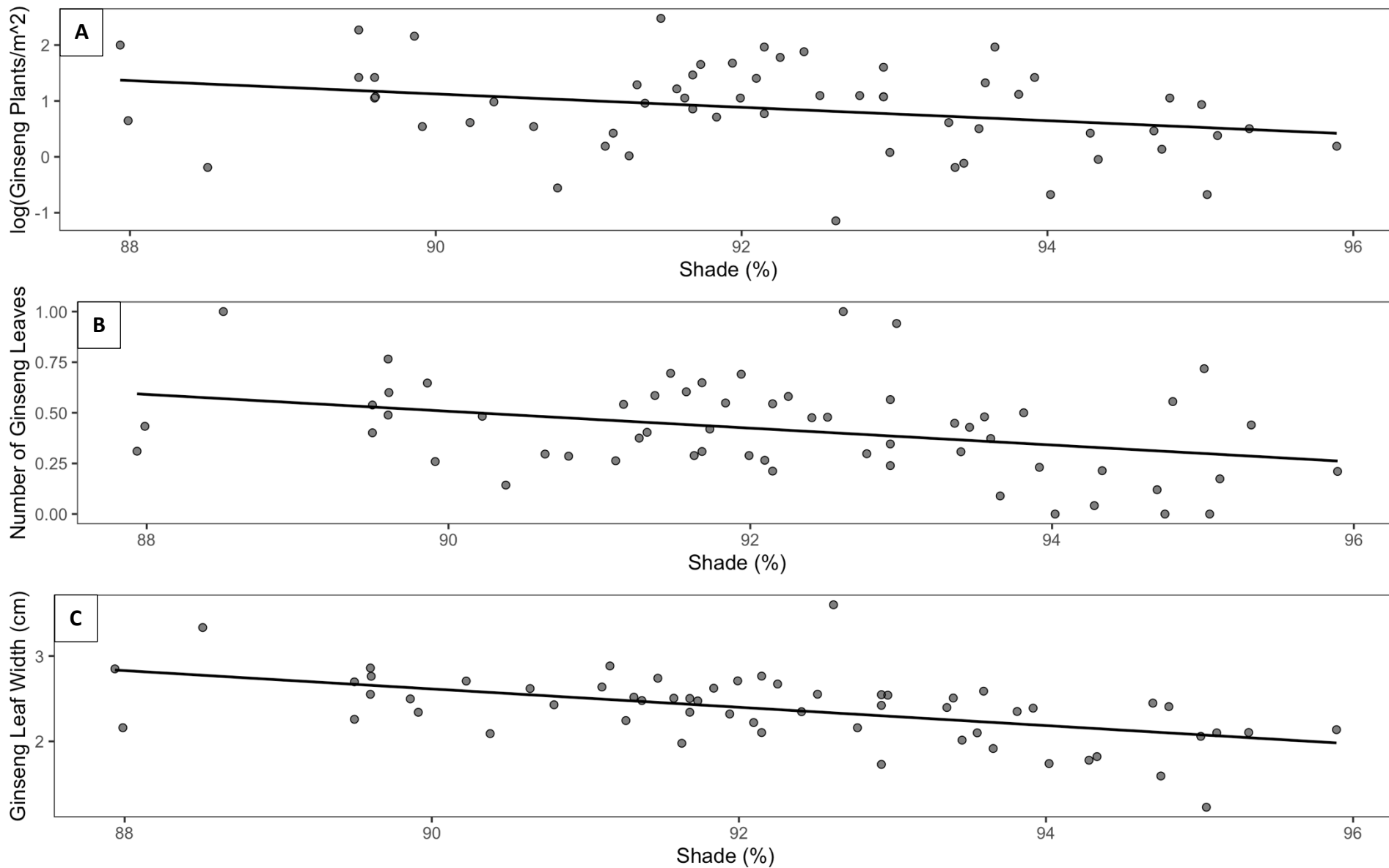


**Figure 1.** Study site location in the Catskill Mountains of New York State, USA, with 2016 planting areas outline in yellow and plots marked with a purple pin (yellow pins indicate plots that were eliminated because ground truthing indicated they weren't suitable for the parameters of the study), and the plot design.



**Figure 2.** This interaction plot illustrates the effect of shade levels on ginseng plant density three years after the seeds were planting with varying seeding rates. The three trend lines indicate three different levels of seeding: the center, medium blue hashed line represents the mean seeding rate across all our plots, while the top, dark blue solid line represents one standard deviation above the mean seeding rate and the bottom, light blue hashed line represents one standard deviation below the mean seeding rate. The convergence of these lines at higher levels of shade suggests that as shade levels increase above 95%, planting higher densities of ginseng seed no longer provides a subsequent increase in the number of ginseng plants.



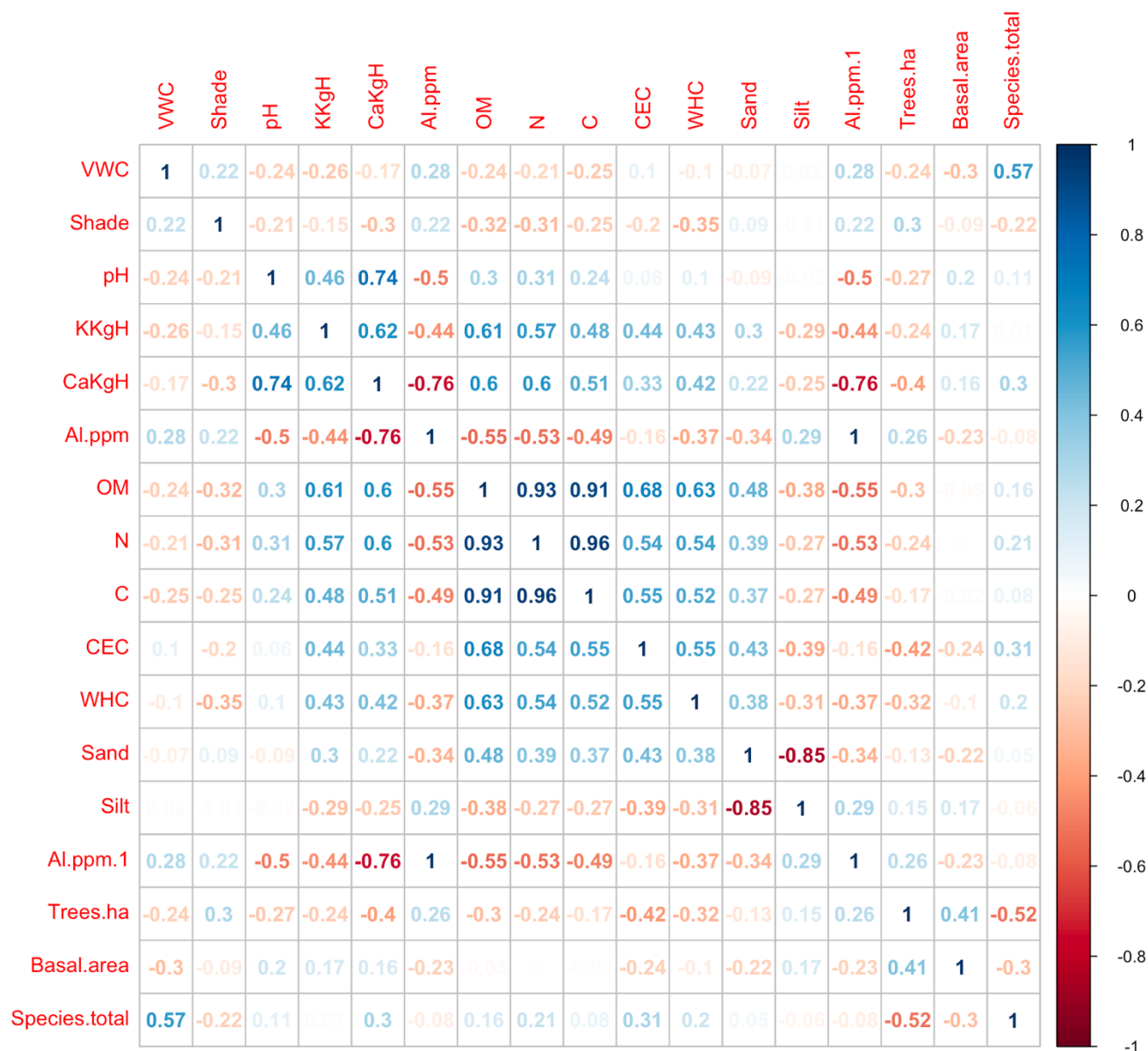
**Figure 3.** Linear relationships between response variables and shade, to illustrate the effect of shade in our models. **A.** Impact of shade on the log of ginseng plant density. **B.** Impact of shade on the average number of ginseng leaves per plant. **C.** Impact of shade on the average width of the central leaflet. The graphs illustrate a consistent relationship found between shade and ginseng performance in our study: as light levels decrease, ginseng plants become less numerous, smaller, and less mature.

<i>Predictors</i>	<b>log(Plants.meter)</b>			<b>Width</b>			<b>Leaves</b>		
	<i>Estimates</i>	<i>CI</i>	<i>p</i>	<i>Estimates</i>	<i>CI</i>	<i>p</i>	<i>Estimates</i>	<i>CI</i>	<i>p</i>
(Intercept)	19.16	9.12 – 29.21	<b>&lt;0.001</b>	11.92	6.77 – 17.07	<b>&lt;0.001</b>	4.69	1.27 – 8.11	<b>0.008</b>
Shade	-0.19	-0.29 – -0.08	<b>&lt;0.001</b>	-0.10	-0.15 – -0.05	<b>&lt;0.001</b>	-0.04	-0.08 – -0.01	<b>0.016</b>
pH	-0.50	-1.19 – 0.19	0.154	0.06	-0.26 – 0.38	0.716	-0.03	-0.23 – 0.17	0.758
Seeds.meter	0.01	-0.01 – 0.03	0.283						
WHC	0.01	-0.03 – 0.04	0.714	-0.01	-0.03 – 0.01	0.311	-0.00	-0.01 – 0.01	0.769
Trees.ha	0.00	0.00 – 0.00	<b>0.048</b>	-0.00	-0.00 – 0.00	0.227	-0.00	-0.00 – 0.00	0.552
Basal.area	-0.02	-0.05 – 0.00	0.102	0.00	-0.01 – 0.01	0.963	-0.00	-0.01 – 0.00	0.394
<b>Random Effects</b>									
$\sigma^2$	0.36			0.11					
$\tau_{00}$	0.12	Stand		0.01	Stand				
ICC	0.25			0.09					
N	21	Stand		21	Stand				
Observations	59			59			59		
R <sup>2</sup> (model/fixed/random)	0.451/0.295/0.156			0.366/0.312/0.054			0.157/0.157/0.00		

**Table 1.** The results from our Generalized Linear Mixed Effects Models (GLMs). The table shows the results of three models, for three response variables: Ginseng plant density (logged to meet assumptions of normality), ginseng leaflet width, and number of ginseng leaves. The predictor variables are shade levels, pH, water holding capacity (WHC), tree density (trees.ha), and tree basal area, as well as the density of seeds planted only for the response variable of ginseng plant density. Random effects values only appear for response variables ginseng plant density and leaflet width because they were negligible for the number of ginseng leaves. The  $r^2$  values at the bottom show the contribution of fixed and random effects to the overall explanatory power of the models

## Supplemental Materials

Fig. S1 Correlation matrix of all environmental variables measured.



Variable	Mean	Minimum, Maximum	Standard Deviation
<b>Number of Ginseng Plants</b>	49.2	5.00, 187	37.7
<b>Ginseng Leaf Width (cm)</b>	2.38	1.23, 3.60	.395
<b>Number of Ginseng Leaves</b>	0.417	0, 1	.230
<b>Volumetric Water Content (%)</b>	17.6	8.80, 31.0	5.71
<b>Shade (%)</b>	92.2	87.9, 95.9	1.91
<b>Soil pH</b>	4.01	3.60, 5.20	.318
<b>Soil Potassium (Kg/Ha)</b>	154	79.6, 375	43.6
<b>Soil Calcium (Kg/Ha)</b>	1530	364, 4250	943
<b>Soil Organic Matter (%)</b>	10.6	6.70, 20.5	2.90
<b>Soil Cation Exchange Capacity</b>	18.3	14.6, 23.0	1.81
<b>Soil Water Holding Capacity (%)</b>	26.8	14.6, 41.0	5.60
<b>Soil Percent Sand</b>	47.6	32.2, 64.5	6.44
<b>Soil Percent Silt</b>	37.9	26.7, 48.8	4.45
<b>Soil Percent Clay</b>	14.6	8.80, 22.2	3.55
<b>Trees per Hectare</b>	427	223, 796	124
<b>Basal Area (m<sup>2</sup>/Ha)</b>	28.7	8.97, 48.6	7.95

**Table S1.** Summary statistics table showing overall site conditions and ginseng performance metrics.