

ACS Farmer-Driven Research CaroVail Alfalfa Treatments Trial Results

2014 Report

April, 2015



Figure 1: Colorful flags marking the seven treatments during the 2014 CaroVail plotwork.

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Introduction

In 2014 ACS consultants met with CaroVail service providers to discuss an interest in using the ACS Farmer-Driven Research approach for testing a number of different alfalfa treatments and to measure impacts on alfalfa yield and forage quality. A number of treatments and plot sites were discussed along with costs. Seven treatments were decided upon and two sites were selected; one at Willet Dairy LLC and another at Oakwood Dairy LLC.

The research question to be investigated was a general investigation into what impact might be measured at each treatment:

“In 2014 growing conditions, on a moderate fertility, 2nd or 3rd year alfalfa field which crop management strategies have a positive return for the investment in terms of forage yield, forage quality?”

Methods

For investigating the use of different fertilizers, fungicides and pesticides on alfalfa the research program was designed to identify a response to any of the products on alfalfa yield and alfalfa forage quality (Figure 2). The products were applied according to product labels and per CaroVail service provider recommendations. All treatments were applied with a four-wheeler with an 8’ boom width. The control treatment consisted of no treatment at all. Treatments were made at seven days after 1st and seven days after 2nd cutting or at about 6” of re growth after 1st and 2nd cutting.

Rep 1	(1) Headline AMP	(2) Quadris	(3) Grizzley	(4) Potash	(5) Potash +B + AMS	(6) Enhanced Y	(7) Control
Rep 2	(8) Potash + B + AMS	(9) Headline AMP	(10) Potash	(11) Enhanced Y	(12) Control	(13) Quadris	(14) Grizzley
Rep 3	(15) Potash	(16) Potash + B + AMS	(17) Enhanced Y	(18) Grizzley	(19) Control	(20) Quadris	(21) Headline AMP

Figure 2: Plot layout design for the two sites. Each treatment was represented three times in a randomized block design.

Plots were hand harvested as close to the date the farmer planned to make a cutting as possible. ACS was responsible for the hand harvest of test plots, plot wet and dry weights and submitting forage analysis to Dairy One in Ithaca, NY. At harvest hand sampling was completed within each plot at two random locations and initial weights were recorded. Samples were dried and re measured coming out of the oven as the dry weight. A combined grab sample of the two yield samples was pulled and sent to Dairy One in Ithaca, NY for forage analysis.

Each forage sample was analyzed by Dairy One for a basic forage sample which included percent moisture, crude protein (CP), acid detergent fiber, neutral detergent fiber (NDF),

phosphorus (P), and Potassium (K), IVTD_{24hrs}, and NDFD_{30hrs} digestibility. These parameters were used to indicate forage quality.

All plots were measured for each parameter and analyzed for statistical differences by Cornell University Statistical Consulting Unit. A mixed model was used for analysis with ‘field’ and ‘treatment’ as fixed effects and ‘block-within-field’ as a random effect.

Weather Conditions and Implications

The 2014 season saw some high rainfall events during August but total seasonal rainfall amounts were much lower than 2013 and followed typical “average” rainfall amounts (Figure 3).

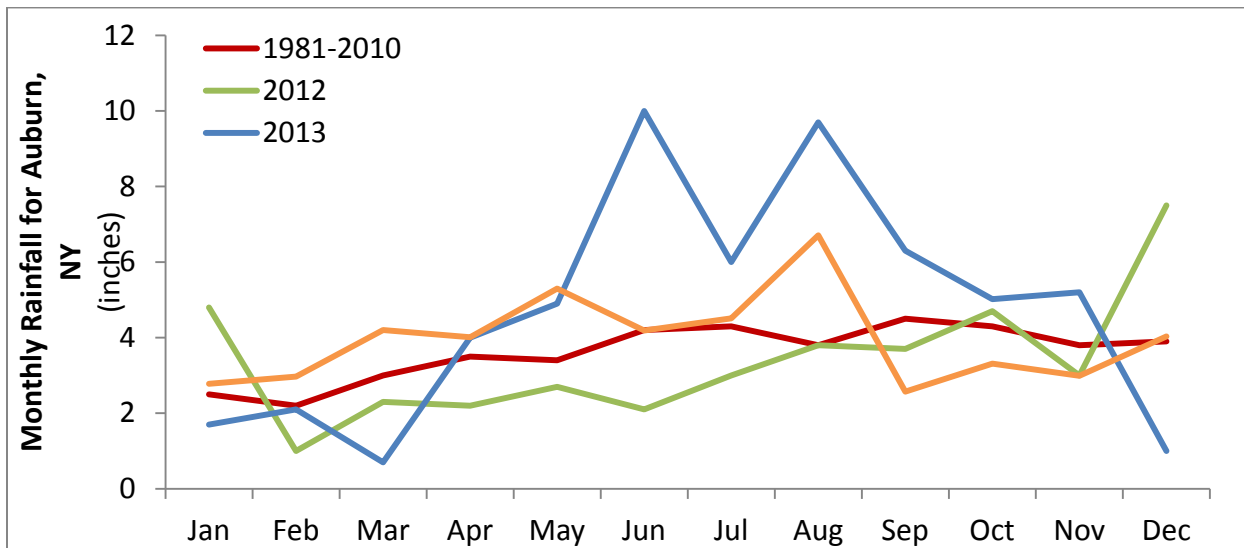


Figure 3: Rainfall from the nearest weather station monitored by the Northeast Regional Climate Center in Auburn, NY.

Summary of Results & Conclusions

The following statistical analysis shows no significant impact on yield or forage quality from the six treatments versus the check.

Sometimes there is a trend that develops in the results that can be missed as a significant result because the data set didn't have enough “power” to tease out a significant outcome. That is not the case with this research. No trends or other interesting but non-significant results were observed that could lead us to narrow the investigation for future experiments other than to look at the variability of yield and the number of treatments and to say generally that more replications would be recommended for any future work.



Cornell University
Cornell Statistical Consulting Unit

**Report for the Statistical Analyses of the data
for the projects of the
Agricultural Consulting Services**

Project: ALF-WIL-CARO

Spring 2015

Project: ALF-WIL-CARO

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Goal

In 2014 growing conditions, on a moderate fertility, 2nd or 3rd year alfalfa field which crop management strategies have a positive return for the investment in terms of yield, quality and estimated milk per acre (combined yield and quality)?

Description of the data

42 plots in 2 sites x 3 blocks x 7 treatments. The seven treatments are: Headline AMP, Quadris, Grizzley, Potash, Potash +B + AMS, Enhanced Y, and Control

The experiment was conducted at 2 sites (WIL, OHA). Within each plot, samples were taken at 2 (WIL) or 3 (OHA) separate cutting times.

Each sample (a cutting of a plot) had one sample submitted for a forage quality analysis (9 measures as indicated below).

Yield	Yield (Dry tons per acre)
CP	%CP (DM)
NDF	%NDF(DM)
Starch	%Starch(DM)
RFV	Relative Feed Value
Ca	%Calcium (DM)
P	%Phosphorus (DM)
Mg	%Magnesium(DM)
K	%Potassium (DM)
S	%Sulfur(DM)
IVTD	IVTD (30hr) (DM)
NDFD	NDFD (30hr) (NDF)

Analysis

Five observations had values of "Control" rather than "control." This was changed and saved into a new variable called "trt."

Cutting values were changed according to email conversation with Patty Ristow (3/10).

OHA 6/27/2014 – 2nd cutting

WIL 7/11/2014 – 2nd cutting

WIL 8/14/2014 – 3rd cutting

OHA 8/20/2014 – 3rd cutting

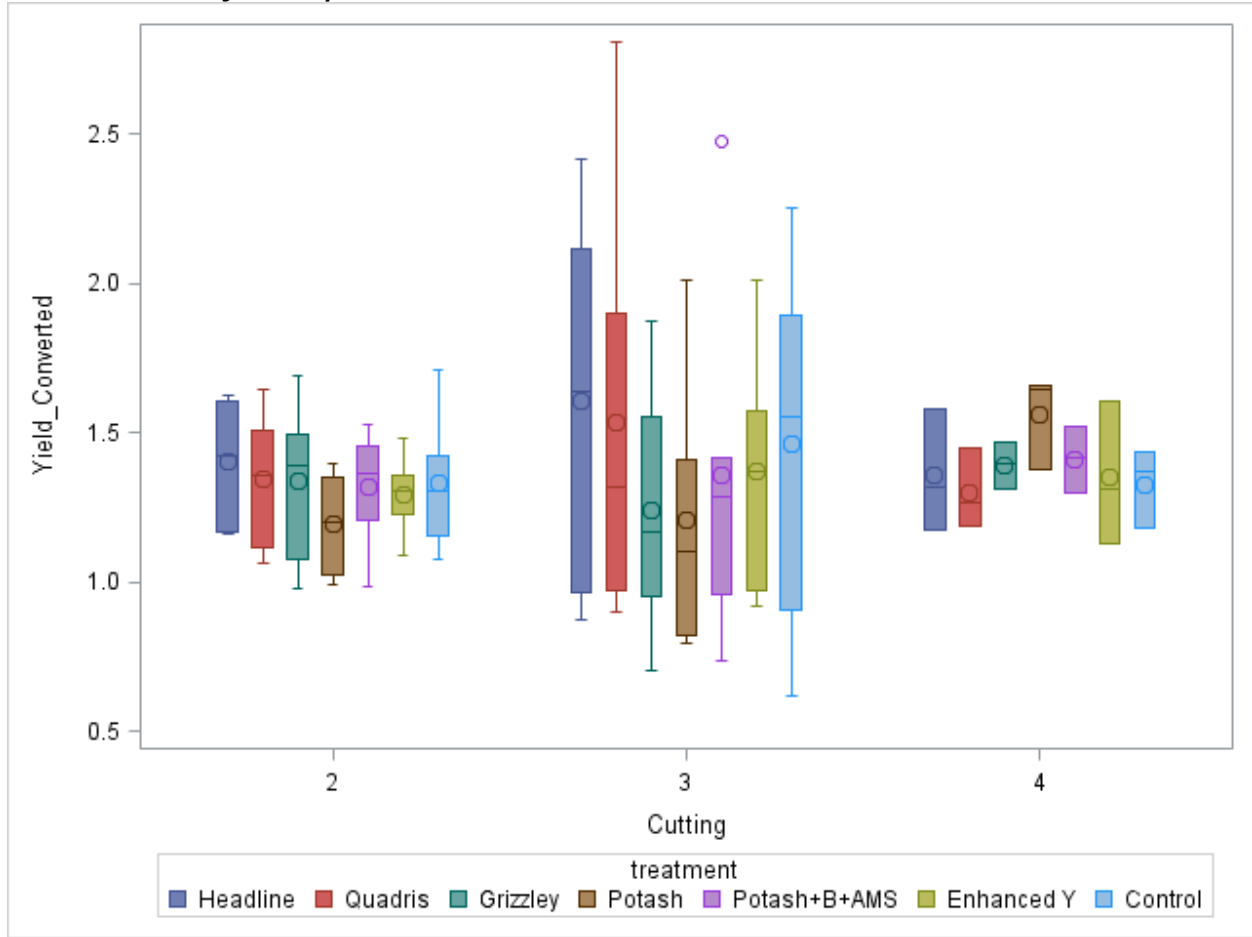
OHA 9/18/2014 – 4th cutting

Ran PROC MIXED in SAS: Fixed effects: trt, cutting, trt x cutting
 Random effects: Site Block(Site) Plot(Block Site);

General conclusions

The treatment *cutting effect was never significant and was removed for all models. This indicates that the effect of treatment was the same for each cutting level. The final additive model did not indicate a treatment effect for any of the response variables.

YIELD - in dry tons/acre



Initial Full Model

```
Model yield_converted=treatment Site treatment*Site;
Random Site Block(Site) Plot(Block Site);
```

Covariance Parameter Estimates	
Cov Parm	Estimate
Site	0.01333
block(Site)	0.02465
Plot(Site*block)	0
Residual	0.1226

Type 3 Tests of Fixed Effects				
Effect	Num DF	Den DF	F Value	Pr > F
Treatment	6	79.2	0.25	0.9574
Cut	2	79.8	0.82	0.4424
Cut*Treatment	12	79.2	0.45	0.9385

Final Model

Model yield_converted=treatment Site;

Random Site Block(Site) Plot(Block Site);

Covariance Parameter Estimates

Cov Parm	Estimate
Site	0.01341
block(Site)	0.02505
Plot(Site*block)	0
Residual	0.1137

Type 3 Tests of Fixed Effects

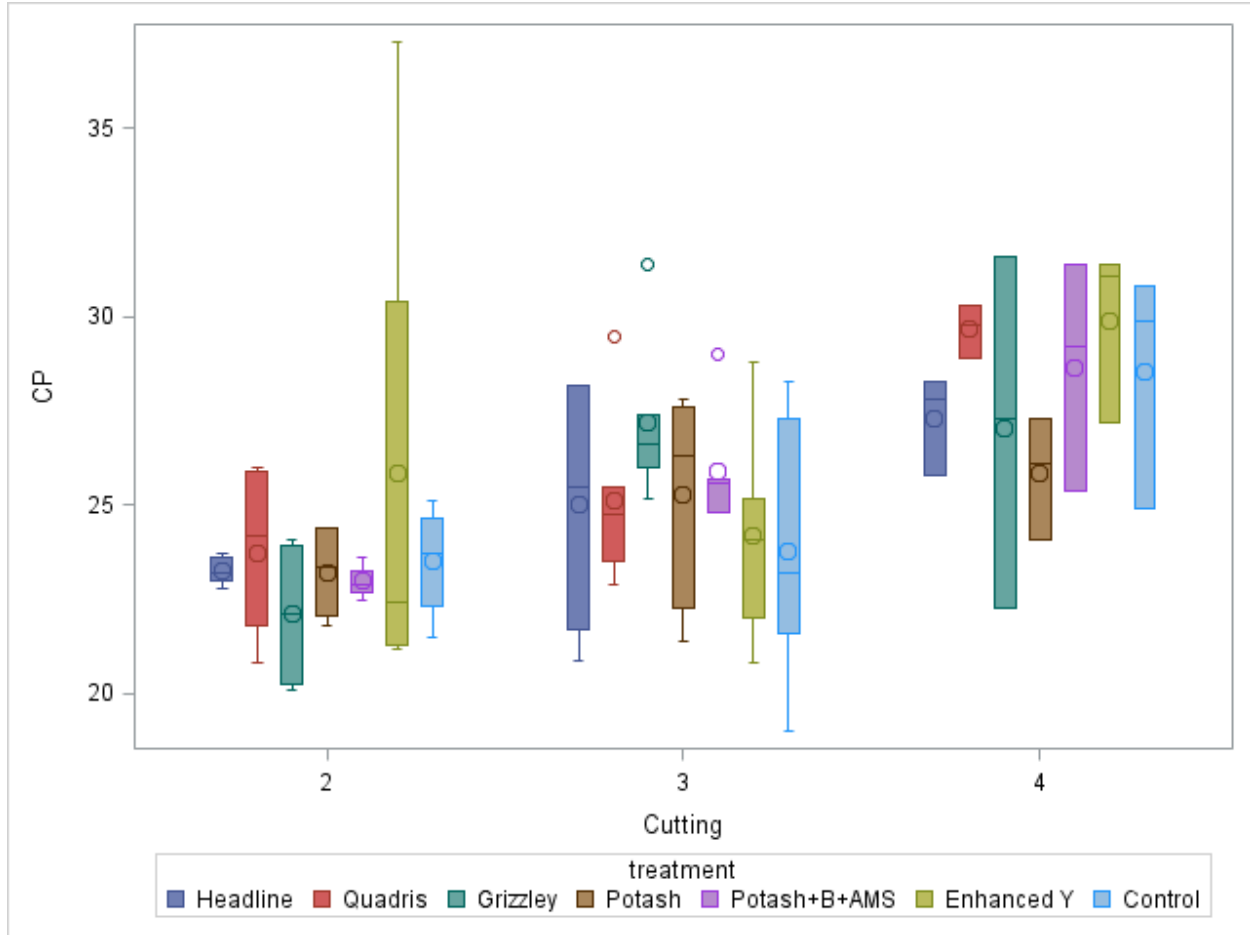
Effect	Num DF	Den DF	F Value	Pr > F
Treatment	6	91.2	0.60	0.7270
Cut	2	91.8	0.90	0.4112

Least Squares Means

Effect	Treatment	Cut	Estimate	Standard Error	DF	t Value	Pr > t
Treatment	Control		1.3542	0.1370	2.33	9.88	0.0060
Treatment	Enhanced Y		1.3066	0.1370	2.33	9.54	0.0065
Treatment	Grizzley		1.2791	0.1370	2.33	9.33	0.0068
Treatment	Headline		1.4467	0.1370	2.33	10.56	0.0051
Treatment	Potash		1.2436	0.1370	2.33	9.08	0.0073
Treatment	Potash+B+AMS		1.3244	0.1370	2.33	9.67	0.0063
Treatment	Quadris		1.3818	0.1370	2.33	10.08	0.0057
Cut		2	1.3166	0.1165	1.23	11.30	0.0339
Cut		3	1.3978	0.1165	1.23	11.99	0.0315
Cut		4	1.2869	0.1345	1.99	9.57	0.0109

Quality Measures

CP



Initial Model

Model CP= treatment Site;

Random Site Block(Site) Plot(Block Site);

Covariance Parameter Estimates	
Cov Parm	Estimate
Site	0
block(Site)	0
Plot(Site*block)	0.01100
Residual	6.9262

Type 3 Tests of Fixed Effects				
Effect	Num DF	Den DF	F Value	Pr > F
Treatment	6	68	0.74	0.6213
Cut	2	70.8	16.90	<.0001
Cut*Treatment	12	67.1	1.18	0.3186

Final Model

Model CP=trt Cutting;

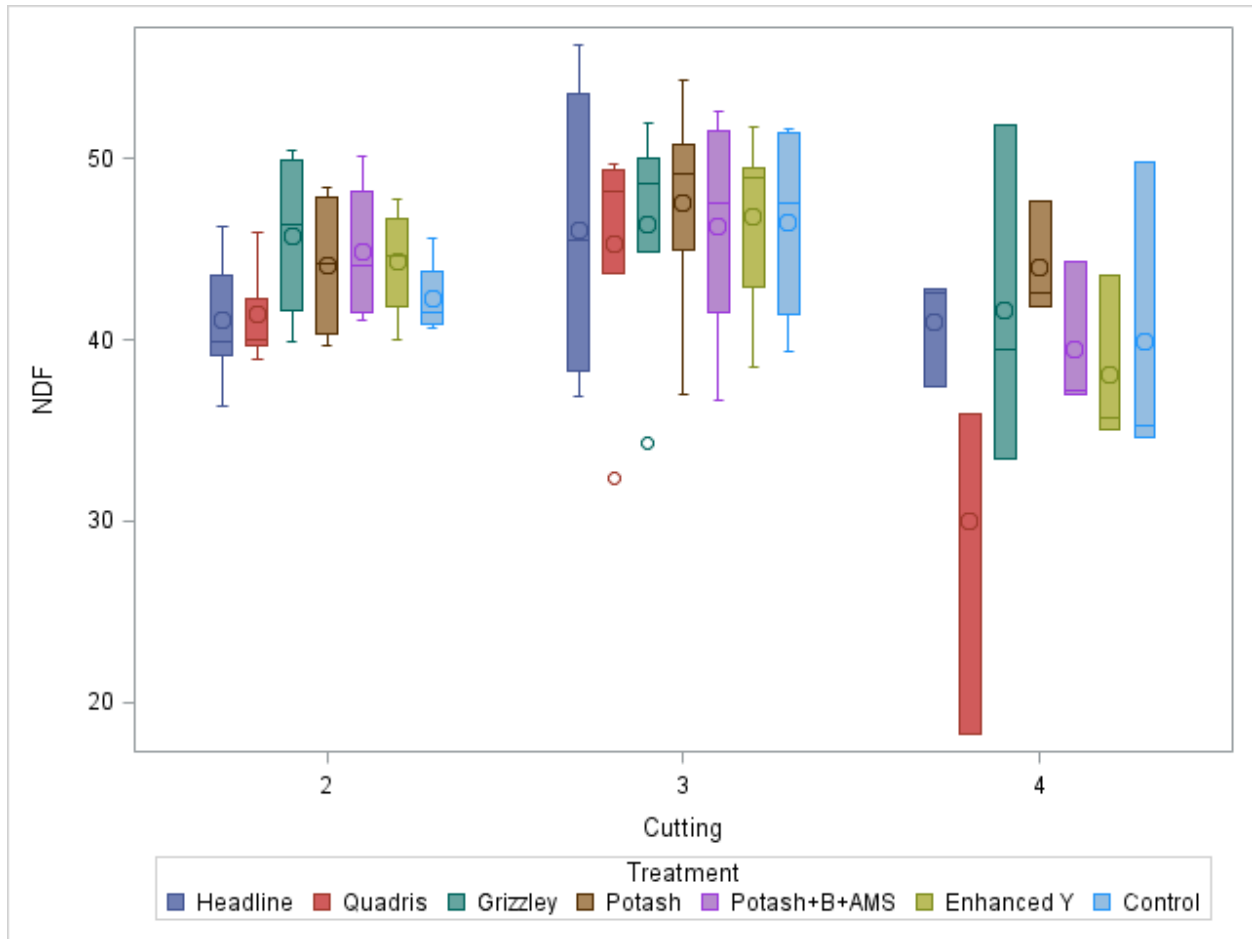
Random Site Block(Site) Plot(Block Site);

Covariance Parameter Estimates	
Cov Parm	Estimate
Site	0
block(Site)	0
Plot(Site*block)	0.01102
Residual	7.1066

Type 3 Tests of Fixed Effects				
Effect	Num DF	Den DF	F Value	Pr > F
Treatment	6	80.2	0.49	0.8117
Cut	2	83.1	16.49	<.0001

Least Squares Means							
Effect	Treatment	Cut	Estimate	Standard Error	DF	t Value	Pr > t
Treatment	Control		25.2788	0.8708	47.6	29.03	<.0001
Treatment	Enhanced Y		26.4902	0.8470	57.5	31.28	<.0001
Treatment	Grizzley		26.1862	0.8534	64.6	30.68	<.0001
Treatment	Headline		25.5612	0.8039	78.4	31.80	<.0001
Treatment	Potash		25.2578	0.8182	72.8	30.87	<.0001
Treatment	Potash+B+AMS		26.0730	0.8141	71.9	32.03	<.0001
Treatment	Quadris		26.3718	0.8330	67.1	31.66	<.0001
Cut		2	23.9017	0.6081	34.8	39.31	<.0001
Cut		3	25.2382	0.5786	25.7	43.62	<.0001
Cut		4	28.5254	0.7463	47.4	38.22	<.0001

NDF



Initial Full Model

```
Model NDF=trt Cutting trt*Cutting;
Random Site Block(Site) Plot(Block Site);
```

Covariance Parameter Estimates	
Cov Parm	Estimate
Site	1.2030
block(Site)	0.6390
Plot(Site*block)	0.004288
Residual	30.9403

Effect	Num DF	Den DF	F Value	Pr > F
Treatment	6	66.8	1.74	0.1258
Cut	2	65.6	9.99	0.0002
Cut*Treatment	12	67	0.67	0.7778

Type 3 Tests of Fixed Effects

Final Model

Model NDF=trt Cutting;

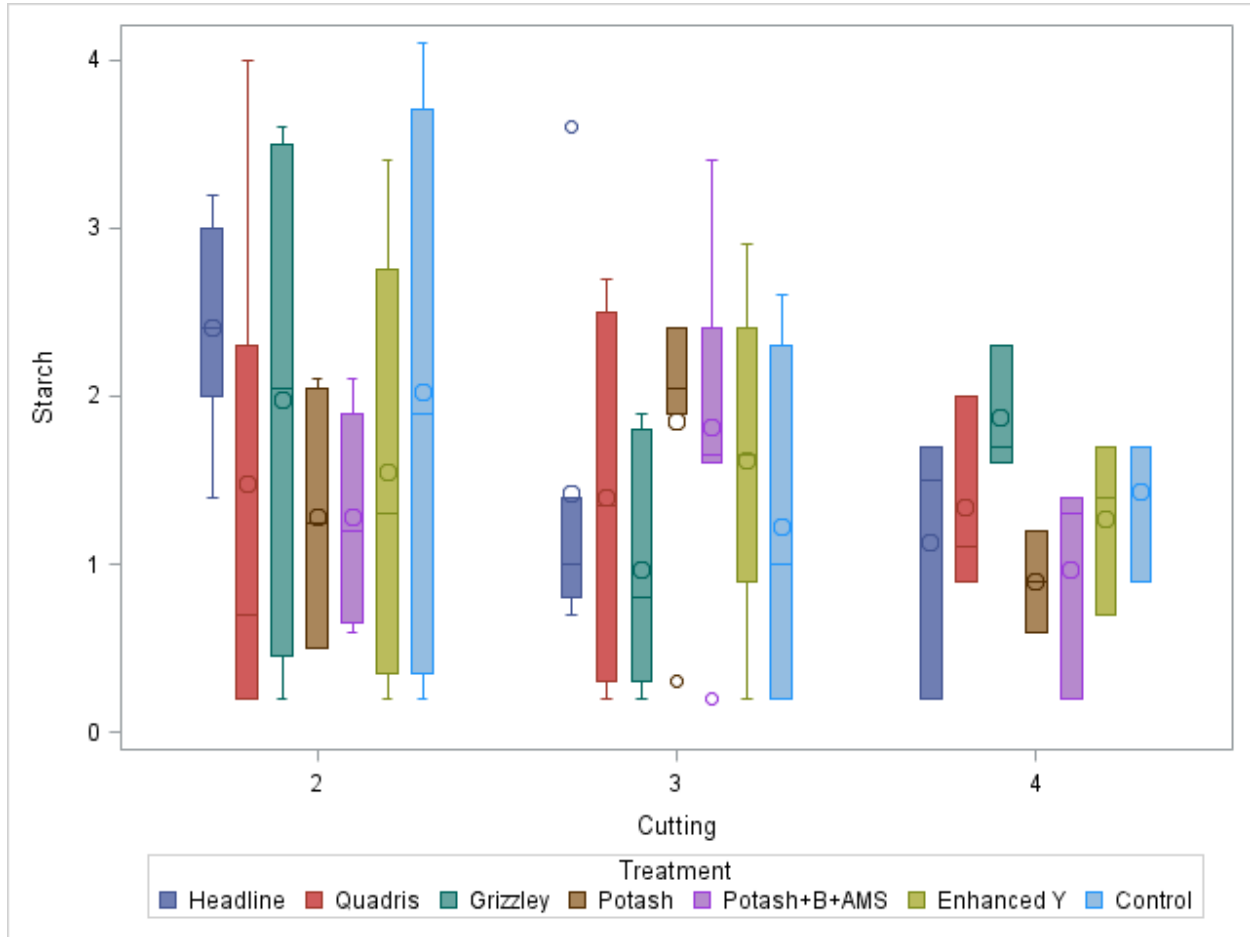
Random Site Block(Site) Plot(Block Site);

Covariance Parameter Estimates	
Cov Parm	Estimate
Site	1.3280
block(Site)	0.8933
Plot(Site*block)	0.002524
Residual	29.4023

Type 3 Tests of Fixed Effects				
Effect	Num DF	Den DF	F Value	Pr > F
Treatment	6	78.6	1.27	0.2806
Cut	2	76.7	10.75	<.0001

Least Squares Means							
Effect	Treatment	Cut	Estimate	Standard Error	DF	t Value	Pr > t
Treatment	Control		42.5681	1.9742	5.26	21.56	<.0001
Treatment	Enhanced Y		42.8833	1.9475	5.04	22.02	<.0001
Treatment	Grizzley		43.9551	1.9958	5.23	22.02	<.0001
Treatment	Headline		41.9309	2.0394	4.67	20.56	<.0001
Treatment	Potash		44.5887	1.9273	4.81	23.14	<.0001
Treatment	Potash+B+AMS		43.1496	1.9295	4.75	22.36	<.0001
Treatment	Quadris		39.3655	2.0230	4.86	19.46	<.0001
Cut		2	43.3037	1.5635	1.7	27.70	0.0029
Cut		3	46.3336	1.5023	1.32	30.84	0.0074
Cut		4	38.2660	2.0054	2.85	19.08	0.0004

Starch



Initial Full Model

```
Model Starch= trt Cutting trt*Cutting;
Random Site Block(Site) Plot(Block Site);
```

Covariance Parameter Estimates	
Cov Parm	Estimate
Site	0.9619
block(Site)	0
Plot(Site*block)	0.000205
Residual	0.6230

Type 3 Tests of Fixed Effects				
Effect	Num DF	Den DF	F Value	Pr > F
Treatment	6	65	0.33	0.9199
Cut	2	68.7	2.31	0.1072
Cut*Treatment	12	63.6	1.38	0.2002

Final Model

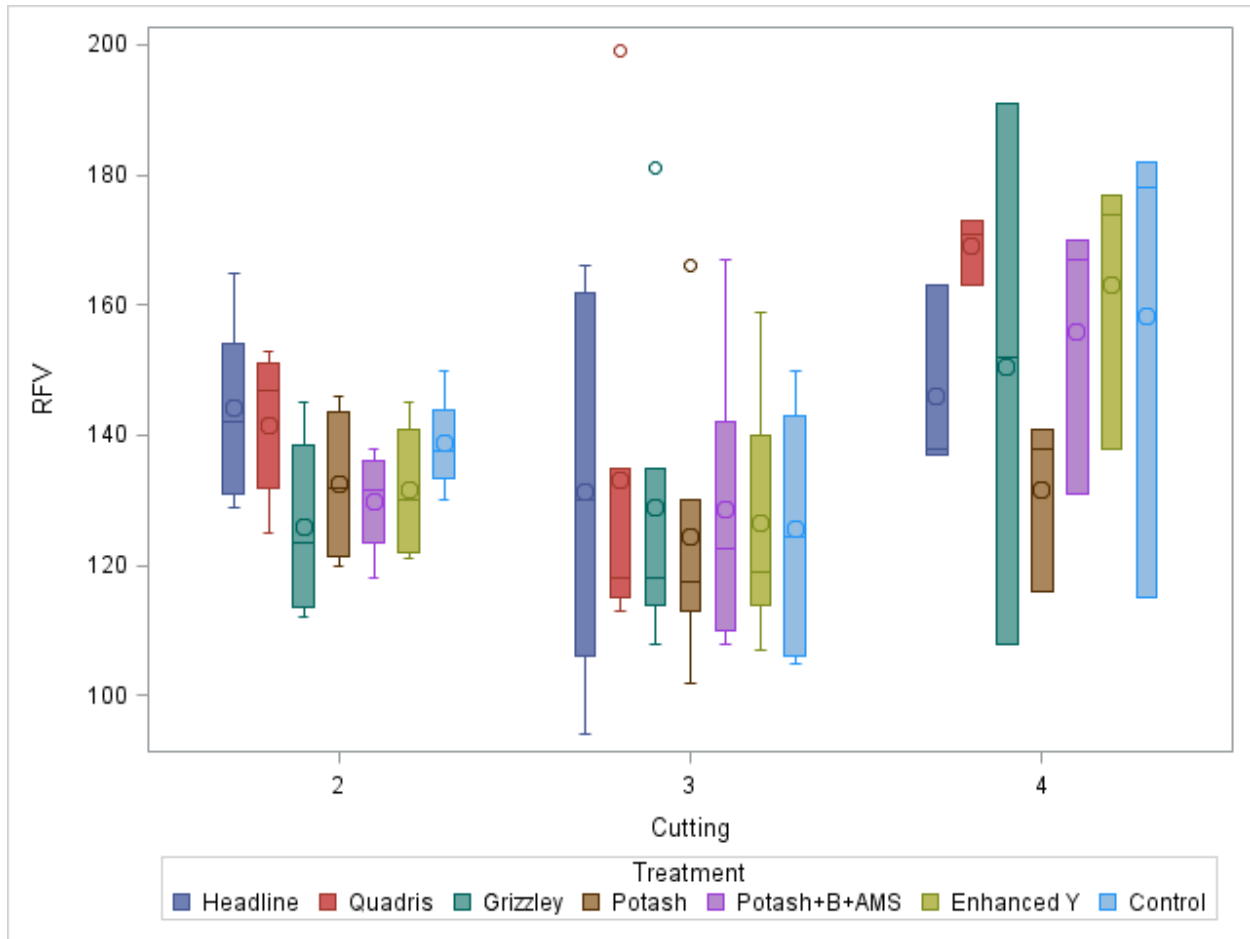
```
Model Starch= trt Cutting;
Random Site Block(Site) Plot(Block Site);
```

Covariance Parameter Estimates	
Cov Parm	Estimate
Site	0.9701
block(Site)	9.17E-18
Plot(Site*block)	0.000161
Residual	0.6606

Type 3 Tests of Fixed Effects				
Effect	Num DF	Den DF	F Value	Pr > F
Treatment	6	78.1	0.22	0.9700
Cut	2	81.2	2.22	0.1156

Least Squares Means							
Effect	Treatment	Cut	Estimate	Standard Error	DF	t Value	Pr > t
Treatment	Control		1.7336	0.7386	1.18	2.35	0.2249
Treatment	Enhanced Y		1.7329	0.7376	1.18	2.35	0.2252
Treatment	Grizzley		1.6976	0.7398	1.18	2.29	0.2304
Treatment	Headline		1.9551	0.7386	1.16	2.65	0.2009
Treatment	Potash		1.6699	0.7368	1.17	2.27	0.2342
Treatment	Potash+B+AMS		1.6730	0.7362	1.17	2.27	0.2337
Treatment	Quadris		1.6590	0.7395	1.17	2.24	0.2377
Cut		2	1.7490	0.7165	1.05	2.44	0.2386
Cut		3	1.4799	0.7152	1.02	2.07	0.2819
Cut		4	1.9658	0.7325	1.13	2.68	0.2040

RFV



Initial Full Model:

```
Model RFV = trt Cutting trt*Cutting;
Random Site Block(Site) Plot(Block Site);
```

Covariance Parameter Estimates	
Cov Parm	Estimate
Site	45.9183
block(Site)	6.5588
Plot(Site*block)	0.2713
Residual	412.21

Type 3 Tests of Fixed Effects				
Effect	Num DF	Den DF	F Value	Pr > F
Treatment	6	67.1	1.11	0.3635
Cut	2	69.2	12.57	<.0001
Cut*Treatment	12	66.9	0.52	0.8937

Final Model

```
Model RFV = trt Cutting;
Random PlotID;
```

Covariance Parameter Estimates	
Cov Parm	Estimate

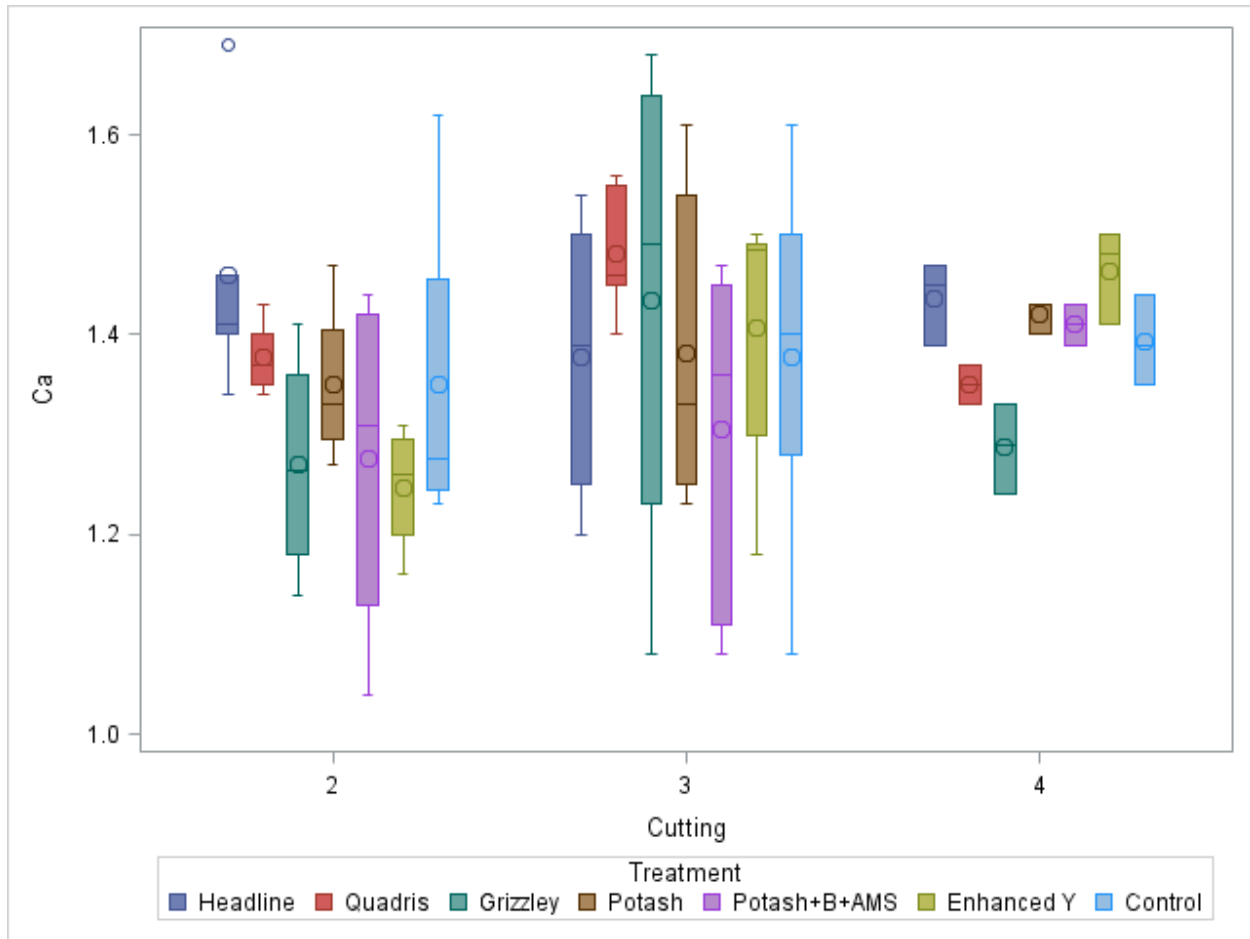
Cov Parm	Estimate
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Covariance Parameter Estimates	
Cov Parm	Estimate
Site	48.6403
block(Site)	8.7451
Plot(Site*block)	0.2508
Residual	382.81

Type 3 Tests of Fixed Effects				
Effect	Num DF	Den DF	F Value	Pr > F
Treatment	6	79.1	0.97	0.4503
Cut	2	81.3	13.67	<.0001

Least Squares Means							
Effect	Treatment	Cut	Estimate	Standard Error	DF	t Value	Pr > t
Treatment	Control		143.49	8.7063	2.82	16.48	0.0007
Treatment	Enhanced Y		142.54	8.5305	2.71	16.71	0.0008
Treatment	Grizzley		139.62	8.9960	2.75	15.52	0.0009
Treatment	Headline		146.66	8.7043	2.46	16.85	0.0013
Treatment	Potash		134.56	8.3912	2.58	16.04	0.0012
Treatment	Potash+B+AMS		141.18	8.2581	2.56	17.10	0.0010
Treatment	Quadris		151.56	8.9680	2.59	16.90	0.0010
Cut		2	137.00	7.5215	1.32	18.21	0.0153
Cut		3	130.06	7.3431	1.17	17.71	0.0230
Cut		4	161.34	8.4536	2	19.09	0.0027

Ca



Initial Full Model

```
Model Ca = trt Cutting trt*Cutting;
Random Site Block(Site) Plot(Block Site);
```

Covariance Parameter Estimates	
Cov Parm	Estimate
Site	0
block(Site)	0
Plot(Site*block)	2.895E-7
Residual	0.01839

Type 3 Tests of Fixed Effects				
Effect	Num DF	Den DF	F Value	Pr > F
Treatment	6	67.6	0.79	0.5825
Cut	2	62.7	1.75	0.1821
Cut*Treatment	12	66.6	0.96	0.4922

Final Model

```
Model Ca = trt Cutting;
Random Site Block(Site) Plot(Block Site);
```

Covariance Parameter Estimates	
Cov Parm	Estimate

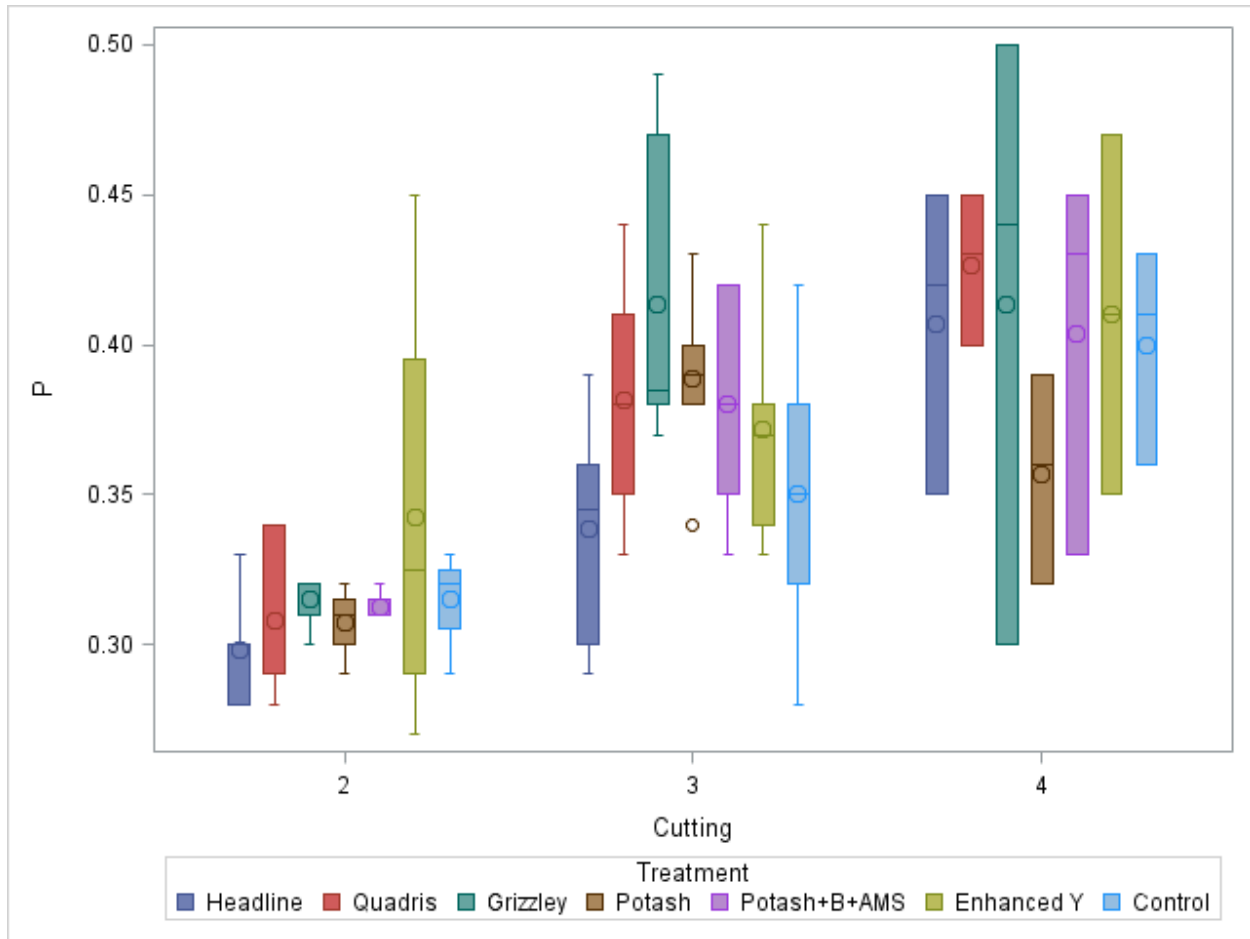
Cov Parm	Estimate
----------	----------

Covariance Parameter Estimates	
Cov Parm	Estimate
Site	0
block(Site)	0
Plot(Site*block)	9.679E-7
Residual	0.01823

Type 3 Tests of Fixed Effects				
Effect	Num DF	Den DF	F Value	Pr > F
Treatment	6	80.3	0.93	0.4787
Cut	2	75.1	1.70	0.1901

Least Squares Means							
Effect	Treatment	Cut	Estimate	Standard Error	DF	t Value	Pr > t
Treatment	Control		1.3716	0.03942	67.5	34.79	<.0001
Treatment	Enhanced Y		1.3693	0.03913	74.6	34.99	<.0001
Treatment	Grizzley		1.3488	0.03968	68.4	33.99	<.0001
Treatment	Headline		1.4211	0.04004	64.1	35.49	<.0001
Treatment	Potash		1.3793	0.03890	80.5	35.46	<.0001
Treatment	Potash+B+AMS		1.3184	0.03884	81.6	33.94	<.0001
Treatment	Quadris		1.4170	0.03991	56.3	35.50	<.0001
Cut		2	1.3360	0.02612	48.6	51.14	<.0001
Cut		3	1.3963	0.02422	17.6	57.65	<.0001
Cut		4	1.3929	0.03653	21.3	38.13	<.0001

P



Initial Full Model

```
Model P = trt Cutting trt*Cutting;
Random Site Block(Site) Plot(Block Site);
```

Covariance Parameter Estimates	
Cov Parm	Estimate
Site	0
block(Site)	0.000286
Plot(Site*block)	0
Residual	0.001512

Type 3 Tests of Fixed Effects				
Effect	Num DF	Den DF	F Value	Pr > F
Treatment	6	67.7	1.30	0.2710
Cut	2	71.4	32.58	<.0001
Cut*Treatment	12	67.7	1.11	0.3651

Final Model

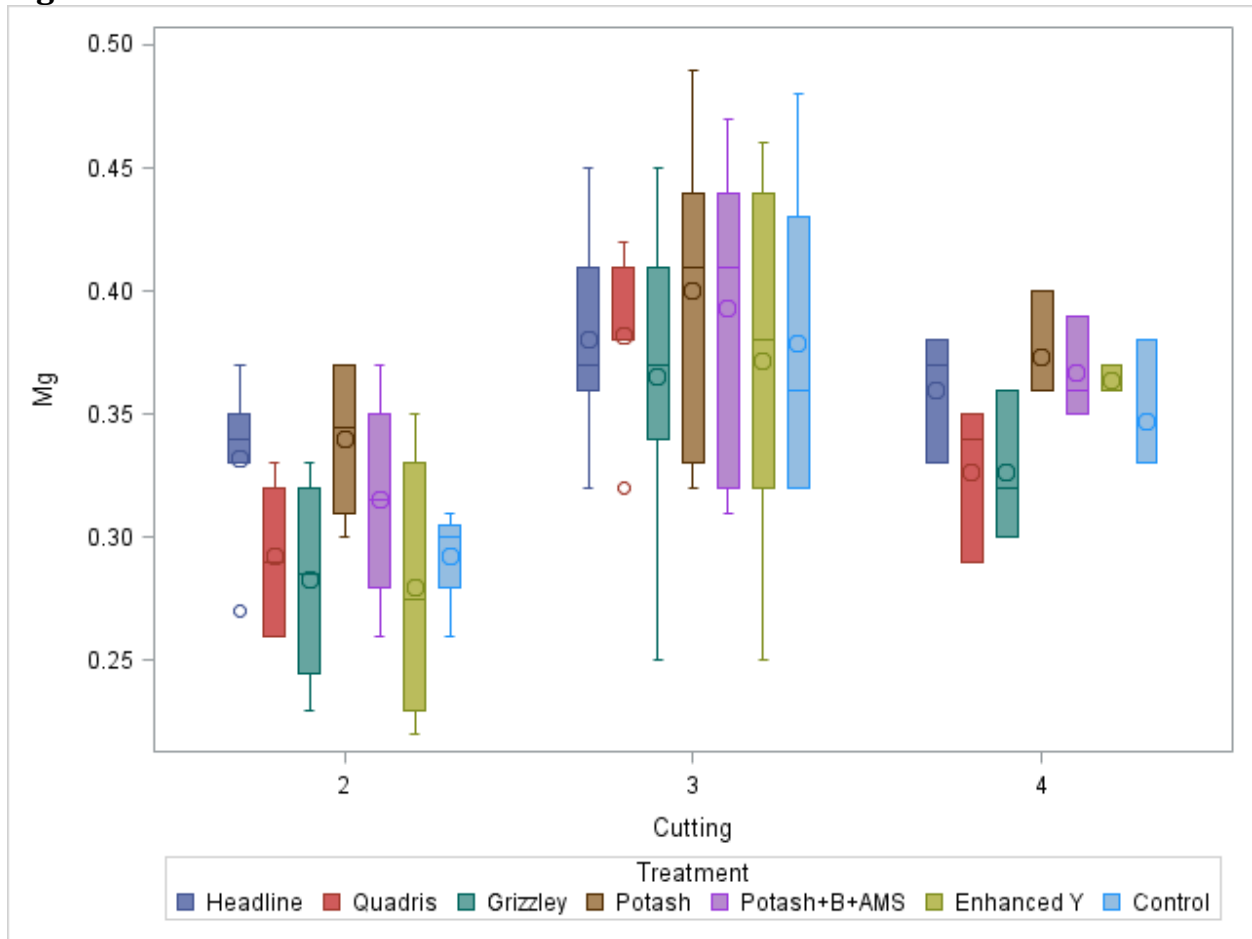
```
Model Ca = trt Cutting;
Random Site Block(Site) Plot(Block Site);
```

Covariance Parameter Estimates	
Cov Parm	Estimate
Site	0
block(Site)	0.000287
Plot(Site*block)	0
Residual	0.001538

Type 3 Tests of Fixed Effects				
Effect	Num DF	Den DF	F Value	Pr > F
Treatment	6	79.8	1.60	0.1589
Cut	2	83.7	32.49	<.0001

Least Squares Means							
Effect	Treatment	Cut	Estimate	Standard Error	DF	t Value	Pr > t
Treatment	Control		0.3494	0.01308	30	26.71	<.0001
Treatment	Enhanced Y		0.3702	0.01308	30	28.29	<.0001
Treatment	Grizzley		0.3817	0.01308	30	29.18	<.0001
Treatment	Headline		0.3422	0.01277	27.7	26.79	<.0001
Treatment	Potash		0.3548	0.01308	30	27.12	<.0001
Treatment	Potash+B+AMS		0.3633	0.01308	30	27.77	<.0001
Treatment	Quadris		0.3686	0.01277	27.7	28.86	<.0001
Cut		2	0.3107	0.01035	12.6	30.02	<.0001
Cut		3	0.3748	0.009189	9.07	40.78	<.0001
Cut		4	0.3989	0.01188	18.3	33.58	<.0001

Mg



Initial Full Model

```
Model Mg = trt Cutting trt*Cutting;
Random Site Block(Site) Plot(Block Site);
```

Covariance Parameter Estimates	
Cov Parm	Estimate
Site	0
block(Site)	0
Plot(Site*block)	3.199E-6
Residual	0.002181

Type 3 Tests of Fixed Effects				
Effect	Num DF	Den DF	F Value	Pr > F
Treatment	6	68.4	1.49	0.1949
Cut	2	71	15.56	<.0001
Cut*Treatment	12	67.6	0.25	0.9945

Final Model

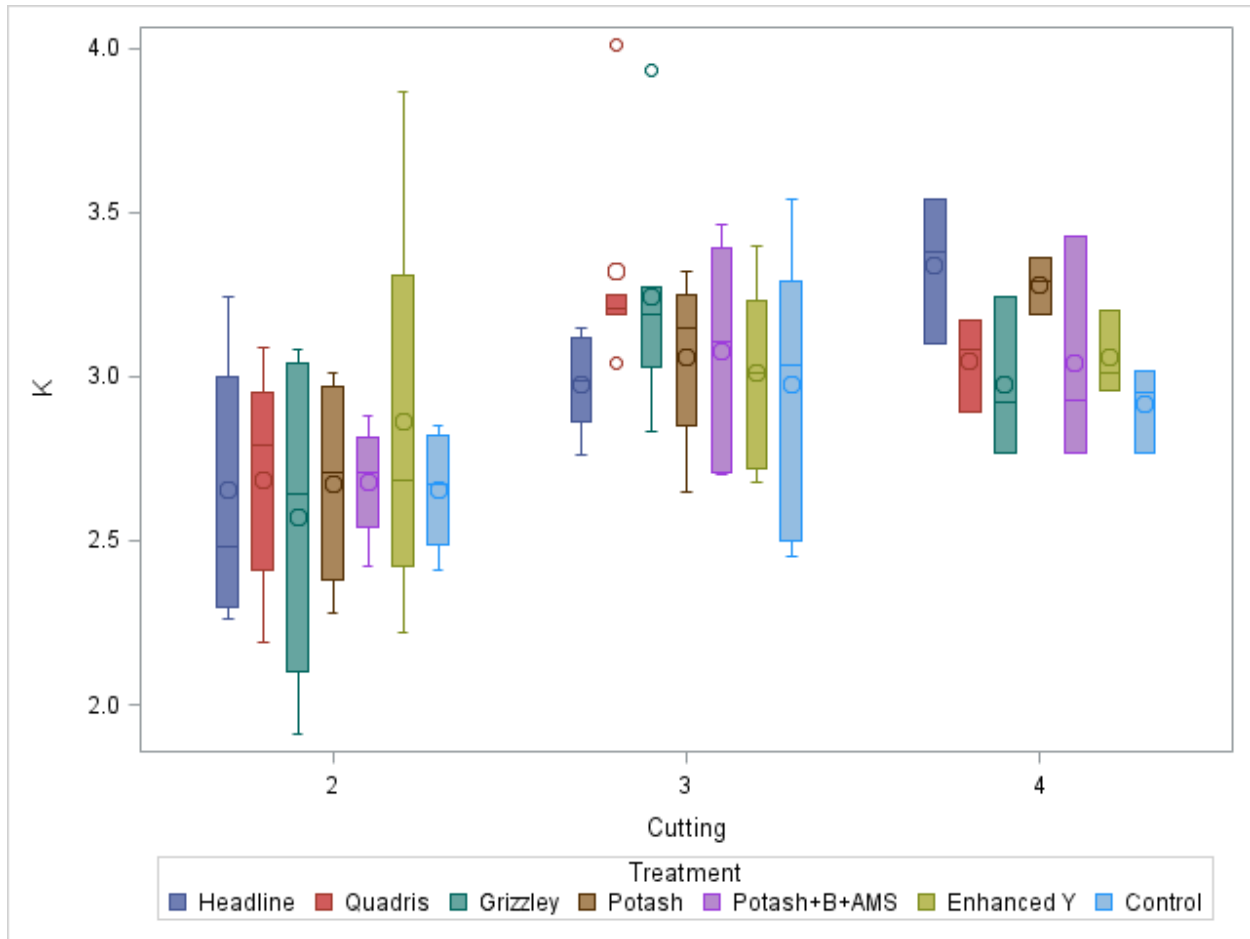
```
Model Mg = trt Cutting;
Random Site Block(Site) Plot(Block Site);
```

Covariance Parameter Estimates	
Cov Parm	Estimate
Site	0
block(Site)	0
Plot(Site*block)	3.395E-6
Residual	0.001932

Type 3 Tests of Fixed Effects				
Effect	Num DF	Den DF	F Value	Pr > F
Treatment	6	80.6	1.68	0.1367
Cut	2	83	17.12	<.0001

Least Squares Means							
Effect	Treatment	Cut	Estimate	Standard Error	DF	t Value	Pr > t
Treatment	Control		0.3365	0.01449	48.3	23.21	<.0001
Treatment	Enhanced Y		0.3338	0.01407	57.9	23.72	<.0001
Treatment	Grizzley		0.3228	0.01414	65.5	22.83	<.0001
Treatment	Headline		0.3510	0.01328	78.9	26.43	<.0001
Treatment	Potash		0.3680	0.01356	72.9	27.15	<.0001
Treatment	Potash+B+AMS		0.3552	0.01350	71.8	26.31	<.0001
Treatment	Quadris		0.3312	0.01379	68.2	24.03	<.0001
Cut		2	0.3069	0.01014	36.1	30.27	<.0001
Cut		3	0.3714	0.009639	27.7	38.53	<.0001
Cut		4	0.3497	0.01237	49.6	28.27	<.0001

K



Initial Full Model

```
Model K = trt Cutting trt*Cutting;
Random Site Block(Site) Plot(Block Site);
```

Covariance Parameter Estimates	
Cov Parm	Estimate
Site	0.07317
block(Site)	0
Plot(Site*block)	0.000083
Residual	0.08771

Type 3 Tests of Fixed Effects				
Effect	Num DF	Den DF	F Value	Pr > F
Treatment	6	67.4	0.45	0.8419
Cut	2	69	13.49	<.0001
Cut*Treatment	12	66.6	0.98	0.4730

Final Model

```
Model K = trt Cutting;
Random Site Block(Site) Plot(Block Site);
```

Covariance Parameter Estimates				
Cov Parm	Estimate			
Site	0.07473			
block(Site)	0			
Plot(Site*block)	0.000085			
Residual	0.08742			
Type 3 Tests of Fixed Effects				
Effect	Num DF	Den DF	F Value	Pr > F
Treatment	6	79.6	0.49	0.8153
Cut	2	81.2	13.96	<.0001

Least Squares Means							
Effect	Treatment	Cut	Estimate	Standard Error	DF	t Value	Pr > t
Treatment	Control		2.7980	0.2147	1.31	13.03	0.0242
Treatment	Enhanced Y		2.9117	0.2139	1.29	13.61	0.0236
Treatment	Grizzley		2.9118	0.2144	1.3	13.58	0.0234
Treatment	Headline		2.8898	0.2126	1.26	13.59	0.0255
Treatment	Potash		2.9286	0.2130	1.28	13.75	0.0242
Treatment	Potash+B+AMS		2.8815	0.2127	1.27	13.54	0.0248
Treatment	Quadris		2.9863	0.2136	1.28	13.98	0.0237
Cut		2	2.6835	0.2037	1.07	13.17	0.0413
Cut		3	3.0762	0.2027	1.03	15.18	0.0384
Cut		4	2.9436	0.2106	1.2	13.98	0.0281