reg_AIC_multInteraction

May 16, 2024

[1]:
```
# Kristina Fauss
# April 19, 2024
# model selection by AIC testing all 1st order interactions

import warnings
warnings.filterwarnings("ignore")

import pandas as pd
import statsmodels.formula.api as smf
from statsmodels.stats.outliers_influence import variance_inflation_factor

from ols_mixedef_custom import *
```

[2]:
```
fp = '/Users/kristinafauss/BackupToBox/Git/lab-flammability-testing-2022/data/
 ↪processed-data/main_dataset.csv'

flamog = pd.read_csv(fp)

# drop na's for flam metrics
print(len(flamog))
for col in ['fh', 'fd', 'pfg', 'temp_change', 'heat_flux_change']:
    flamog.dropna(subset=col, inplace=True)
print(len(flamog))

flamog['plant_id']=[str(a)+'_'+str(b) for a,b in zip(flamog['plant'],␣
 ↪flamog['species'])]

# drop hetarb - only 2 data points
flamog = flamog[flamog.species!='HETARB']
# report
print(flamog.columns)
flamog.head()
```

```
172
171
Index(['Unnamed: 0', 'species', 'plant', 'date', 'total_branch_mass',
       'total_leaf_mass', 'stem_mass_ratio', 'leaf_mass_ratio', 'leaf_lfm',
       'thickness', 'leaf_wet_mass', 'leaf_dry_mass', 'stem_lfm', 'stem_width',
```

```
       'stem_wet_mass', 'stem_dry_mass', 'stem_sav', 'lfm', 'leaf_dmc',
       'stem_dmc', 'dmc', 'leaf_area', 'leaf_sav', 'LMA', 'SLA', 'rep',
       'branch_length', 'branch_width', 'branch_height', 'sample_wt',
       'no_branches', 'mpa', 'notes_on_plant_char', 'start_time',
       'ambient_temp', 'ambient_humidity', 'pre_ignition_glow',
       'first_glow_time', 'ignition', 'primary_ignition',
       'primary_time_of_flame_end', 'secondary_ignition',
       'secondary_time_of_flame_end', 'third_ignition',
       'third_time_of_ignition_flame_end', 'time_fh', 'fh', 'time_of_glow_end',
       'end_time', 'thermocoupler_height', 'hotplate_height',
       'notes_on_flam_data', 'fd', 'tti', 'pfg', 'max_temp',
       'time_at_max_temp', 'max_temp_sensor', 'start_temp',
       'start_temp_sensor', 'stable_avg_temp', 'temp_change', 'avg_temp_ch3',
       'max_heat_flux_loessCH7', 'time_at_max_heat_flux_loessCH7',
       'max_heat_flux_loessCH8', 'time_at_max_heat_flux_loessCH8',
       'avg_heat_flux_stableCH7', 'avg_heat_flux_stableCH8',
       'heat_flux_change', 'prop_ig', 'wet_mass', 'dry_mass', 'gdw_gfw',
       'dw_flam_sample', 'ww_flam_sample', 'branch_volume', 'branching',
       'sample_density', 'dw_sppdev', 'plant_id'],
      dtype='object')
```

[2]:

	Unnamed: 0	species	plant	date	total_branch_mass	total_leaf_mass	\
0	1	ARCDEN	1	2022-08-10	20.347	19.505	
1	2	ARCDEN	1	2022-08-10	20.347	19.505	
2	3	ARCDEN	1	2022-08-10	20.347	19.505	
3	4	ARCDEN	1	2022-08-10	20.347	19.505	
4	5	ARCDEN	1	2022-08-10	20.347	19.505	

	stem_mass_ratio	leaf_mass_ratio	leaf_lfm	thickness	…	wet_mass	\
0	0.510564	0.489436	251.06912	0.514	…	1.151	
1	0.510564	0.489436	251.06912	0.514	…	1.151	
2	0.510564	0.489436	251.06912	0.514	…	1.151	
3	0.510564	0.489436	251.06912	0.514	…	1.151	
4	0.510564	0.489436	251.06912	0.514	…	1.151	

	dry_mass	gdw_gfw	dw_flam_sample	ww_flam_sample	branch_volume	\
0	0.3683	0.242414	1.291195	4.035205	1082.04	
1	0.3683	0.242414	1.429372	4.467028	1370.20	
2	0.3683	0.242414	1.283923	4.012477	682.04	
3	0.3683	0.242414	1.283923	4.012477	1262.25	
4	0.3683	0.242414	0.811215	2.535185	819.00	

	branching	sample_density	dw_sppdev	plant_id
0	0.416667	0.004923	0.923122	1_ARCDEN
1	0.322581	0.004303	1.348152	1_ARCDEN
2	0.294118	0.007766	0.900752	1_ARCDEN
3	0.466667	0.004196	0.900752	1_ARCDEN

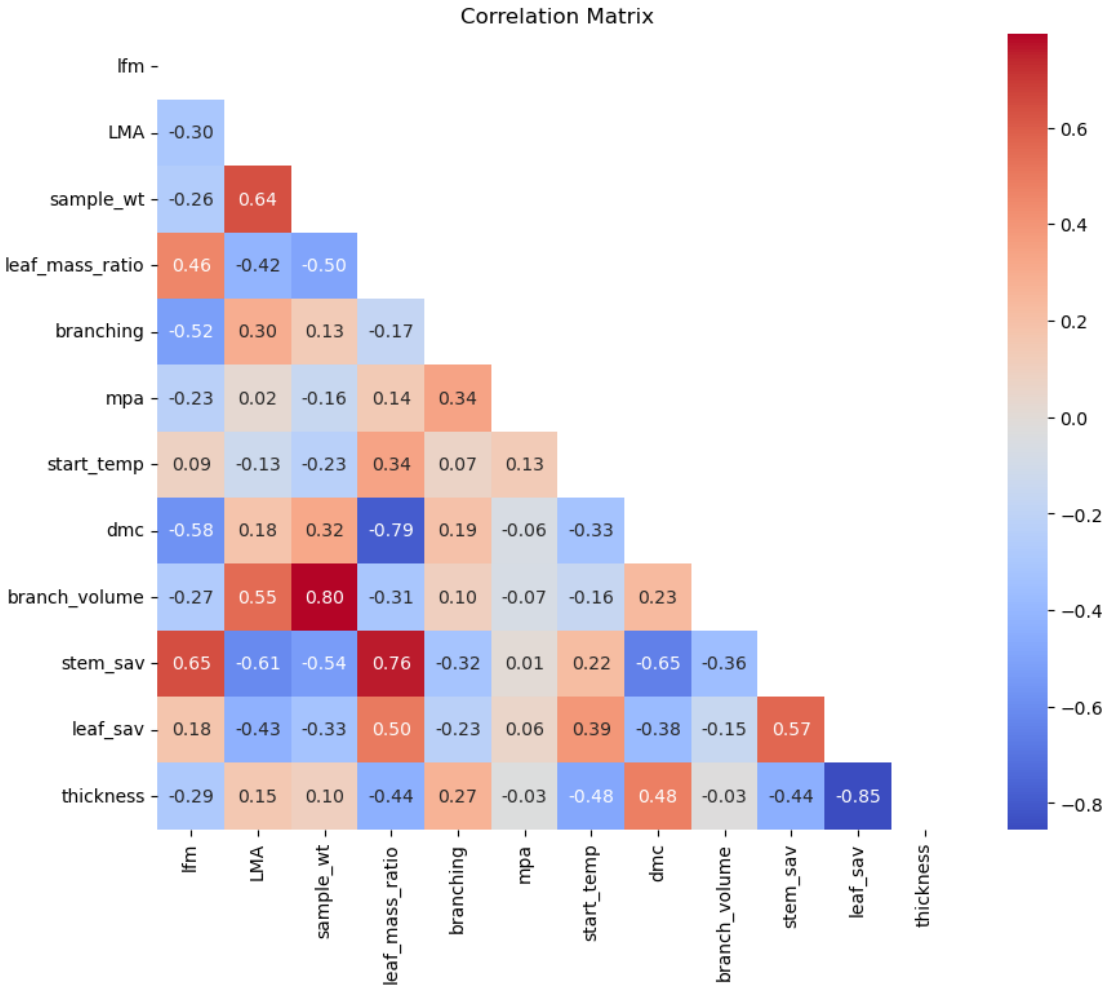
```
4   0.500000        0.004086  -0.553297  1_ARCDEN

[5 rows x 81 columns]
```

[3]:
```
flamog.species.value_counts()
```

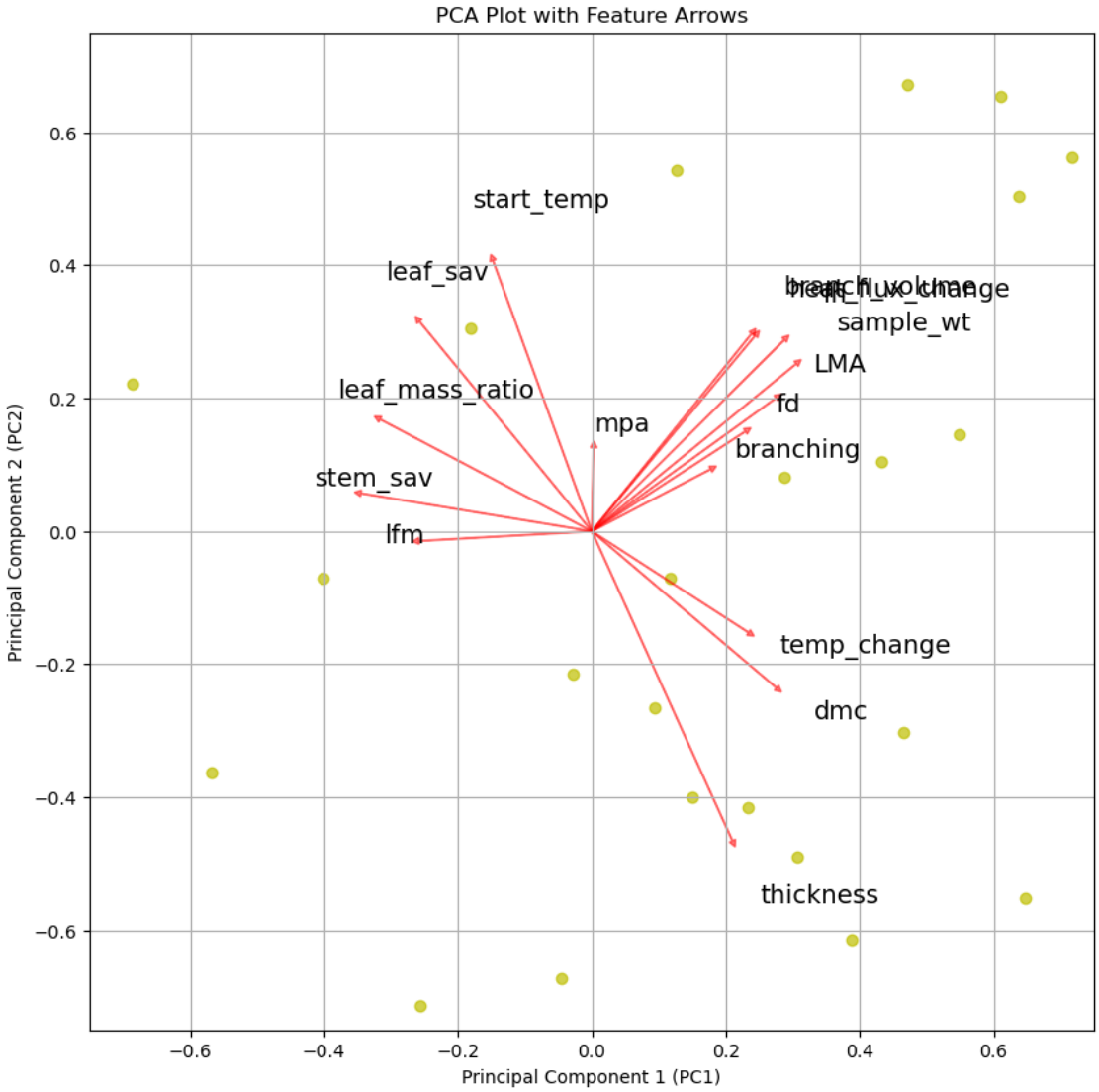
[3]:
```
species
ERIKAR    37
SALLEU    36
CEAGRI    29
SALAPI    22
MALLAU    20
ARTCAL    13
ARCDEN     8
Name: count, dtype: int64
```

1 Examine Correlation & Structure in Num. Var's

[4]:
```
cols_num_use = ['lfm', 'LMA', 'sample_wt', 'leaf_mass_ratio', 'branching',␣
 ↪'mpa', 'start_temp', 'dmc', 'branch_volume', 'stem_sav', 'leaf_sav',␣
 ↪'thickness']

corrplot(flamog, cols_num_use)
```



[5]:
```
PCAplot(flamog, cols_num_use+['fh','fd','temp_change','heat_flux_change'])
```



2 Modeling Preprocessing

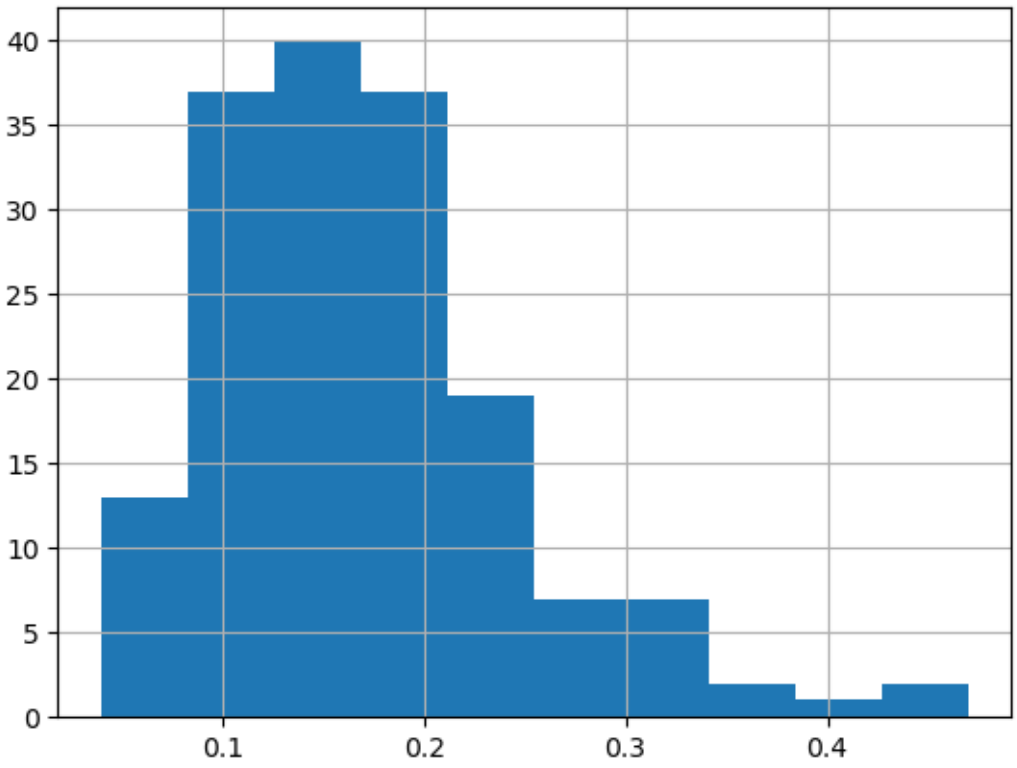
[6]:
```
# scale and center
cols_all = ['fh', 'fd', 'temp_change', 'heat_flux_change'] + cols_num_use
flam = scale_and_center(flamog, cols_all, cols_no_change=['plant_id',␣
 ↪'species', 'ignition'])

# declare as factors
flam['species'] = pd.Categorical(flam['species'])
flam['plant_id'] = pd.Categorical(flam['plant_id'])
flam['ignition'] = pd.Categorical(flam['ignition'])
```

```
# drop na's
print(len(flam))
cols_all_dpna = cols_all + ['plant_id', 'species', 'ignition']
flam.dropna(subset=cols_all_dpna, inplace=True)
print(len(flam))

# declare all possible IV cols to model
cols_use = cols_num_use #+ ['species']
print(cols_use)
```

```
165
158
['lfm', 'LMA', 'sample_wt', 'leaf_mass_ratio', 'branching', 'mpa', 'start_temp',
'dmc', 'branch_volume', 'stem_sav', 'leaf_sav', 'thickness']
```

[7]:
```
flamog.mpa.hist()
```

[7]: <Axes: >



3 Run Model Selector

3.0.1 NOTE: Random effect is simply `plant_id`

- NO nested effects
- NO 'species'

It was not possible to test all combinations. Therefore, only combinations of significnt interaction terms and all singletons will be tested.

[8]:
```
mxs = len(cols_use)
mns = 0
mxi = 0
mni = 0
```

4 Flame Height

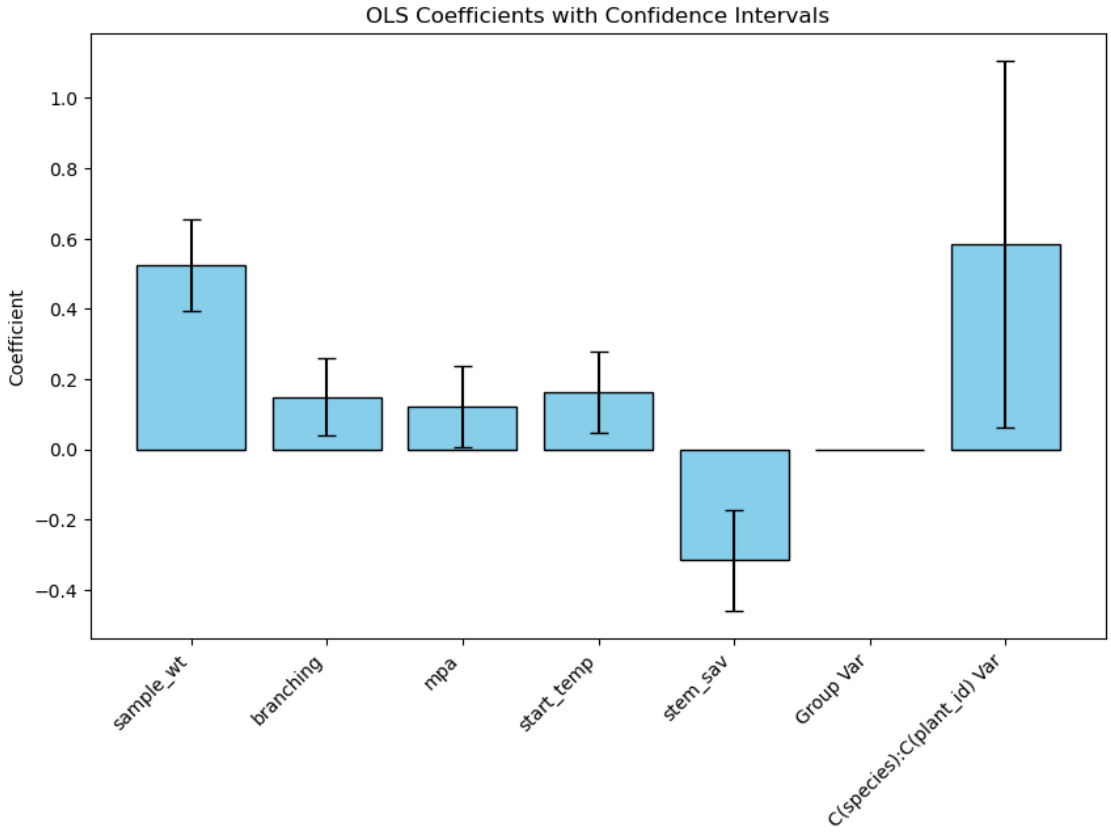
[9]:
```
yvar='fh'
cols=cols_use
df=flam

compare_predictors_mixedeff(df, cols, yvar)
```

	cols	aics	pvals	coefs	top_mod
0	thickness	364.006952	-0.035795	7.120582e-01	True
1	leaf_sav	363.918737	-0.052448	6.383973e-01	True
2	mpa	363.735106	0.050483	5.231286e-01	True
3	start_temp	362.308272	0.107725	1.736033e-01	True
4	dmc	362.239188	0.139224	1.646000e-01	True
5	leaf_mass_ratio	361.985783	-0.176500	1.380189e-01	False
6	lfm	359.193313	-0.347787	2.636709e-02	False
7	stem_sav	357.100275	-0.591178	2.478364e-07	False
8	LMA	351.291339	0.516249	1.118780e-04	False
9	branching	347.983813	0.273746	2.927882e-05	False
10	branch_volume	346.249230	0.329668	1.482620e-05	False
11	sample_wt	310.075185	0.563605	1.117563e-15	False

[10]:
```
AIC_iterator(flam, cols_use, Y_VAR='fh',
             minnumsingle=mns, maxnumsingle=mxs, minnumint=mni, maxnumint=mxi)
```

```
ERROR: Formula model error: fh ~ leaf_sav*thickness

Columns present in sig. interaction terms: {'branching', 'lfm', 'sample_wt',
'mpa'}

Total Num. Cols : Num. Sig. Int. Cols;  12 : 4

Significant Interactions:
```

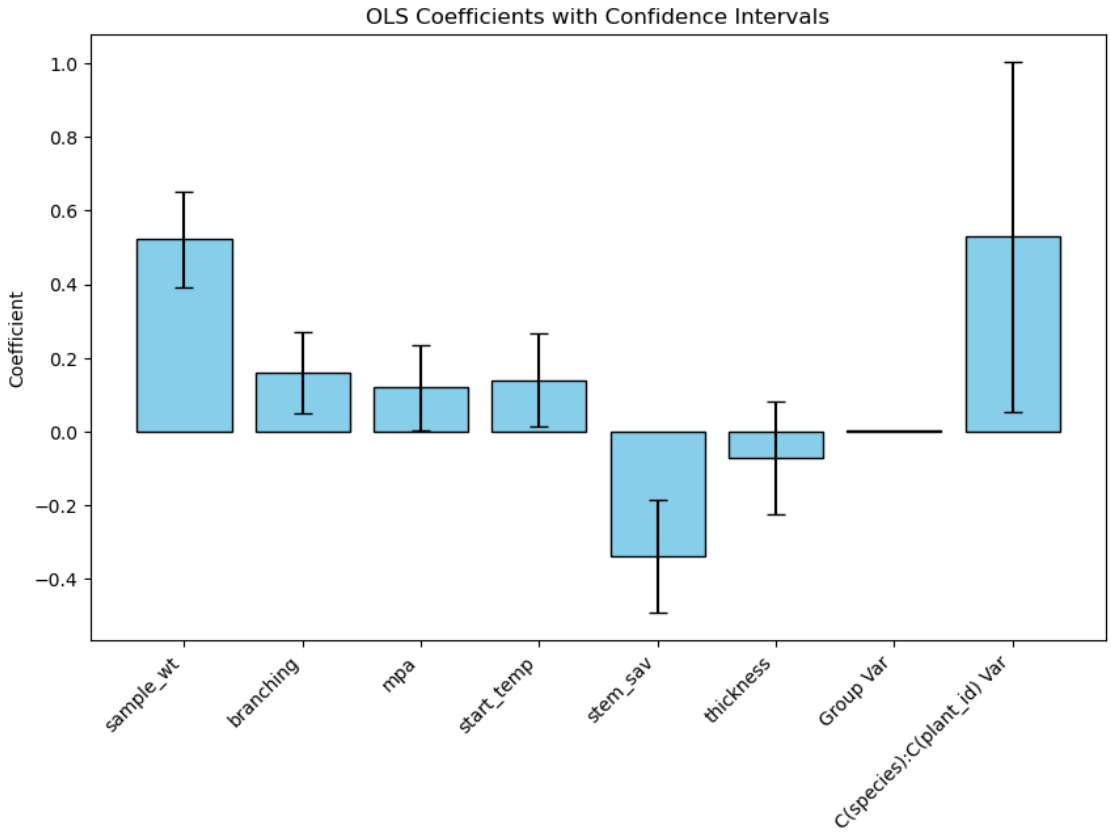
```
('lfm', 'sample_wt')
('sample_wt', 'mpa')
('sample_wt', 'branching')

Number of formulas: 4096
ERROR: Formula model error: fh ~


fh ~ sample_wt + branching + mpa + start_temp + stem_sav
fh ~ sample_wt + branching + mpa + start_temp + stem_sav + thickness
fh ~ LMA + sample_wt + branching + mpa + start_temp + stem_sav
fh ~ sample_wt + branching + mpa + start_temp + branch_volume + stem_sav
fh ~ sample_wt + branching + mpa + start_temp + stem_sav + leaf_sav


                Mixed Linear Model Regression Results
========================================================================
Model:                  MixedLM     Dependent Variable:     fh
No. Observations:       158         Method:                 ML
No. Groups:             7           Scale:                  0.2476
Min. group size:        8           Log-Likelihood:         -138.3458
Max. group size:        37          Converged:              Yes
Mean group size:        22.6
------------------------------------------------------------------------
                           Coef.  Std.Err.   z    P>|z| [0.025 0.975]
------------------------------------------------------------------------
Intercept                   0.058    0.070  0.839 0.402 -0.078  0.195
sample_wt                   0.525    0.066  7.945 0.000  0.395  0.654
branching                   0.150    0.055  2.702 0.007  0.041  0.258
mpa                         0.121    0.059  2.047 0.041  0.005  0.237
start_temp                  0.163    0.059  2.759 0.006  0.047  0.279
stem_sav                   -0.316    0.073 -4.302 0.000 -0.460 -0.172
Group Var                   0.000
C(species):C(plant_id) Var  0.145    0.133
========================================================================
```



Mixed Linear Model Regression Results

Model:	MixedLM	Dependent Variable:	fh
No. Observations:	158	Method:	ML
No. Groups:	7	Scale:	0.2509
Min. group size:	8	Log-Likelihood:	-138.0382
Max. group size:	37	Converged:	No
Mean group size:	22.6		

	Coef.	Std.Err.	z	P>|z|	[0.025	0.975]
Intercept	0.055	0.069	0.793	0.428	-0.081	0.191
sample_wt	0.522	0.066	7.910	0.000	0.393	0.651
branching	0.160	0.056	2.825	0.005	0.049	0.270
mpa	0.119	0.059	2.029	0.042	0.004	0.235
start_temp	0.140	0.065	2.160	0.031	0.013	0.266
stem_sav	-0.338	0.078	-4.319	0.000	-0.491	-0.185
thickness	-0.072	0.078	-0.919	0.358	-0.226	0.082
Group Var	0.001					
C(species):C(plant_id) Var	0.133	0.121				

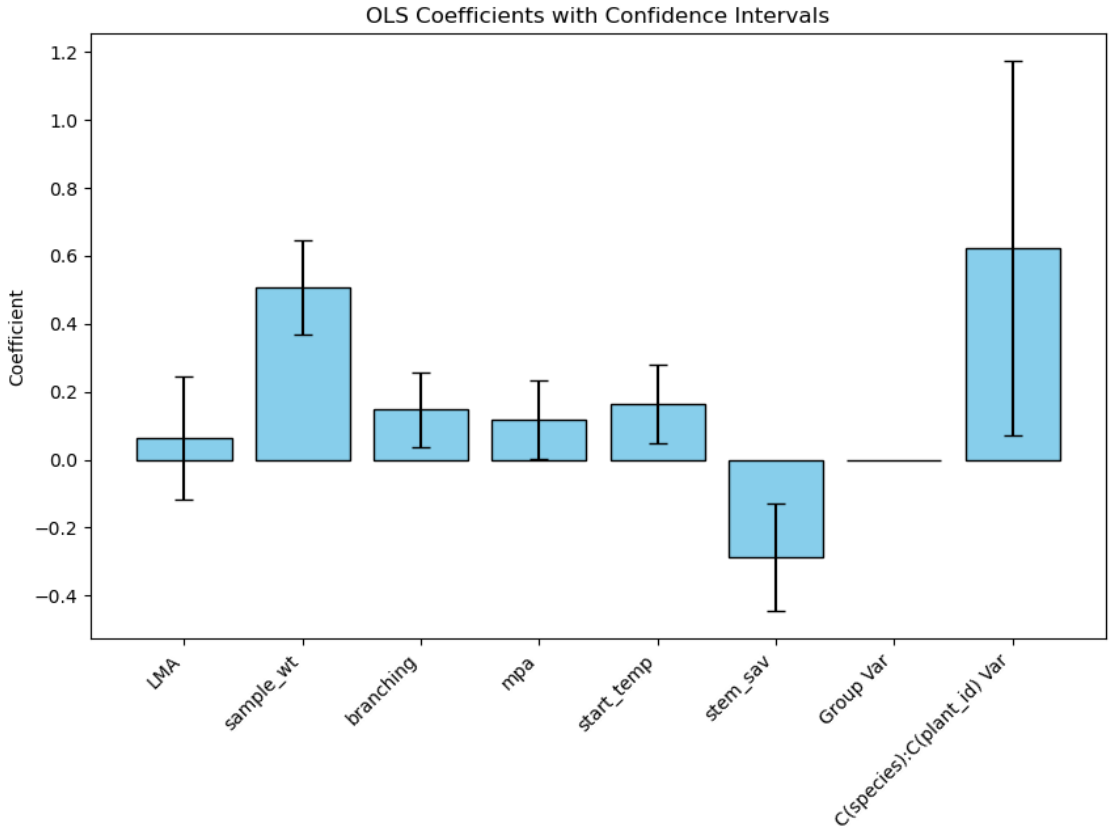


Mixed Linear Model Regression Results

Model:	MixedLM	Dependent Variable:	fh
No. Observations:	158	Method:	ML
No. Groups:	7	Scale:	0.2438
Min. group size:	8	Log-Likelihood:	-138.1197
Max. group size:	37	Converged:	Yes
Mean group size:	22.6		

	Coef.	Std.Err.	z	P>|z|	[0.025	0.975]
Intercept	0.060	0.071	0.848	0.396	-0.078	0.198
LMA	0.064	0.093	0.684	0.494	-0.119	0.246
sample_wt	0.507	0.071	7.184	0.000	0.369	0.646
branching	0.147	0.055	2.652	0.008	0.038	0.256
mpa	0.117	0.060	1.962	0.050	0.000	0.233
start_temp	0.162	0.059	2.749	0.006	0.047	0.278
stem_sav	-0.286	0.081	-3.543	0.000	-0.445	-0.128
Group Var	0.000					

```
C(species):C(plant_id) Var  0.152    0.138
=============================================================================
```

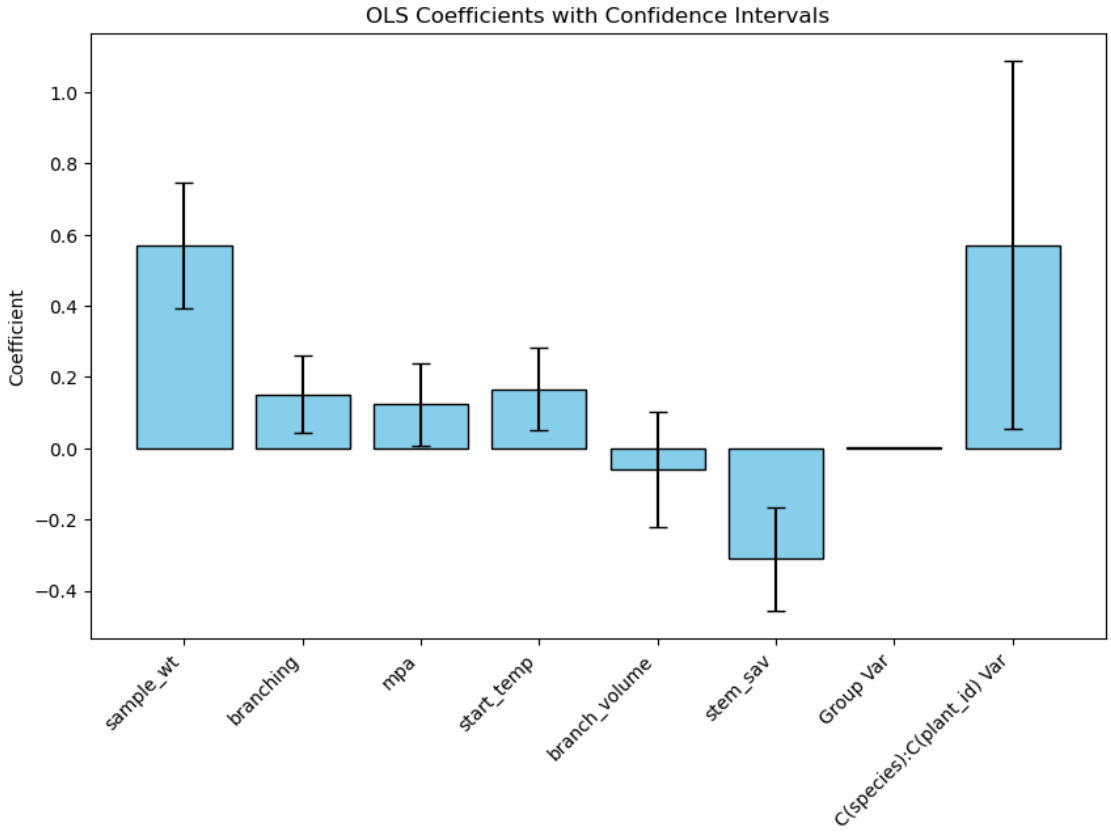


Mixed Linear Model Regression Results

Model:	MixedLM	Dependent Variable:	fh
No. Observations:	158	Method:	ML
No. Groups:	7	Scale:	0.2478
Min. group size:	8	Log-Likelihood:	-138.1348
Max. group size:	37	Converged:	No
Mean group size:	22.6		

	Coef.	Std.Err.	z	P>|z|	[0.025	0.975]
Intercept	0.056	0.070	0.807	0.419	-0.081	0.193
sample_wt	0.569	0.091	6.287	0.000	0.392	0.747
branching	0.151	0.055	2.731	0.006	0.043	0.259
mpa	0.123	0.059	2.089	0.037	0.008	0.239
start_temp	0.165	0.059	2.798	0.005	0.050	0.281
branch_volume	-0.059	0.082	-0.713	0.476	-0.220	0.102

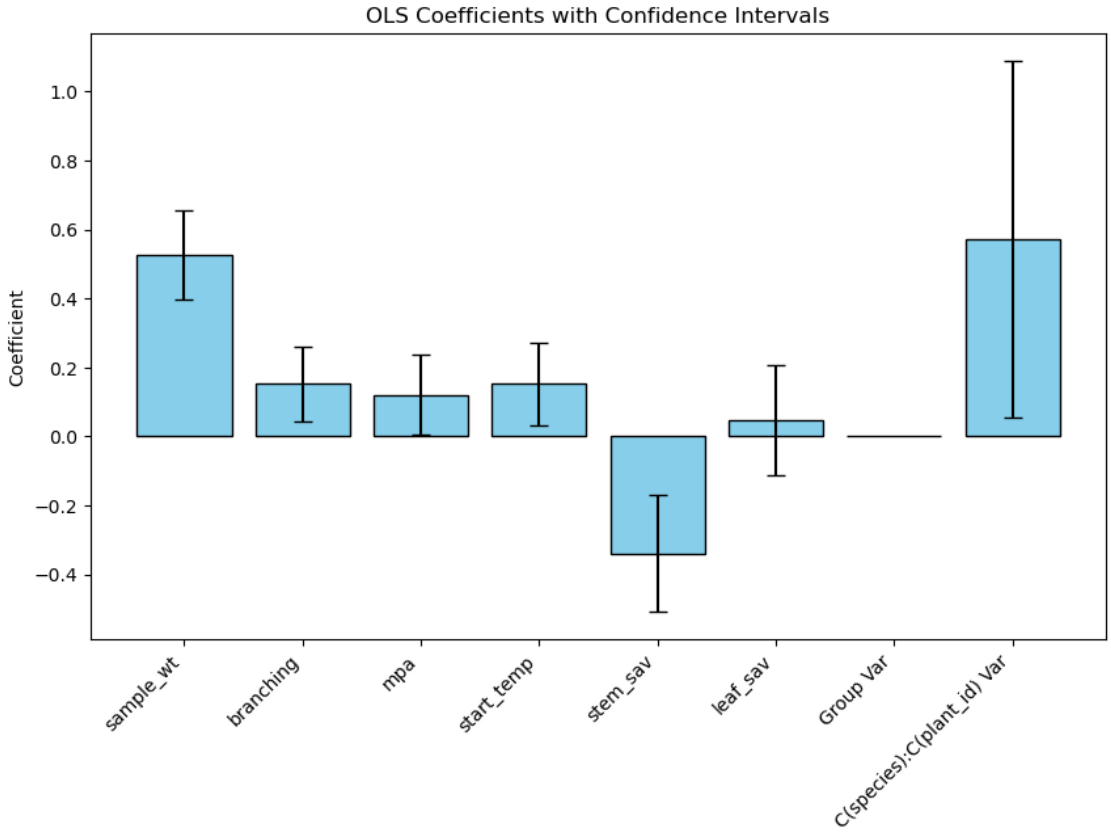
```
stem_sav                    -0.311    0.074 -4.181 0.000 -0.457 -0.165
Group Var                    0.000
C(species):C(plant_id) Var   0.142    0.131
=================================================================
```



Mixed Linear Model Regression Results

```
=================================================================
Model:                  MixedLM     Dependent Variable:     fh
No. Observations:       158         Method:                 ML
No. Groups:             7           Scale:                  0.2480
Min. group size:        8           Log-Likelihood:         -138.2001
Max. group size:        37          Converged:              Yes
Mean group size:        22.6
-----------------------------------------------------------------
                          Coef.  Std.Err.    z    P>|z| [0.025 0.975]
-----------------------------------------------------------------
Intercept                 0.057    0.070  0.824 0.410 -0.079  0.194
sample_wt                 0.528    0.066  7.987 0.000  0.398  0.657
branching                 0.152    0.055  2.742 0.006  0.043  0.261
mpa                       0.121    0.059  2.047 0.041  0.005  0.236
```

```
start_temp                   0.153    0.062  2.478 0.013  0.032  0.273
stem_sav                    -0.339    0.086 -3.940 0.000 -0.508 -0.170
leaf_sav                     0.048    0.082  0.581 0.561 -0.113  0.209
Group Var                    0.000
C(species):C(plant_id) Var   0.142    0.131
=================================================================
```



5 Flame Duration

[11]:
```
yvar='fd'
cols=cols_use
df=flam
compare_predictors_mixedeff(df, cols, yvar)
```

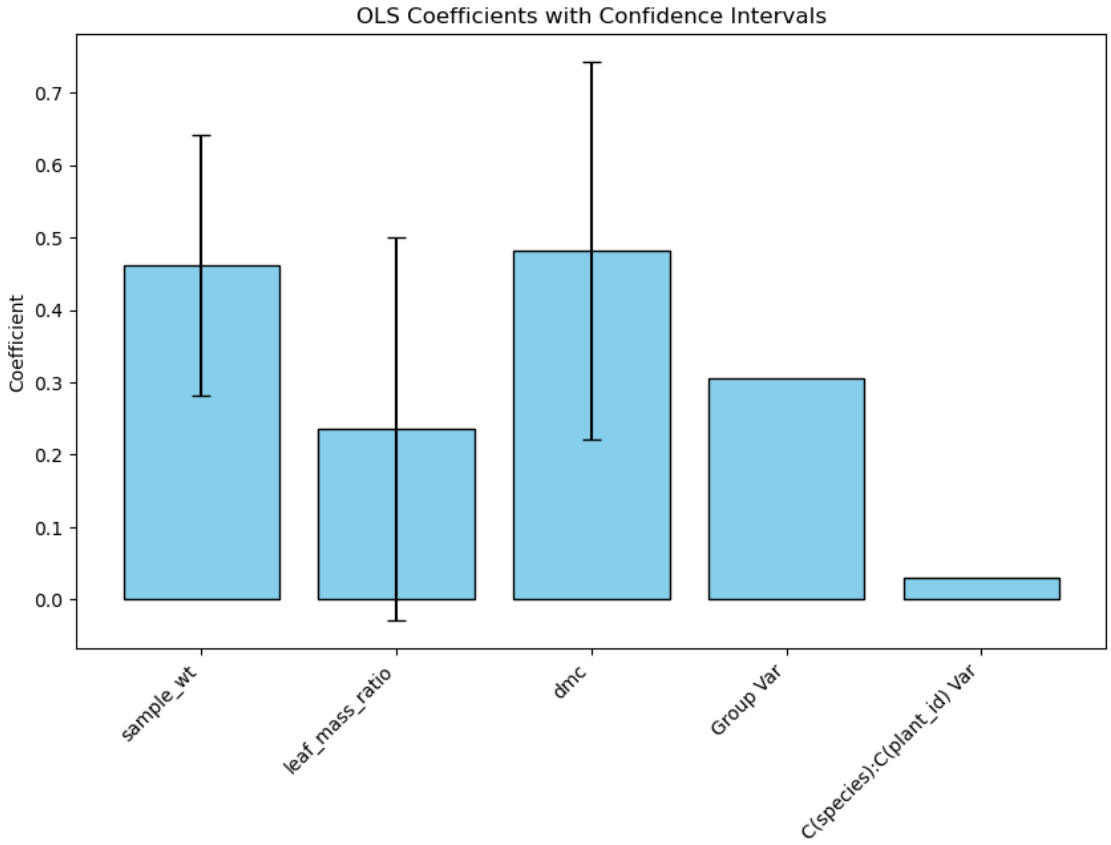
	cols	aics	pvals	coefs	top_mod
0	mpa	436.873240	-0.030688	7.437746e-01	True
1	start_temp	436.079075	-0.065230	5.218623e-01	True
2	thickness	435.387128	0.080096	5.179140e-01	True
3	leaf_sav	435.007152	-0.100602	3.998897e-01	True

```
4               LMA  434.967441  0.233946  9.034159e-02     True
5   leaf_mass_ratio  434.235530 -0.190051  5.249440e-01    False
6               lfm  433.629983 -0.229844  1.616765e-01    False
7          stem_sav  433.615000 -0.317586  6.588064e-02    False
8         branching  433.207184  0.180716  5.759355e-02    False
9     branch_volume  425.968222  0.336634  8.489578e-04    False
10              dmc  424.962442  0.402439  3.168880e-04    False
11        sample_wt  412.060412  0.487190  4.197782e-09    False
```

[12]:
```
AIC_iterator(flam, cols_use, Y_VAR='fd',
             minnumsingle=mns, maxnumsingle=mxs, minnumint=mni, maxnumint=mxi)
```

```
ERROR: Formula model error: fd ~ leaf_sav*thickness

Columns present in sig. interaction terms: {'lfm', 'sample_wt', 'dmc'}

Total Num. Cols : Num. Sig. Int. Cols;  12 : 3

Significant Interactions:
('sample_wt', 'dmc')
('lfm', 'sample_wt')

Number of formulas: 4096
ERROR: Formula model error: fd ~


fd ~ sample_wt + leaf_mass_ratio + dmc
fd ~ sample_wt + leaf_mass_ratio + branching + dmc
fd ~ sample_wt + dmc
fd ~ sample_wt + leaf_mass_ratio + dmc + leaf_sav
fd ~ sample_wt + leaf_mass_ratio + start_temp + dmc
fd ~ sample_wt + leaf_mass_ratio + dmc + thickness
fd ~ lfm + sample_wt + leaf_mass_ratio + dmc
fd ~ LMA + sample_wt + leaf_mass_ratio + dmc


               Mixed Linear Model Regression Results
=========================================================================
Model:               MixedLM    Dependent Variable:    fd
No. Observations:    158        Method:                ML
No. Groups:          7          Scale:                 0.6227
Min. group size:     8          Log-Likelihood:        -195.5946
Max. group size:     37         Converged:             No
Mean group size:     22.6
-------------------------------------------------------------------------
                          Coef. Std.Err.   z   P>|z| [0.025 0.975]
-------------------------------------------------------------------------
Intercept                 0.022    0.180 0.121 0.904 -0.331  0.375
```

```
sample_wt                  0.461    0.092 5.013 0.000  0.281  0.642
leaf_mass_ratio            0.235    0.135 1.747 0.081 -0.029  0.500
dmc                        0.482    0.133 3.627 0.000  0.222  0.742
Group Var                  0.190
C(species):C(plant_id) Var 0.018
=================================================================
```

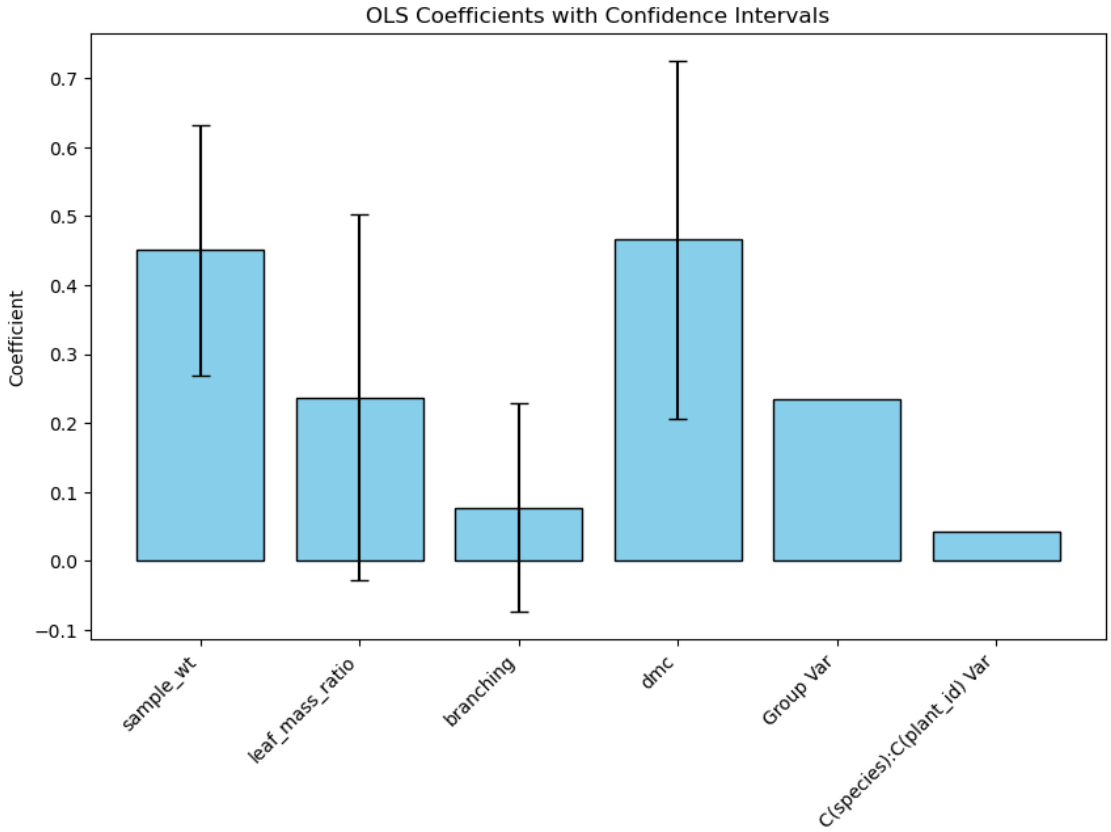


Mixed Linear Model Regression Results

Model:	MixedLM	Dependent Variable:	fd
No. Observations:	158	Method:	ML
No. Groups:	7	Scale:	0.6183
Min. group size:	8	Log-Likelihood:	-195.1007
Max. group size:	37	Converged:	Yes
Mean group size:	22.6		

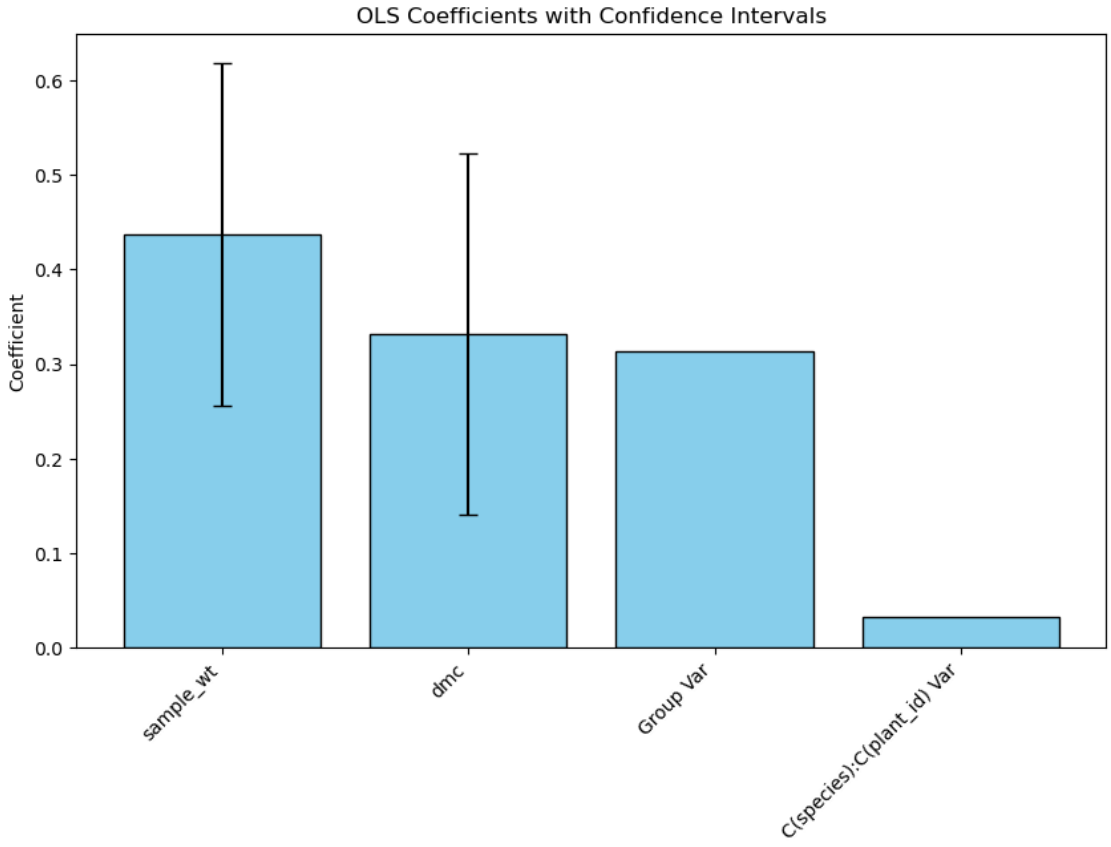
	Coef.	Std.Err.	z	P>|z|	[0.025	0.975]
Intercept	0.013	0.162	0.082	0.935	-0.304	0.331
sample_wt	0.450	0.093	4.843	0.000	0.268	0.632

```
leaf_mass_ratio            0.237    0.135 1.749 0.080 -0.029  0.502
branching                  0.077    0.077 1.004 0.315 -0.074  0.228
dmc                        0.466    0.132 3.519 0.000  0.206  0.725
Group Var                  0.145
C(species):C(plant_id) Var 0.027
=================================================================
```




```
            Mixed Linear Model Regression Results
=================================================================
Model:               MixedLM    Dependent Variable:    fd
No. Observations:    158        Method:                ML
No. Groups:          7          Scale:                 0.6338
Min. group size:     8          Log-Likelihood:        -197.2186
Max. group size:     37         Converged:             No
Mean group size:     22.6
-----------------------------------------------------------------
                           Coef. Std.Err.   z   P>|z| [0.025 0.975]
-----------------------------------------------------------------
Intercept                  0.016    0.184 0.085 0.933 -0.345  0.376
sample_wt                  0.438    0.092 4.738 0.000  0.257  0.619
```

```
dmc                          0.332    0.098 3.404 0.001  0.141  0.523
Group Var                    0.199
C(species):C(plant_id) Var   0.020
================================================================
```

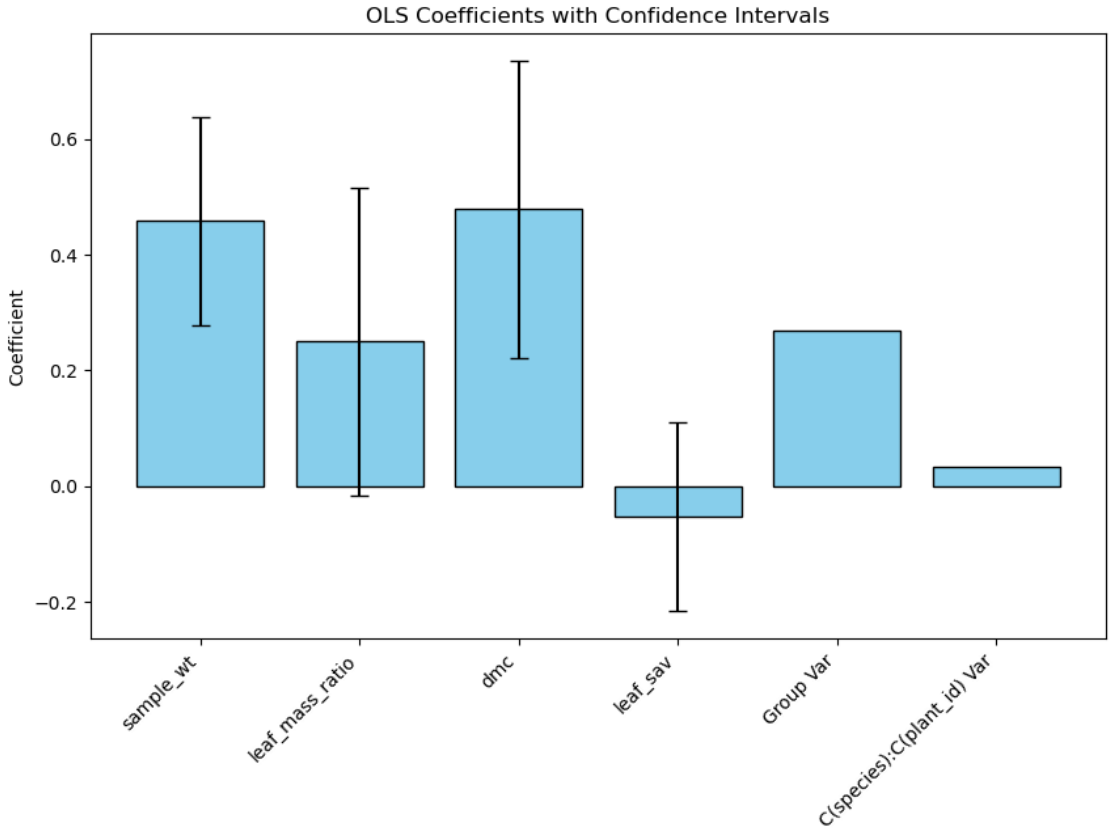


Mixed Linear Model Regression Results

Model:	MixedLM	Dependent Variable:	fd
No. Observations:	158	Method:	ML
No. Groups:	7	Scale:	0.6213
Min. group size:	8	Log-Likelihood:	-195.2923
Max. group size:	37	Converged:	Yes
Mean group size:	22.6		

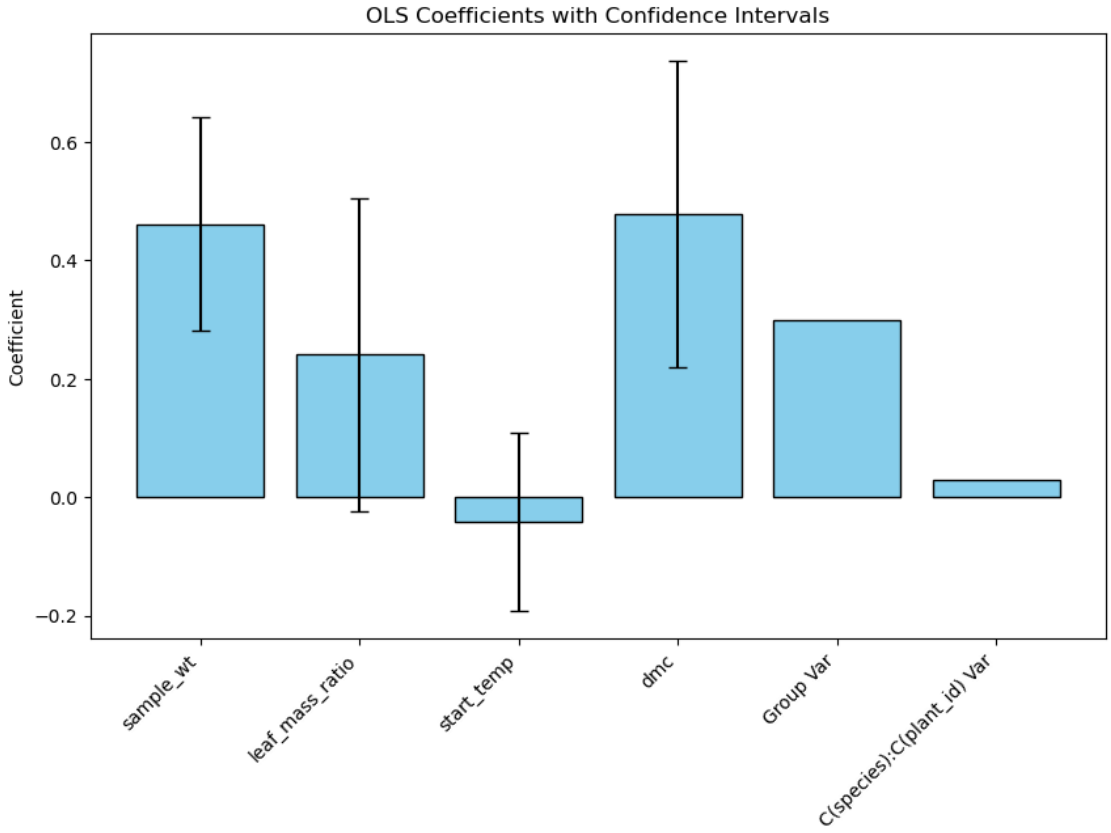
	Coef.	Std.Err.	z	P>|z|	[0.025	0.975]
Intercept	0.018	0.171	0.108	0.914	-0.317	0.353
sample_wt	0.458	0.092	4.991	0.000	0.278	0.639
leaf_mass_ratio	0.249	0.136	1.837	0.066	-0.017	0.516
dmc	0.478	0.131	3.652	0.000	0.222	0.735

```
leaf_sav                   -0.053    0.083 -0.637 0.524 -0.216  0.110
Group Var                   0.167
C(species):C(plant_id) Var  0.021
=============================================================================
```



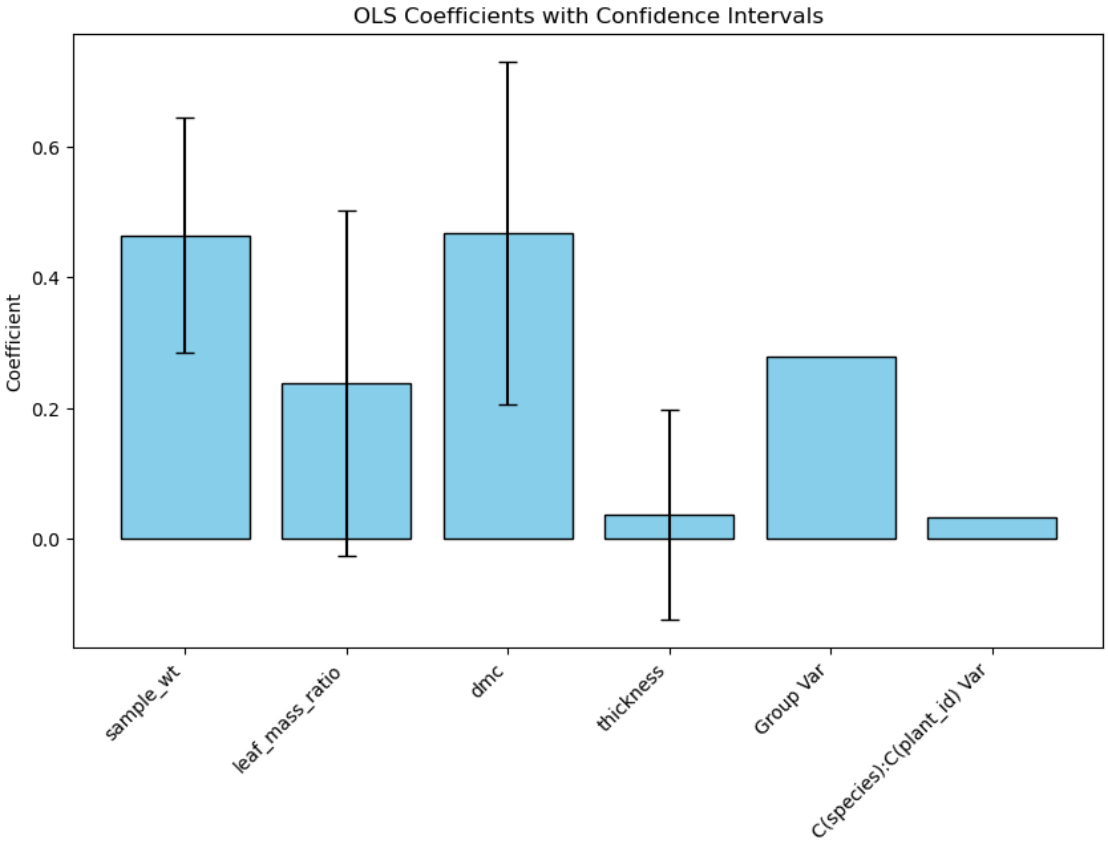

```
                Mixed Linear Model Regression Results
=============================================================================
Model:                  MixedLM     Dependent Variable:     fd
No. Observations:       158         Method:                 ML
No. Groups:             7           Scale:                  0.6219
Min. group size:        8           Log-Likelihood:         -195.4003
Max. group size:        37          Converged:              No
Mean group size:        22.6
-----------------------------------------------------------------------------
                          Coef.  Std.Err.    z    P>|z| [0.025 0.975]
-----------------------------------------------------------------------------
Intercept                  0.025    0.178  0.137 0.891 -0.325  0.374
sample_wt                  0.462    0.092  5.018 0.000  0.281  0.642
leaf_mass_ratio            0.241    0.135  1.786 0.074 -0.023  0.505
start_temp                -0.041    0.077 -0.536 0.592 -0.192  0.109
```

```
dmc                          0.478    0.132  3.622 0.000  0.220  0.737
Group Var                    0.186
C(species):C(plant_id) Var   0.018
=================================================================
```




```
               Mixed Linear Model Regression Results
=================================================================
Model:               MixedLM    Dependent Variable:    fd
No. Observations:    158        Method:                ML
No. Groups:          7          Scale:                 0.6221
Min. group size:     8          Log-Likelihood:        -195.4083
Max. group size:     37         Converged:             No
Mean group size:     22.6
-----------------------------------------------------------------
                         Coef. Std.Err.   z   P>|z| [0.025 0.975]
-----------------------------------------------------------------
Intercept                0.019    0.173 0.109 0.913 -0.321  0.359
sample_wt                0.465    0.092 5.067 0.000  0.285  0.644
leaf_mass_ratio          0.238    0.135 1.771 0.077 -0.025  0.502
dmc                      0.468    0.134 3.502 0.000  0.206  0.731
```

```
thickness                   0.036    0.082 0.444 0.657 -0.124  0.197
Group Var                   0.173
C(species):C(plant_id) Var  0.020
================================================================
```

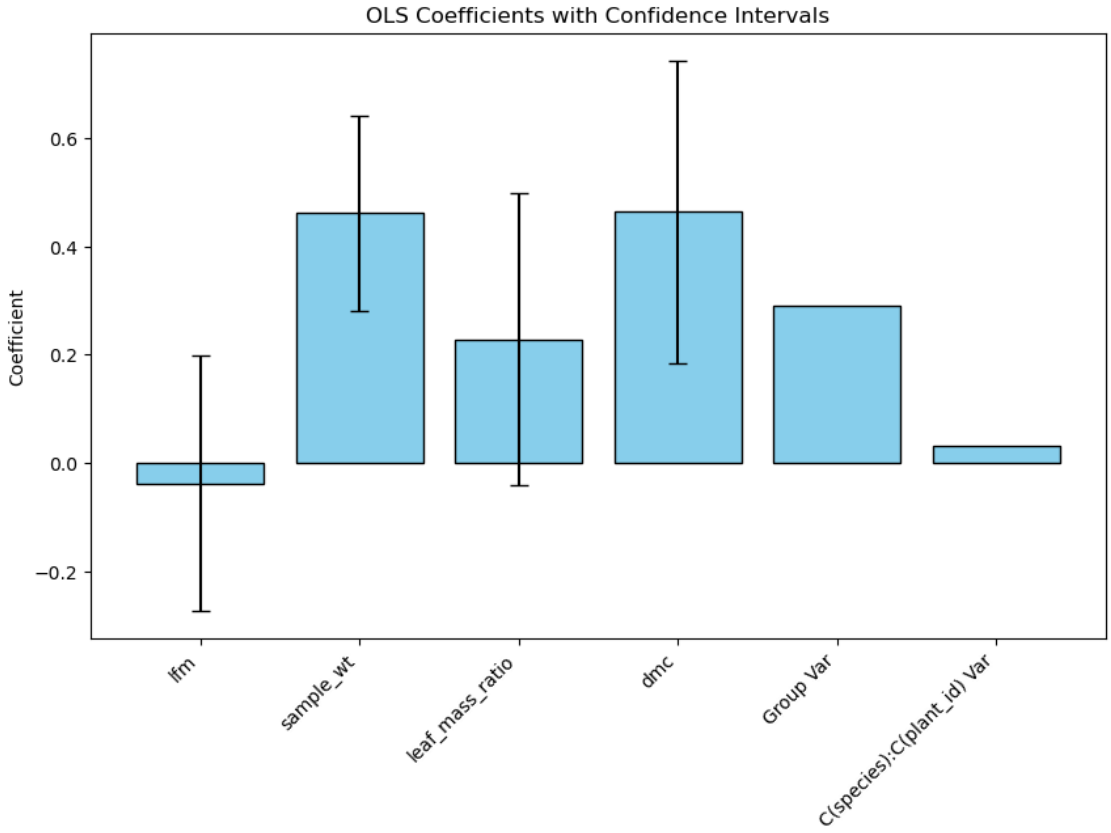


Mixed Linear Model Regression Results

Model:	MixedLM	Dependent Variable:	fd
No. Observations:	158	Method:	ML
No. Groups:	7	Scale:	0.6222
Min. group size:	8	Log-Likelihood:	-195.5408
Max. group size:	37	Converged:	No
Mean group size:	22.6		

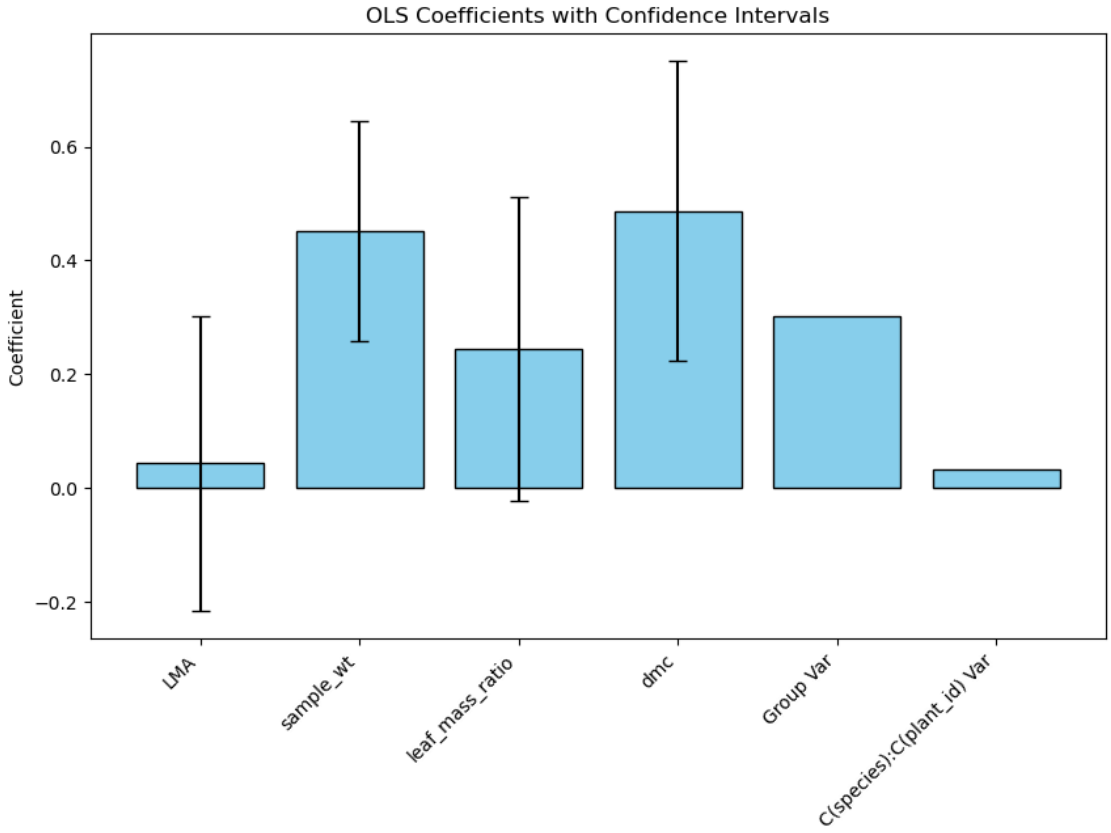
	Coef.	Std.Err.	z	P>|z|	[0.025	0.975]
Intercept	0.018	0.177	0.103	0.918	-0.329	0.365
lfm	-0.037	0.120	-0.309	0.757	-0.273	0.198
sample_wt	0.461	0.092	5.001	0.000	0.280	0.642
leaf_mass_ratio	0.228	0.137	1.664	0.096	-0.041	0.498

```
dmc                          0.464    0.142  3.258 0.001  0.185  0.743
Group Var                    0.181
C(species):C(plant_id) Var   0.020
=================================================================
```




```
               Mixed Linear Model Regression Results
=================================================================
Model:               MixedLM    Dependent Variable:    fd
No. Observations:    158        Method:                ML
No. Groups:          7          Scale:                 0.6221
Min. group size:     8          Log-Likelihood:        -195.5724
Max. group size:     37         Converged:             Yes
Mean group size:     22.6
-----------------------------------------------------------------
                          Coef. Std.Err.   z   P>|z| [0.025 0.975]
-----------------------------------------------------------------
Intercept                 0.018    0.180 0.099 0.921 -0.334  0.370
LMA                       0.043    0.132 0.323 0.747 -0.217  0.302
sample_wt                 0.451    0.098 4.592 0.000  0.259  0.644
leaf_mass_ratio           0.244    0.137 1.785 0.074 -0.024  0.511
```

```
dmc                          0.487    0.135 3.610 0.000  0.223  0.751
Group Var                    0.187
C(species):C(plant_id) Var 0.019
===============================================================
```



6 Temp Change

[13]:
```
yvar='temp_change'
cols=cols_use
df=flam
compare_predictors_mixedeff(df, cols, yvar)
```

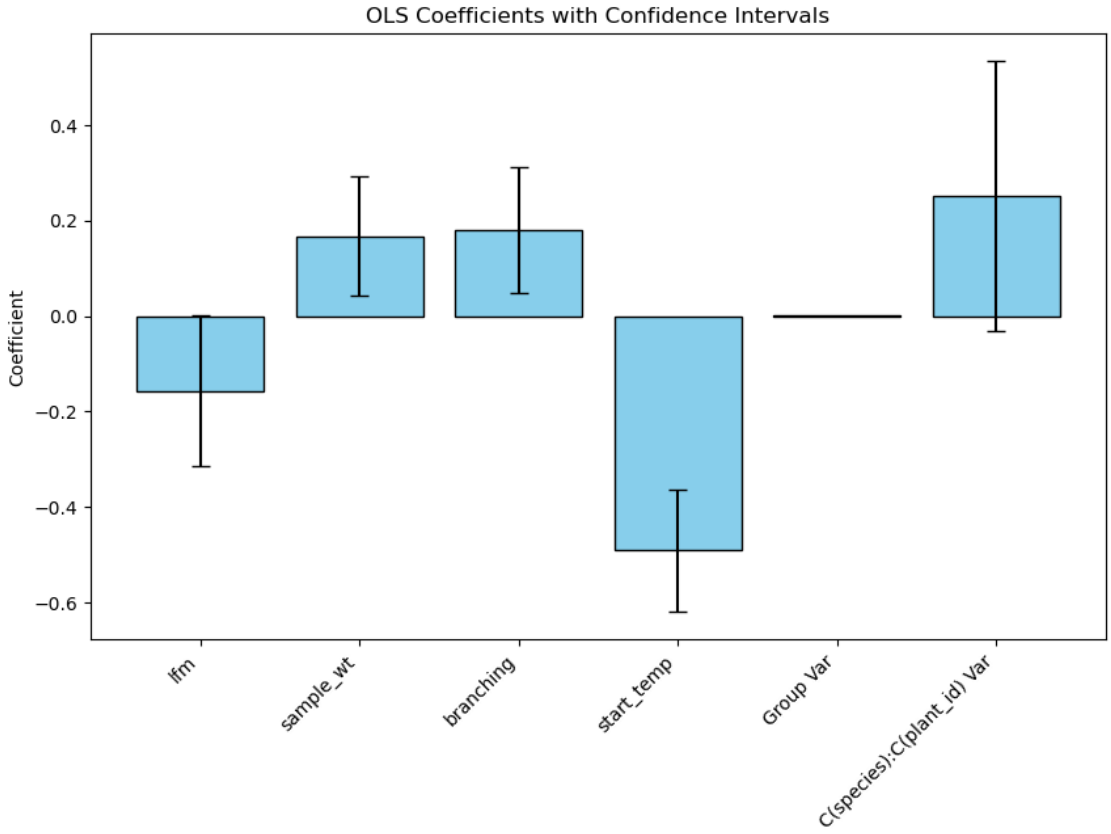
	cols	aics	pvals	coefs	top_mod
0	LMA	401.455324	0.146477	3.628360e-01	True
1	branch_volume	400.626960	0.115343	2.132302e-01	True
2	dmc	397.858765	0.229424	2.942629e-02	False
3	lfm	396.316699	-0.330708	1.533037e-02	False
4	leaf_sav	396.311562	-0.298959	1.317164e-02	False
5	thickness	395.855289	0.268303	9.864805e-03	False

```
6               mpa  395.786266  0.227803  1.088857e-02    False
7          stem_sav  395.612568 -0.369712  7.787386e-03    False
8   leaf_mass_ratio  394.783638 -0.334845           NaN    False
9         sample_wt  394.549162  0.274254  4.605771e-03    False
10        branching  388.874141  0.278646  2.061610e-04    False
11       start_temp  367.827414 -0.493711  1.473413e-10    False
```

[14]:
```
AIC_iterator(flam, cols_use, Y_VAR='temp_change',
             minnumsingle=mns, maxnumsingle=mxs, minnumint=mni, maxnumint=mxi)
```

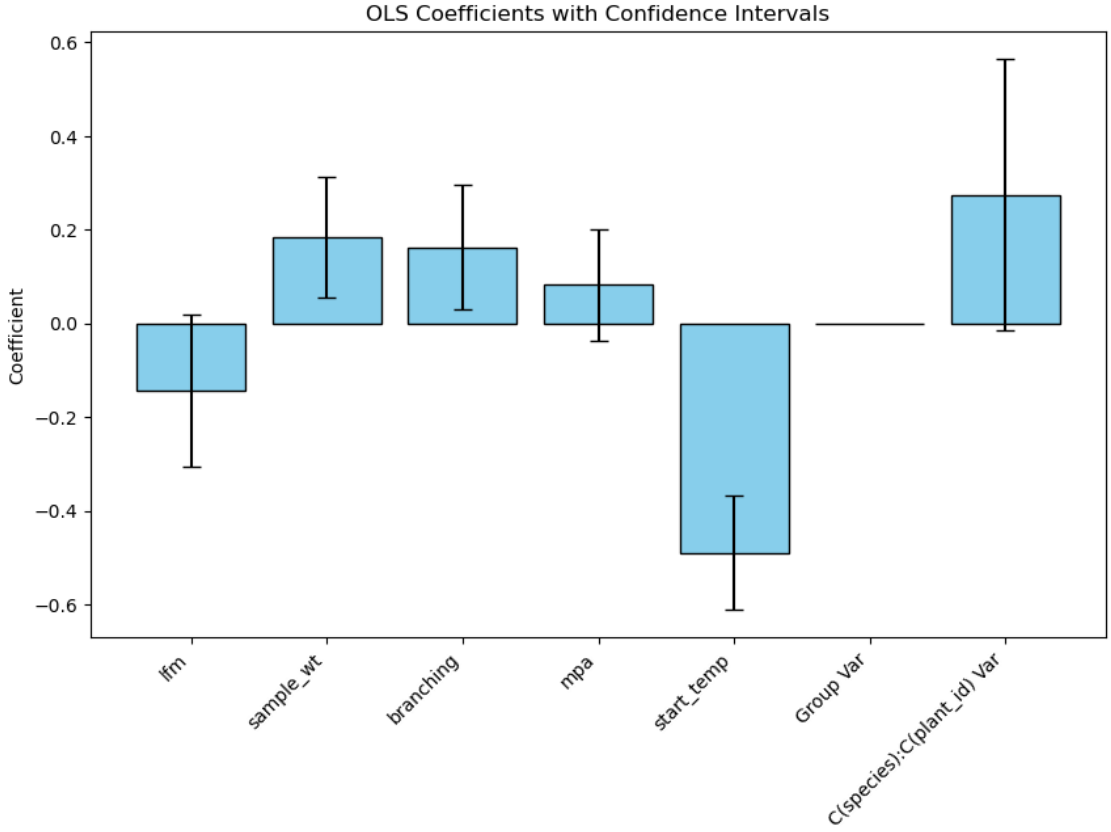
```
Columns present in sig. interaction terms: {'start_temp', 'lfm'}

Total Num. Cols : Num. Sig. Int. Cols;  12 : 2

Significant Interactions:
('lfm', 'start_temp')

Number of formulas: 4096
ERROR: Formula model error: temp_change ~


temp_change ~ lfm + sample_wt + branching + start_temp
temp_change ~ lfm + sample_wt + branching + mpa + start_temp
temp_change ~ sample_wt + branching + mpa + start_temp
temp_change ~ lfm + LMA + sample_wt + branching + start_temp
temp_change ~ lfm + sample_wt + branching + start_temp + dmc
temp_change ~ lfm + sample_wt + branching + start_temp + branch_volume
temp_change ~ sample_wt + branching + start_temp
temp_change ~ sample_wt + branching + mpa + start_temp + stem_sav
temp_change ~ lfm + sample_wt + branching + start_temp + thickness
temp_change ~ lfm + sample_wt + leaf_mass_ratio + branching + start_temp
temp_change ~ lfm + sample_wt + branching + start_temp + stem_sav
temp_change ~ LMA + sample_wt + branching + mpa + start_temp + stem_sav
temp_change ~ lfm + sample_wt + branching + mpa + start_temp + branch_volume


                Mixed Linear Model Regression Results
========================================================================
Model:               MixedLM    Dependent Variable:    temp_change
No. Observations:    158        Method:                ML
No. Groups:          7          Scale:                 0.4032
Min. group size:     8          Log-Likelihood:        -166.2581
Max. group size:     37         Converged:             No
Mean group size:     22.6
------------------------------------------------------------------------
                          Coef.  Std.Err.   z    P>|z| [0.025 0.975]
------------------------------------------------------------------------
```

```
Intercept                    0.032    0.072  0.440 0.660 -0.110  0.174
lfm                         -0.157    0.081 -1.949 0.051 -0.315  0.001
sample_wt                    0.167    0.064  2.628 0.009  0.043  0.292
branching                    0.180    0.067  2.677 0.007  0.048  0.312
start_temp                  -0.491    0.065 -7.501 0.000 -0.619 -0.362
Group Var                    0.000
C(species):C(plant_id) Var   0.101    0.091
=================================================================
```




```
                Mixed Linear Model Regression Results
=================================================================
Model:               MixedLM    Dependent Variable:    temp_change
No. Observations:    158        Method:                ML
No. Groups:          7          Scale:                 0.3951
Min. group size:     8          Log-Likelihood:        -165.5277
Max. group size:     37         Converged:             Yes
Mean group size:     22.6
-----------------------------------------------------------------
                         Coef.  Std.Err.   z    P>|z| [0.025 0.975]
-----------------------------------------------------------------
```

Intercept	0.035	0.072	0.477	0.633	-0.107	0.177
lfm	-0.144	0.083	-1.741	0.082	-0.306	0.018
sample_wt	0.183	0.066	2.791	0.005	0.055	0.312
branching	0.162	0.068	2.383	0.017	0.029	0.296
mpa	0.082	0.061	1.338	0.181	-0.038	0.201
start_temp	-0.490	0.062	-7.910	0.000	-0.611	-0.368
Group Var	0.000					
C(species):C(plant_id) Var	0.108	0.093				

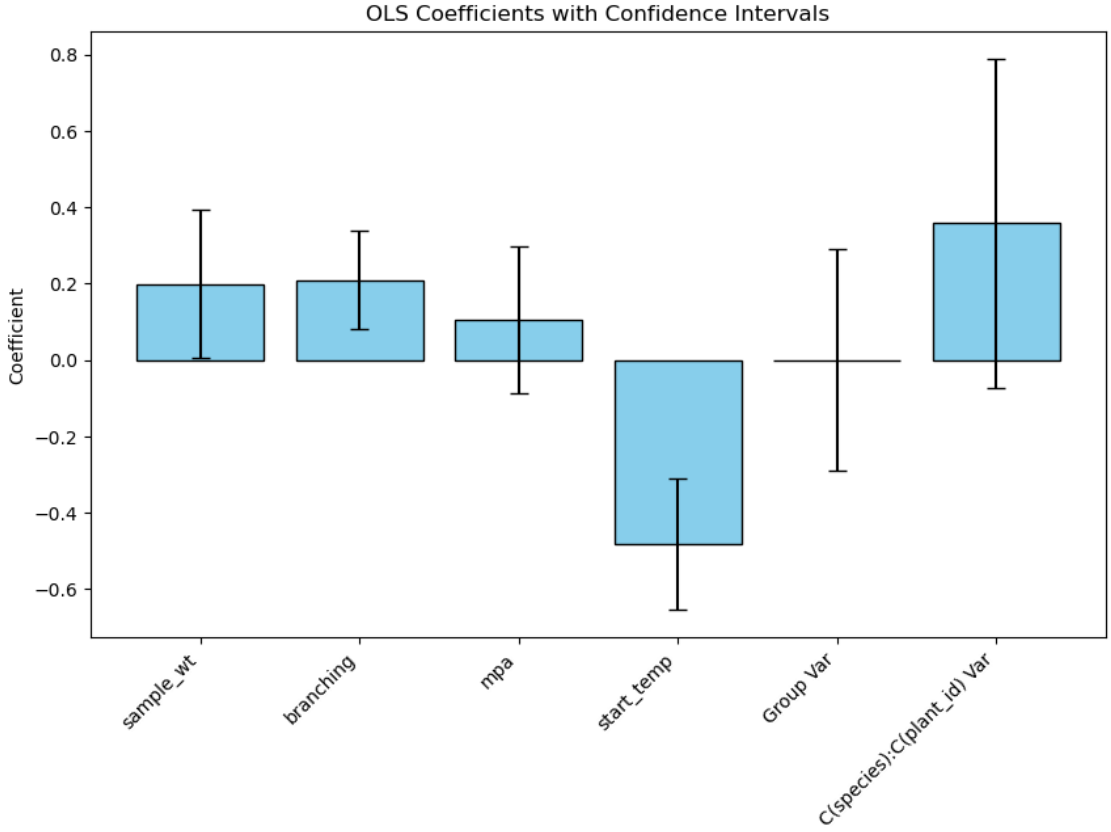


Mixed Linear Model Regression Results

Model:	MixedLM	Dependent Variable:	temp_change
No. Observations:	158	Method:	ML
No. Groups:	7	Scale:	0.3870
Min. group size:	8	Log-Likelihood:	-166.9324
Max. group size:	37	Converged:	Yes
Mean group size:	22.6		

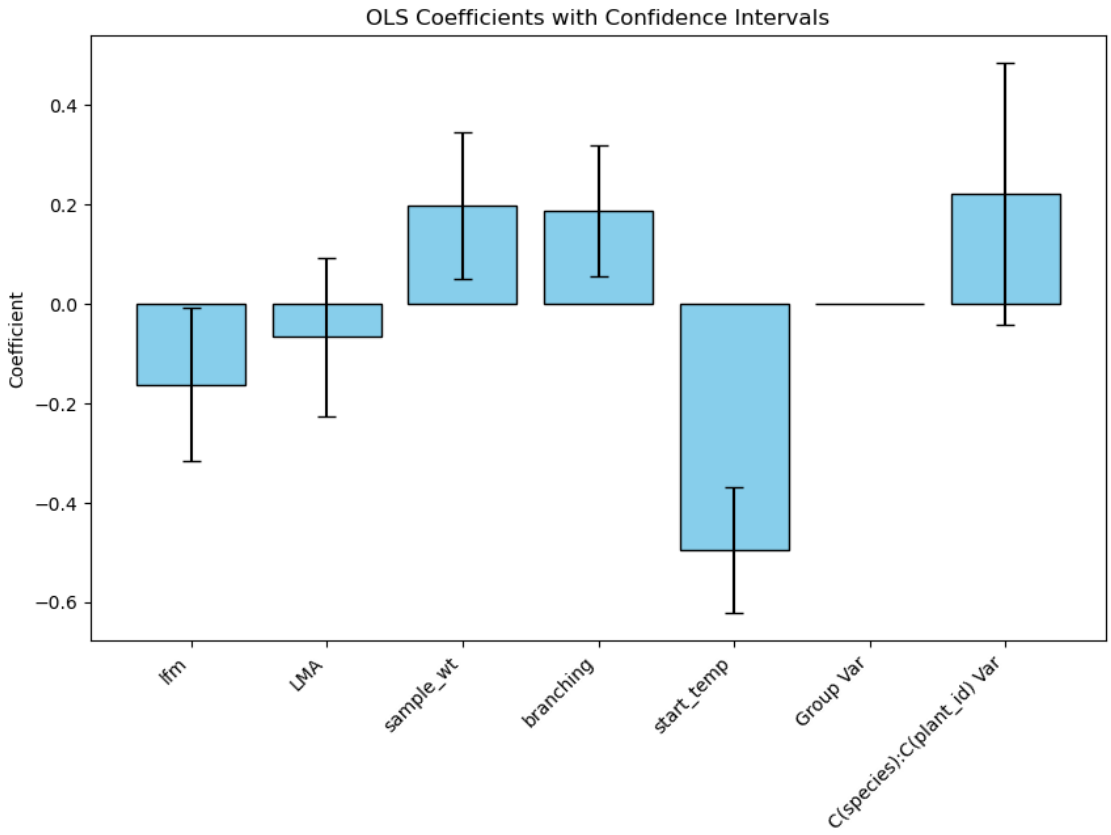
	Coef.	Std.Err.	z	P>|z|	[0.025	0.975]

```
-------------------------------------------------------------------
Intercept                    0.038    0.084  0.459 0.646 -0.125  0.202
sample_wt                    0.198    0.099  2.003 0.045  0.004  0.391
branching                    0.208    0.066  3.158 0.002  0.079  0.338
mpa                          0.105    0.098  1.075 0.282 -0.086  0.296
start_temp                  -0.483    0.087 -5.535 0.000 -0.654 -0.312
Group Var                    0.000    0.092
C(species):C(plant_id) Var   0.138    0.137
===================================================================
```



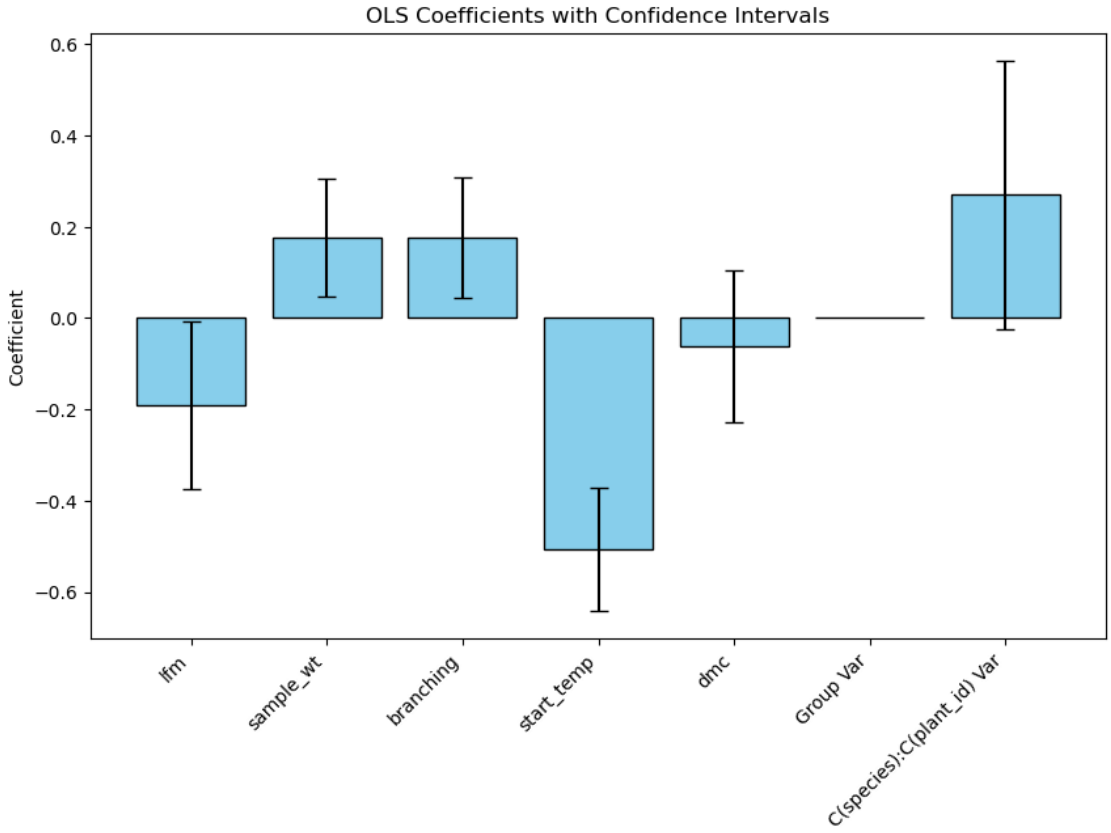

```
                Mixed Linear Model Regression Results
===================================================================
Model:                MixedLM     Dependent Variable:     temp_change
No. Observations:     158         Method:                 ML
No. Groups:           7           Scale:                  0.4079
Min. group size:      8           Log-Likelihood:         -165.9353
Max. group size:      37          Converged:              Yes
Mean group size:      22.6
-------------------------------------------------------------------
                          Coef.  Std.Err.   z    P>|z| [0.025 0.975]
```

```
----------------------------------------------------------------------
Intercept                    0.029    0.070  0.415 0.678 -0.109  0.167
lfm                         -0.163    0.079 -2.069 0.039 -0.317 -0.009
LMA                         -0.067    0.081 -0.822 0.411 -0.226  0.092
sample_wt                    0.199    0.075  2.641 0.008  0.051  0.347
branching                    0.187    0.068  2.769 0.006  0.055  0.320
start_temp                  -0.495    0.065 -7.646 0.000 -0.622 -0.368
Group Var                    0.000
C(species):C(plant_id) Var   0.091    0.086
======================================================================
```




```
                Mixed Linear Model Regression Results
======================================================================
Model:               MixedLM    Dependent Variable:    temp_change
No. Observations:    158        Method:                ML
No. Groups:          7          Scale:                 0.3983
Min. group size:     8          Log-Likelihood:        -166.0088
Max. group size:     37         Converged:             No
Mean group size:     22.6
----------------------------------------------------------------------
```

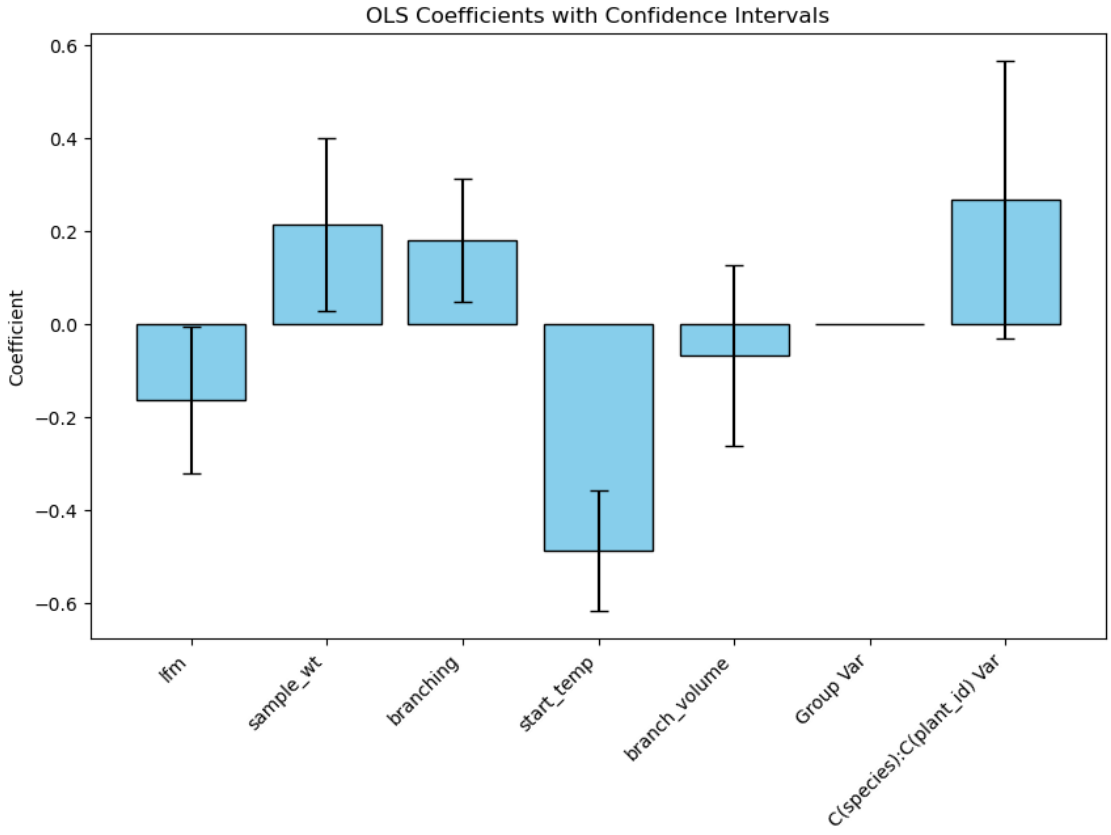
	Coef.	Std.Err.	z	P>|z|	[0.025	0.975]
Intercept	0.035	0.073	0.476	0.634	-0.108	0.178
lfm	-0.190	0.094	-2.027	0.043	-0.374	-0.006
sample_wt	0.176	0.065	2.691	0.007	0.048	0.304
branching	0.176	0.067	2.616	0.009	0.044	0.307
start_temp	-0.506	0.069	-7.347	0.000	-0.641	-0.371
dmc	-0.061	0.085	-0.713	0.476	-0.227	0.106
Group Var	0.000					
C(species):C(plant_id) Var	0.107	0.095				



Mixed Linear Model Regression Results

Model:	MixedLM	Dependent Variable:	temp_change
No. Observations:	158	Method:	ML
No. Groups:	7	Scale:	0.3987
Min. group size:	8	Log-Likelihood:	-166.0308
Max. group size:	37	Converged:	No
Mean group size:	22.6		

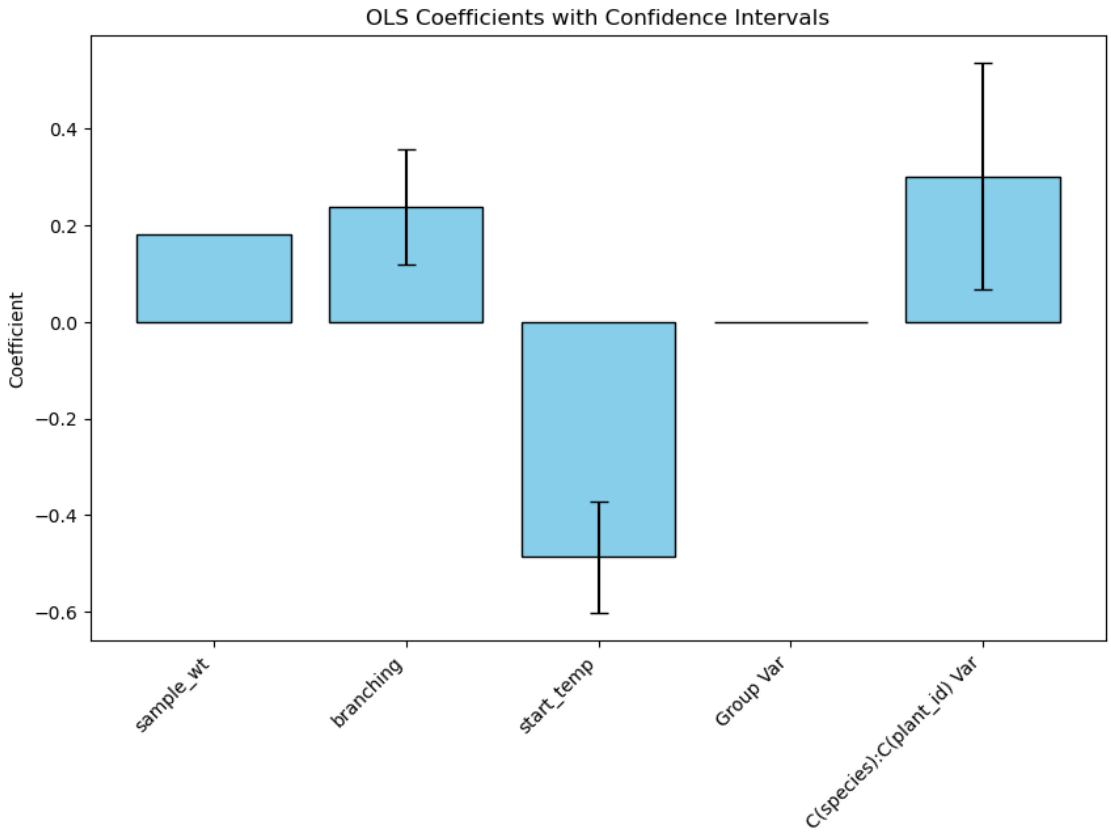
	Coef.	Std.Err.	z	P>|z|	[0.025	0.975]
Intercept	0.031	0.073	0.422	0.673	-0.112	0.174
lfm	-0.162	0.081	-2.003	0.045	-0.321	-0.004
sample_wt	0.214	0.095	2.262	0.024	0.029	0.400
branching	0.181	0.067	2.687	0.007	0.049	0.312
start_temp	-0.487	0.066	-7.388	0.000	-0.616	-0.358
branch_volume	-0.067	0.099	-0.673	0.501	-0.261	0.128
Group Var	0.000					
C(species):C(plant_id) Var	0.107	0.096				



Mixed Linear Model Regression Results

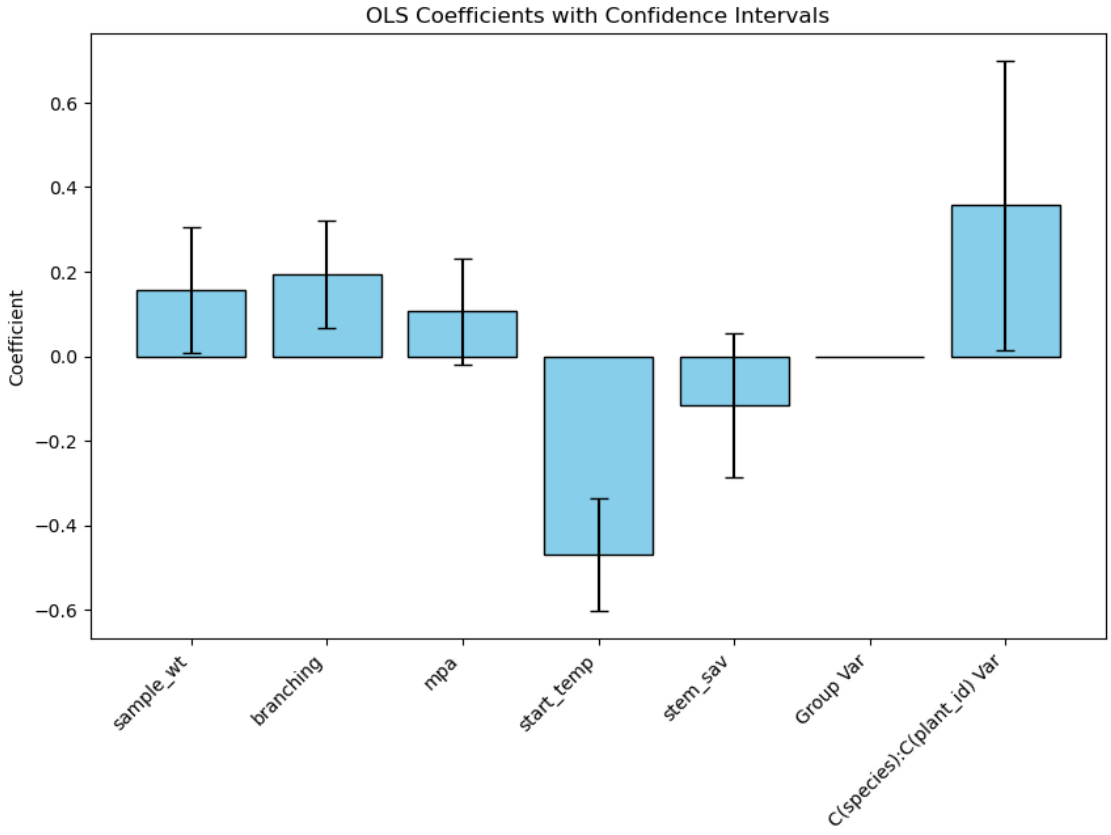
Model:	MixedLM	Dependent Variable:	temp_change
No. Observations:	158	Method:	ML
No. Groups:	7	Scale:	0.4026
Min. group size:	8	Log-Likelihood:	-168.0349
Max. group size:	37	Converged:	Yes

```
Mean group size:      22.6
------------------------------------------------------------------------
                          Coef.  Std.Err.    z    P>|z| [0.025 0.975]
------------------------------------------------------------------------
Intercept                  0.032    0.067  0.484 0.629 -0.099  0.164
sample_wt                  0.182
branching                  0.238    0.061  3.926 0.000  0.119  0.356
start_temp                -0.487    0.059 -8.232 0.000 -0.602 -0.371
Group Var                  0.000
C(species):C(plant_id) Var 0.121    0.076
========================================================================
```




```
                Mixed Linear Model Regression Results
========================================================================
Model:               MixedLM    Dependent Variable:    temp_change
No. Observations:    158        Method:                ML
No. Groups:          7          Scale:                 0.3829
Min. group size:     8          Log-Likelihood:        -166.0473
Max. group size:     37         Converged:             Yes
Mean group size:     22.6
```

	Coef.	Std.Err.	z	P>|z|	[0.025	0.975]
Intercept	0.033	0.076	0.436	0.663	-0.115	0.181
sample_wt	0.157	0.075	2.083	0.037	0.009	0.305
branching	0.194	0.065	3.003	0.003	0.067	0.321
mpa	0.106	0.064	1.661	0.097	-0.019	0.232
start_temp	-0.470	0.068	-6.947	0.000	-0.602	-0.337
stem_sav	-0.116	0.087	-1.340	0.180	-0.286	0.054
Group Var	0.000					
C(species):C(plant_id) Var	0.136	0.108				

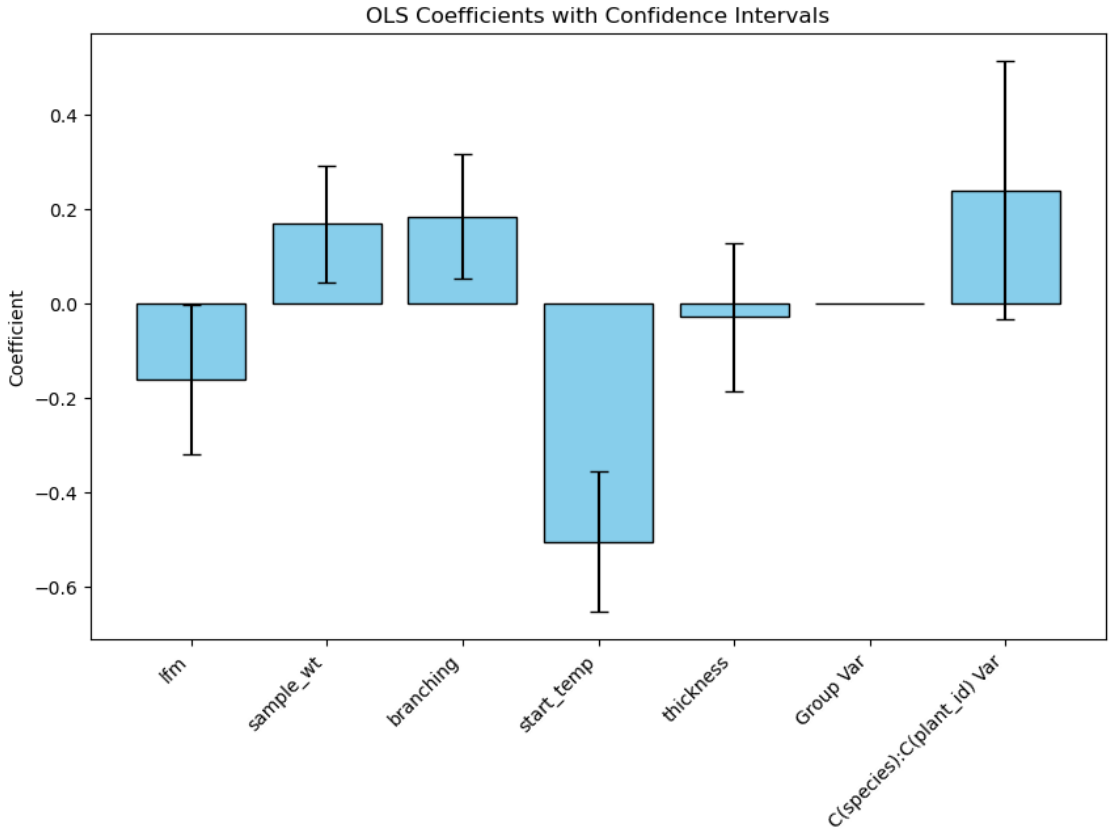


Mixed Linear Model Regression Results

Model:	MixedLM	Dependent Variable:	temp_change
No. Observations:	158	Method:	ML
No. Groups:	7	Scale:	0.4054
Min. group size:	8	Log-Likelihood:	-166.1777
Max. group size:	37	Converged:	No

Mean group size: 22.6

	Coef.	Std.Err.	z	P>|z|	[0.025	0.975]
Intercept	0.031	0.072	0.427	0.669	-0.110	0.171
lfm	-0.161	0.080	-2.012	0.044	-0.319	-0.004
sample_wt	0.168	0.063	2.665	0.008	0.044	0.292
branching	0.184	0.068	2.723	0.006	0.052	0.316
start_temp	-0.505	0.076	-6.659	0.000	-0.653	-0.356
thickness	-0.029	0.080	-0.366	0.714	-0.187	0.128
Group Var	0.000					
C(species):C(plant_id) Var	0.097	0.089				

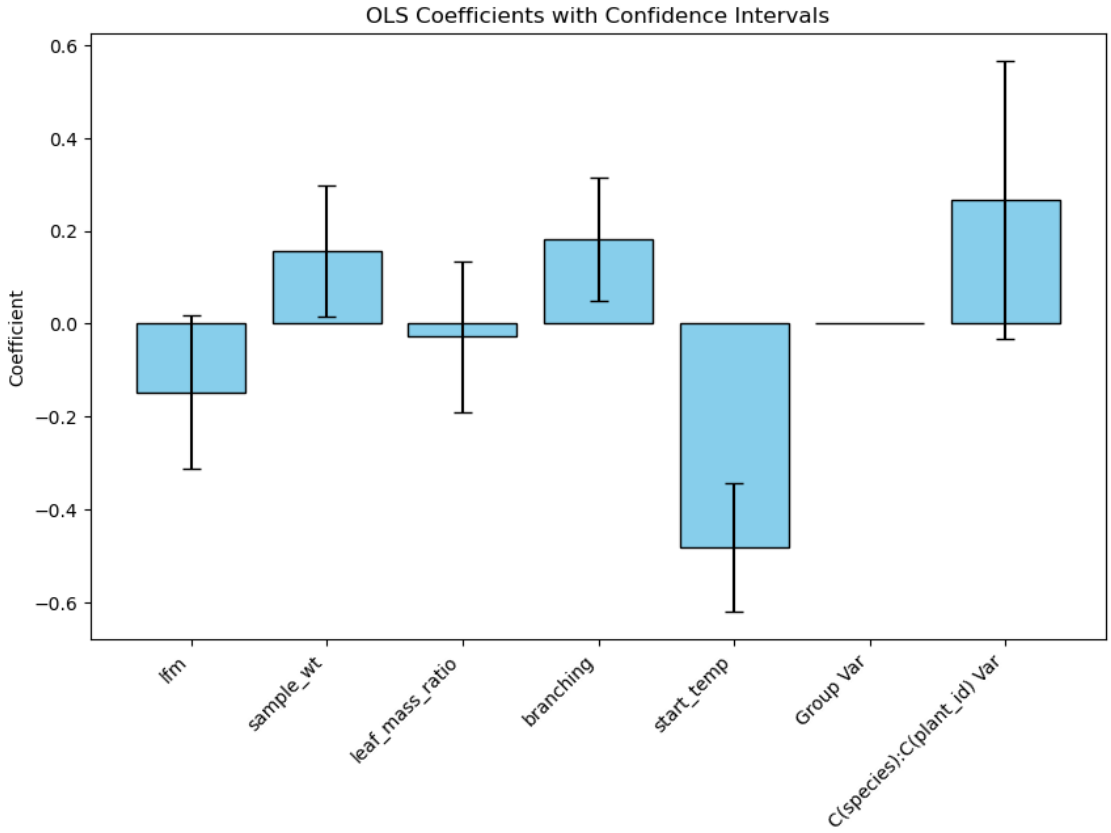


Mixed Linear Model Regression Results

Model:	MixedLM	Dependent Variable:	temp_change
No. Observations:	158	Method:	ML
No. Groups:	7	Scale:	0.3998
Min. group size:	8	Log-Likelihood:	-166.2053

Max. group size:	37	Converged:	Yes
Mean group size:	22.6		

	Coef.	Std.Err.	z	P>|z|	[0.025	0.975]
Intercept	0.032	0.073	0.439	0.661	-0.111	0.175
lfm	-0.147	0.085	-1.735	0.083	-0.313	0.019
sample_wt	0.157	0.072	2.181	0.029	0.016	0.298
leaf_mass_ratio	-0.028	0.083	-0.341	0.733	-0.190	0.134
branching	0.183	0.068	2.684	0.007	0.049	0.316
start_temp	-0.482	0.070	-6.864	0.000	-0.620	-0.345
Group Var	0.000					
C(species):C(plant_id) Var	0.107	0.097				

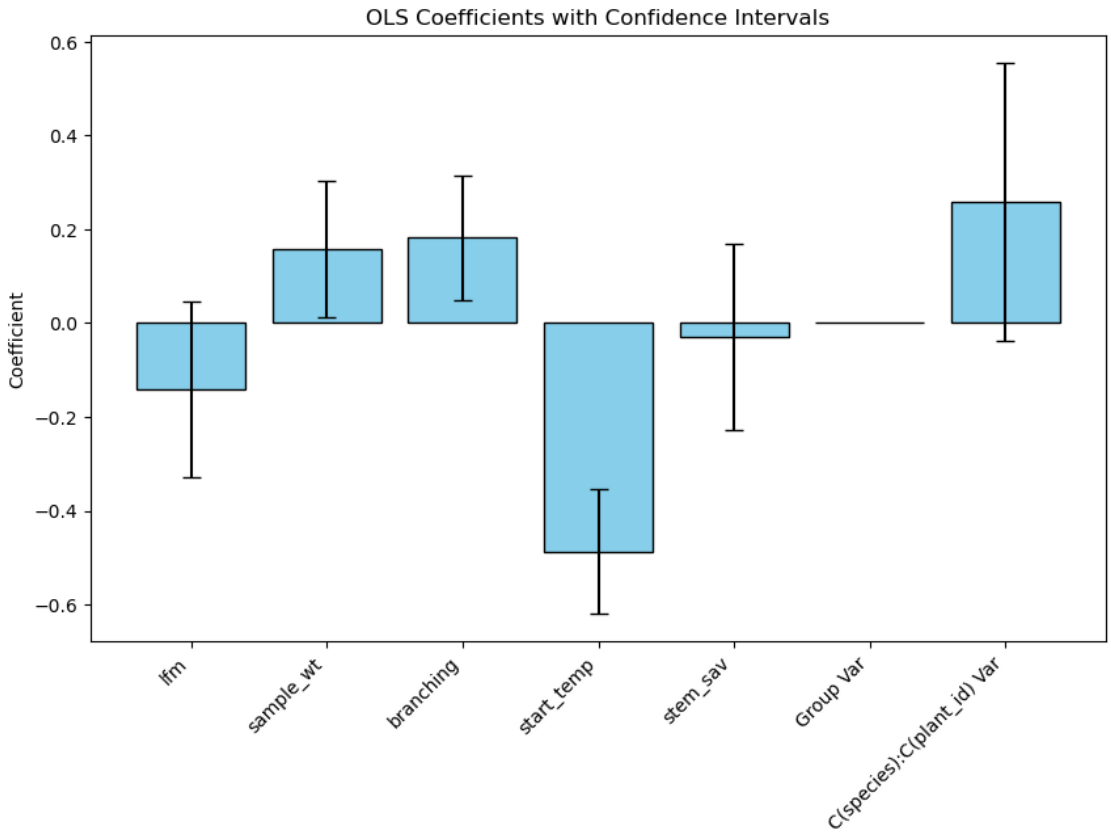


Mixed Linear Model Regression Results

Model:	MixedLM	Dependent Variable:	temp_change
No. Observations:	158	Method:	ML
No. Groups:	7	Scale:	0.4015

Min. group size:	8	Log-Likelihood:	-166.2121
Max. group size:	37	Converged:	Yes
Mean group size:	22.6		

	Coef.	Std.Err.	z	P>|z|	[0.025	0.975]
Intercept	0.031	0.073	0.427	0.670	-0.111	0.173
lfm	-0.141	0.096	-1.470	0.142	-0.329	0.047
sample_wt	0.158	0.074	2.132	0.033	0.013	0.303
branching	0.182	0.068	2.676	0.007	0.049	0.315
start_temp	-0.487	0.068	-7.188	0.000	-0.619	-0.354
stem_sav	-0.029	0.101	-0.291	0.771	-0.227	0.168
Group Var	0.000					
C(species):C(plant_id) Var	0.104	0.096				

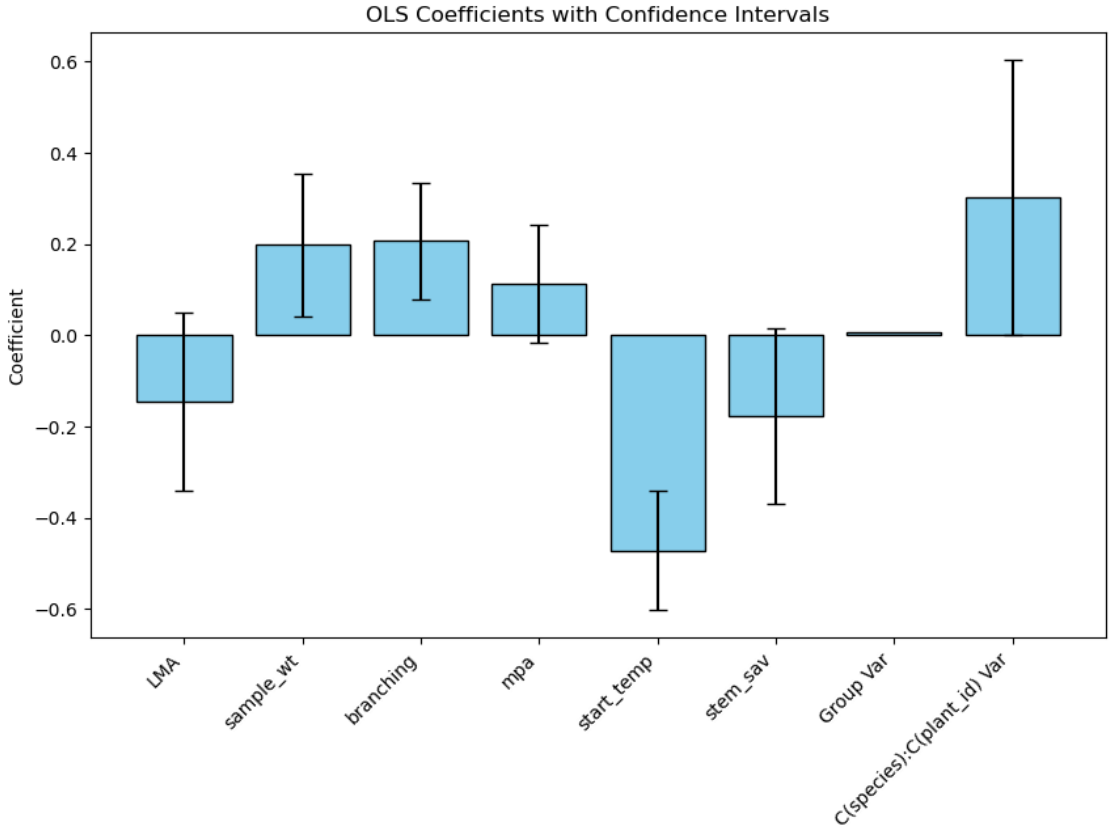


Mixed Linear Model Regression Results

Model:	MixedLM	Dependent Variable:	temp_change
No. Observations:	158	Method:	ML

No. Groups:	7	Scale:	0.3872
Min. group size:	8	Log-Likelihood:	-165.2164
Max. group size:	37	Converged:	Yes
Mean group size:	22.6		

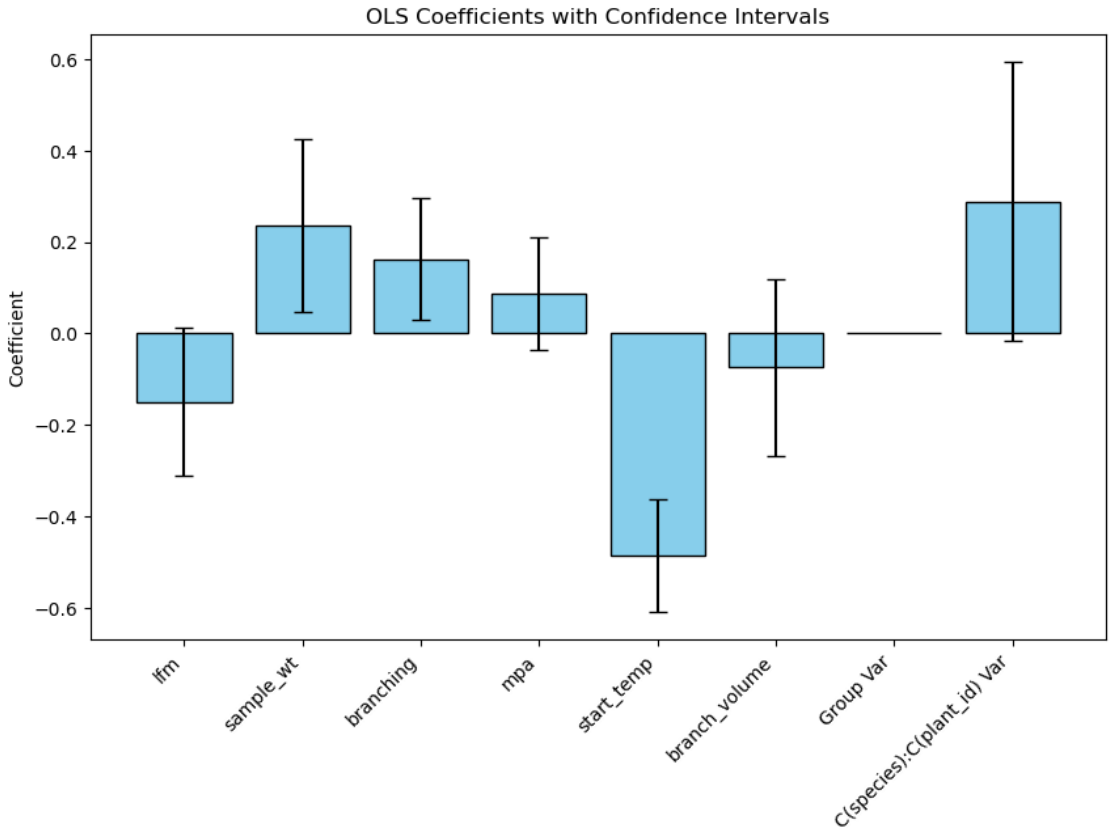
	Coef.	Std.Err.	z	P>|z|	[0.025	0.975]
Intercept	0.028	0.076	0.366	0.715	-0.121	0.176
LMA	-0.146	0.099	-1.472	0.141	-0.340	0.048
sample_wt	0.199	0.080	2.494	0.013	0.043	0.355
branching	0.206	0.065	3.182	0.001	0.079	0.333
mpa	0.112	0.066	1.703	0.089	-0.017	0.241
start_temp	-0.472	0.067	-7.082	0.000	-0.602	-0.341
stem_sav	-0.177	0.099	-1.794	0.073	-0.371	0.016
Group Var	0.003					
C(species):C(plant_id) Var	0.117	0.096				



Mixed Linear Model Regression Results

Model:	MixedLM	Dependent Variable:	temp_change
No. Observations:	158	Method:	ML
No. Groups:	7	Scale:	0.3908
Min. group size:	8	Log-Likelihood:	-165.2415
Max. group size:	37	Converged:	Yes
Mean group size:	22.6		

	Coef.	Std.Err.	z	P>|z|	[0.025	0.975]
Intercept	0.033	0.073	0.453	0.651	-0.110	0.177
lfm	-0.149	0.083	-1.794	0.073	-0.312	0.014
sample_wt	0.236	0.096	2.457	0.014	0.048	0.425
branching	0.162	0.068	2.385	0.017	0.029	0.295
mpa	0.086	0.063	1.376	0.169	-0.037	0.209
start_temp	-0.486	0.063	-7.736	0.000	-0.609	-0.363
branch_volume	-0.074	0.099	-0.752	0.452	-0.268	0.119
Group Var	0.000					
C(species):C(plant_id) Var	0.113	0.097				



7 Heat Flux Change

[15]:
```
yvar='heat_flux_change'
cols=cols_use
df=flam
compare_predictors_mixedeff(df, cols, yvar)
```

	cols	aics	pvals	coefs	top_mod
0	mpa	411.826041	-0.046794	6.066879e-01	True
1	thickness	411.597043	0.081887	4.818602e-01	True
2	dmc	410.370768	0.142433	1.813702e-01	True
3	start_temp	409.489495	0.152893	1.064645e-01	False
4	lfm	407.509224	-0.302763	3.131805e-02	False
5	leaf_sav	407.063694	-0.289654	3.109377e-02	False
6	leaf_mass_ratio	406.447131	-0.288720	9.929759e-03	False
7	stem_sav	405.623189	-0.354519	1.509678e-03	False
8	branching	404.072725	0.223362	3.867067e-03	False
9	LMA	391.352558	0.534987	6.245420e-07	False
10	branch_volume	391.130515	0.396857	1.602737e-06	False
11	sample_wt	331.797298	0.728534	1.295792e-20	False

[16]:
```
AIC_iterator(flam, cols_use, Y_VAR='heat_flux_change',
             minnumsingle=mns, maxnumsingle=mxs, minnumint=mni, maxnumint=mxi)
```

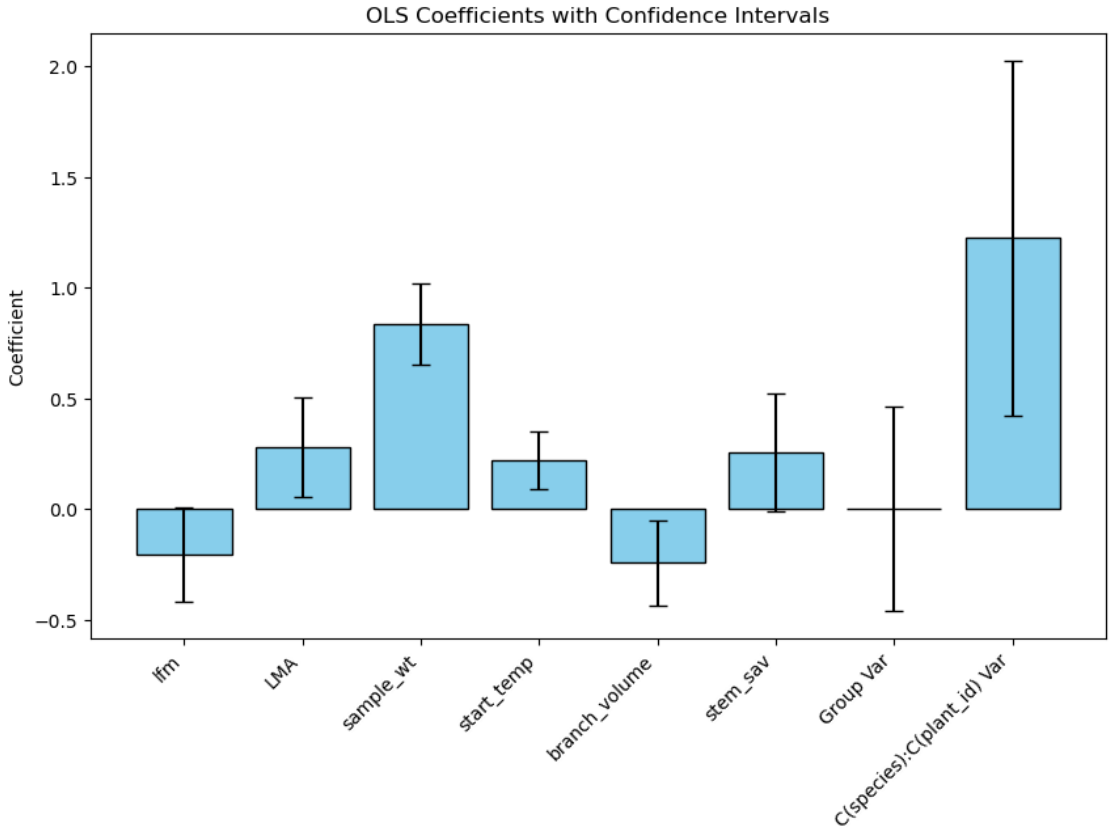
```
ERROR: Formula model error: heat_flux_change ~ leaf_sav*thickness

Columns present in sig. interaction terms: {'start_temp', 'sample_wt'}

Total Num. Cols : Num. Sig. Int. Cols;  12 : 2

Significant Interactions:
('sample_wt', 'start_temp')

Number of formulas: 4096
ERROR: Formula model error: heat_flux_change ~


heat_flux_change ~ lfm + LMA + sample_wt + start_temp + branch_volume + stem_sav
heat_flux_change ~ lfm + LMA + sample_wt + start_temp + branch_volume + stem_sav
+ leaf_sav
heat_flux_change ~ LMA + sample_wt + start_temp + branch_volume
heat_flux_change ~ LMA + sample_wt + branching + start_temp + branch_volume
heat_flux_change ~ lfm + LMA + sample_wt + start_temp + branch_volume + stem_sav
+ thickness
heat_flux_change ~ LMA + sample_wt + branching + start_temp + branch_volume +
stem_sav
heat_flux_change ~ lfm + LMA + sample_wt + branching + start_temp +
branch_volume + stem_sav
```

```
heat_flux_change ~ LMA + sample_wt + start_temp + branch_volume + stem_sav
heat_flux_change ~ lfm + LMA + sample_wt + start_temp + branch_volume
heat_flux_change ~ LMA + sample_wt + mpa + start_temp + branch_volume
heat_flux_change ~ lfm + LMA + sample_wt + mpa + start_temp + branch_volume +
stem_sav
heat_flux_change ~ lfm + LMA + sample_wt + start_temp + dmc + branch_volume +
stem_sav
heat_flux_change ~ lfm + LMA + sample_wt + leaf_mass_ratio + start_temp +
branch_volume + stem_sav
heat_flux_change ~ lfm + LMA + sample_wt + start_temp + branch_volume + stem_sav
+ leaf_sav + thickness
heat_flux_change ~ LMA + sample_wt + start_temp + branch_volume + thickness
```

Mixed Linear Model Regression Results

Model:	MixedLM	Dependent Variable:	heat_flux_change
No. Observations:	158	Method:	ML
No. Groups:	7	Scale:	0.2437
Min. group size:	8	Log-Likelihood:	-149.8710
Max. group size:	37	Converged:	Yes
Mean group size:	22.6		

	Coef.	Std.Err.	z	P>|z|	[0.025	0.975]
Intercept	-0.005	0.092	-0.058	0.954	-0.186	0.175
lfm	-0.207	0.109	-1.904	0.057	-0.421	0.006
LMA	0.280	0.115	2.441	0.015	0.055	0.504
sample_wt	0.837	0.093	8.986	0.000	0.655	1.020
start_temp	0.219	0.067	3.290	0.001	0.088	0.349
branch_volume	-0.242	0.098	-2.474	0.013	-0.434	-0.050
stem_sav	0.255	0.135	1.885	0.059	-0.010	0.520
Group Var	0.001	0.117				
C(species):C(plant_id) Var	0.299	0.202				

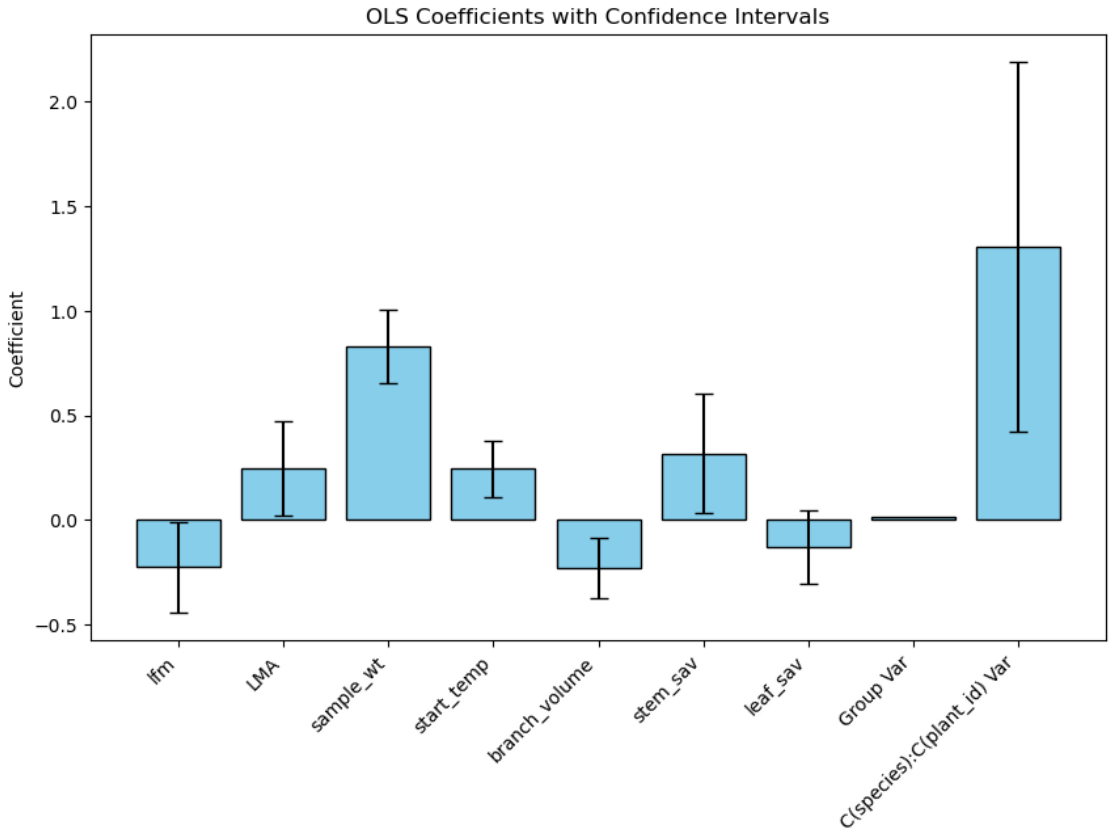


Mixed Linear Model Regression Results

Model:	MixedLM	Dependent Variable:	heat_flux_change
No. Observations:	158	Method:	ML
No. Groups:	7	Scale:	0.2374
Min. group size:	8	Log-Likelihood:	-149.1485
Max. group size:	37	Converged:	No
Mean group size:	22.6		

	Coef.	Std.Err.	z	P>|z|	[0.025	0.975]
Intercept	-0.001	0.091	-0.007	0.994	-0.179	0.178
lfm	-0.227	0.110	-2.054	0.040	-0.443	-0.010
LMA	0.247	0.116	2.129	0.033	0.020	0.474
sample_wt	0.829	0.091	9.133	0.000	0.651	1.007
start_temp	0.244	0.068	3.560	0.000	0.110	0.378
branch_volume	-0.231	0.074	-3.118	0.002	-0.376	-0.086
stem_sav	0.317	0.145	2.184	0.029	0.033	0.602
leaf_sav	-0.130	0.089	-1.466	0.143	-0.304	0.044
Group Var	0.004					
C(species):C(plant_id) Var	0.310	0.220				

==========

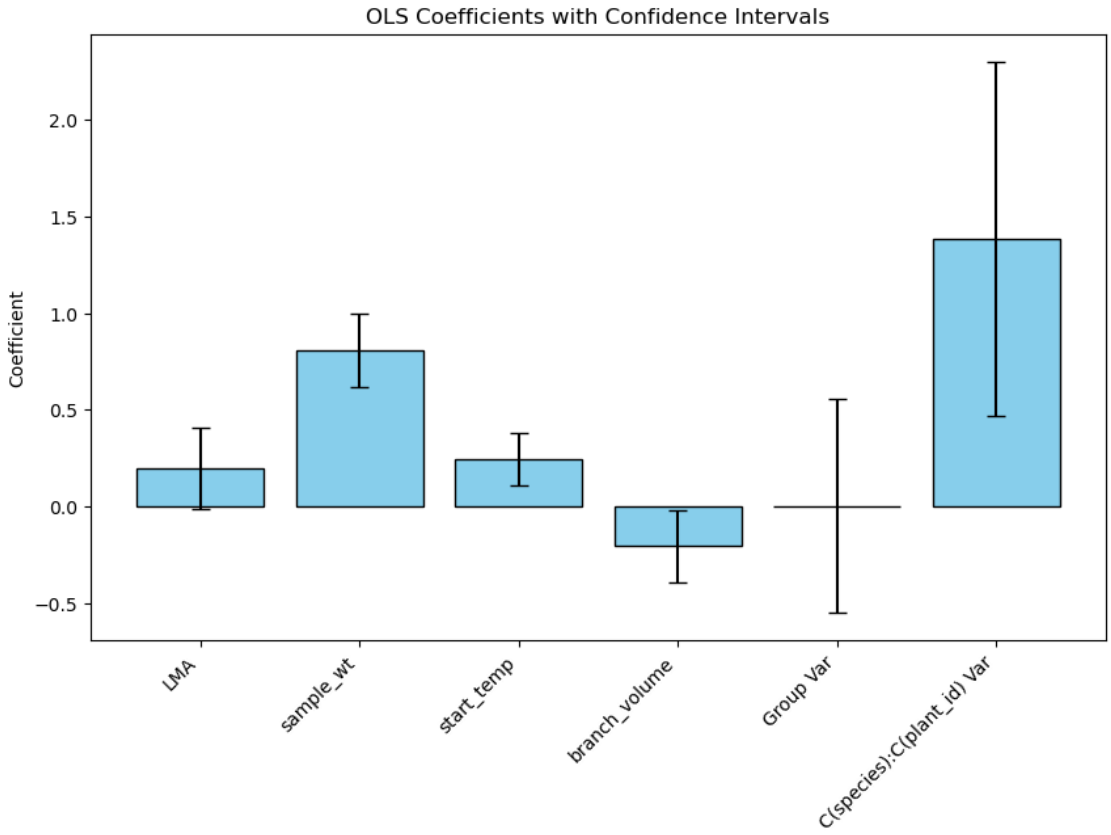


Mixed Linear Model Regression Results

Model:	MixedLM	Dependent Variable:	heat_flux_change
No. Observations:	158	Method:	ML
No. Groups:	7	Scale:	0.2435
Min. group size:	8	Log-Likelihood:	-152.1711
Max. group size:	37	Converged:	Yes
Mean group size:	22.6		

	Coef.	Std.Err.	z	P>|z|	[0.025	0.975]
Intercept	-0.026	0.100	-0.263	0.792	-0.223	0.170
LMA	0.198	0.107	1.856	0.063	-0.011	0.407
sample_wt	0.806	0.097	8.324	0.000	0.616	0.996
start_temp	0.245	0.070	3.514	0.000	0.108	0.382
branch_volume	-0.204	0.095	-2.147	0.032	-0.389	-0.018
Group Var	0.001	0.139				
C(species):C(plant_id) Var	0.338	0.230				

==========

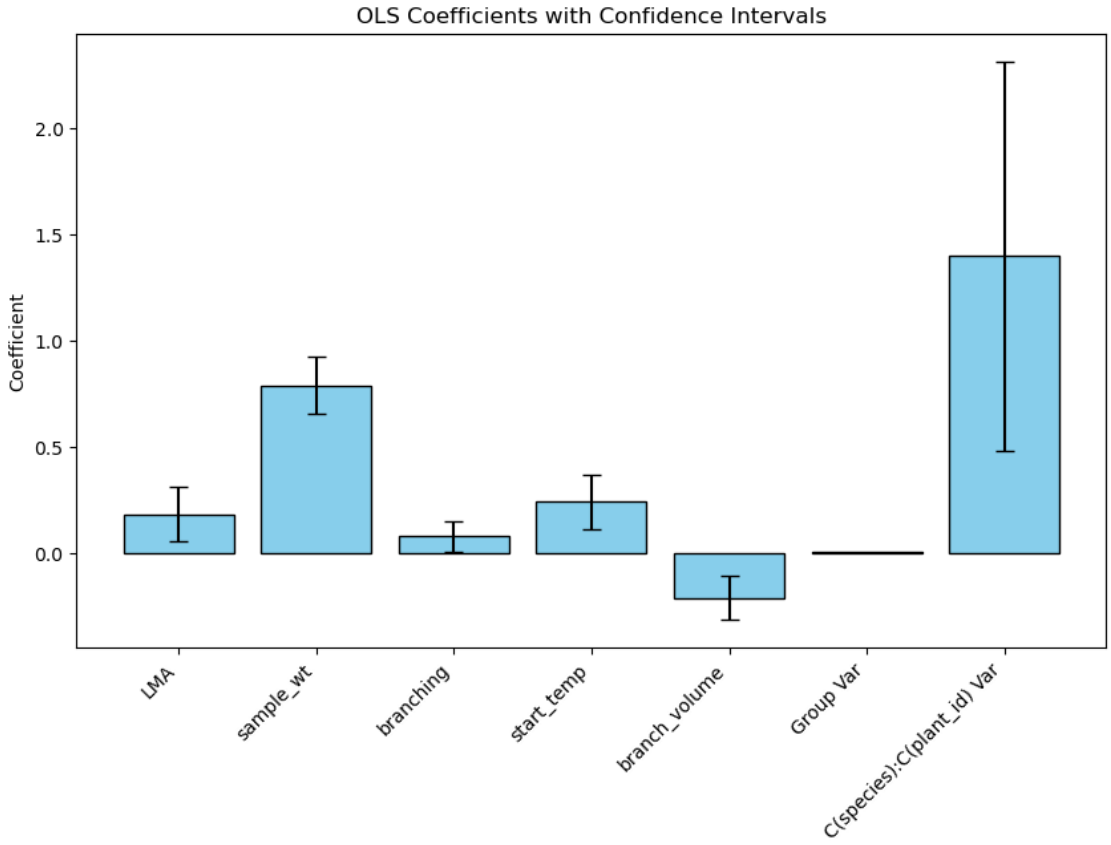


Mixed Linear Model Regression Results

Model:	MixedLM	Dependent Variable:	heat_flux_change
No. Observations:	158	Method:	ML
No. Groups:	7	Scale:	0.2399
Min. group size:	8	Log-Likelihood:	-151.2040
Max. group size:	37	Converged:	Yes
Mean group size:	22.6		

	Coef.	Std.Err.	z	P>|z|	[0.025	0.975]
Intercept	-0.022	0.085	-0.257	0.797	-0.188	0.145
LMA	0.185	0.065	2.828	0.005	0.057	0.313
sample_wt	0.792	0.070	11.328	0.000	0.655	0.929
branching	0.082	0.036	2.251	0.024	0.011	0.153
start_temp	0.242	0.065	3.731	0.000	0.115	0.370
branch_volume	-0.209	0.052	-3.996	0.000	-0.312	-0.106
Group Var	0.001					

```
C(species):C(plant_id) Var  0.336    0.229
=============================================================================
```

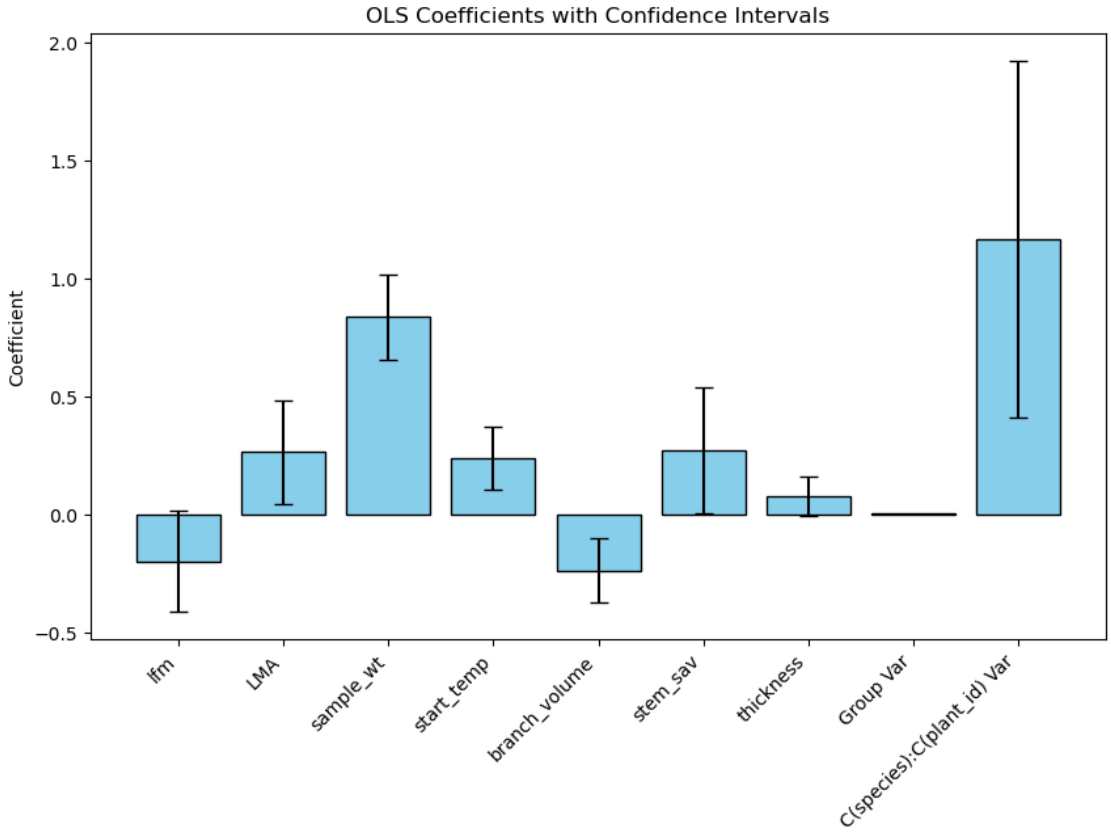


Mixed Linear Model Regression Results

Model:	MixedLM	Dependent Variable:	heat_flux_change
No. Observations:	158	Method:	ML
No. Groups:	7	Scale:	0.2453
Min. group size:	8	Log-Likelihood:	-149.4937
Max. group size:	37	Converged:	Yes
Mean group size:	22.6		

	Coef.	Std.Err.	z	P>|z|	[0.025	0.975]
Intercept	-0.001	0.087	-0.010	0.992	-0.171	0.169
lfm	-0.197	0.108	-1.813	0.070	-0.409	0.016
LMA	0.266	0.111	2.396	0.017	0.048	0.483
sample_wt	0.836	0.091	9.162	0.000	0.657	1.015
start_temp	0.241	0.068	3.531	0.000	0.107	0.376
branch_volume	-0.235	0.069	-3.431	0.001	-0.369	-0.101

stem_sav	0.273	0.135	2.019	0.044	0.008	0.537
thickness	0.081	0.043	1.893	0.058	-0.003	0.165
Group Var	0.002					
C(species):C(plant_id) Var	0.286	0.191				

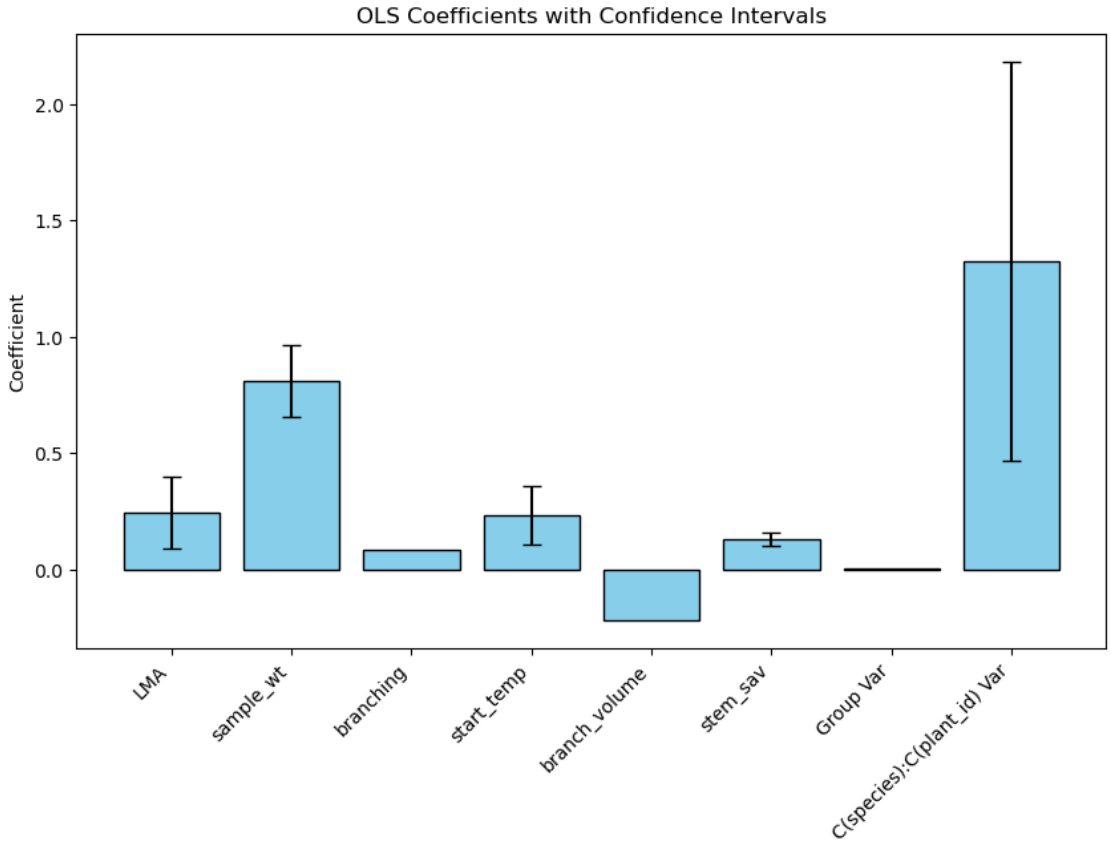


Mixed Linear Model Regression Results

Model:	MixedLM	Dependent Variable:	heat_flux_change
No. Observations:	158	Method:	ML
No. Groups:	7	Scale:	0.2414
Min. group size:	8	Log-Likelihood:	-150.5856
Max. group size:	37	Converged:	Yes
Mean group size:	22.6		

	Coef.	Std.Err.	z	P>|z|	[0.025	0.975]
Intercept	-0.013	0.059	-0.229	0.819	-0.129	0.102
LMA	0.244	0.080	3.062	0.002	0.088	0.400
sample_wt	0.809	0.080	10.165	0.000	0.653	0.965

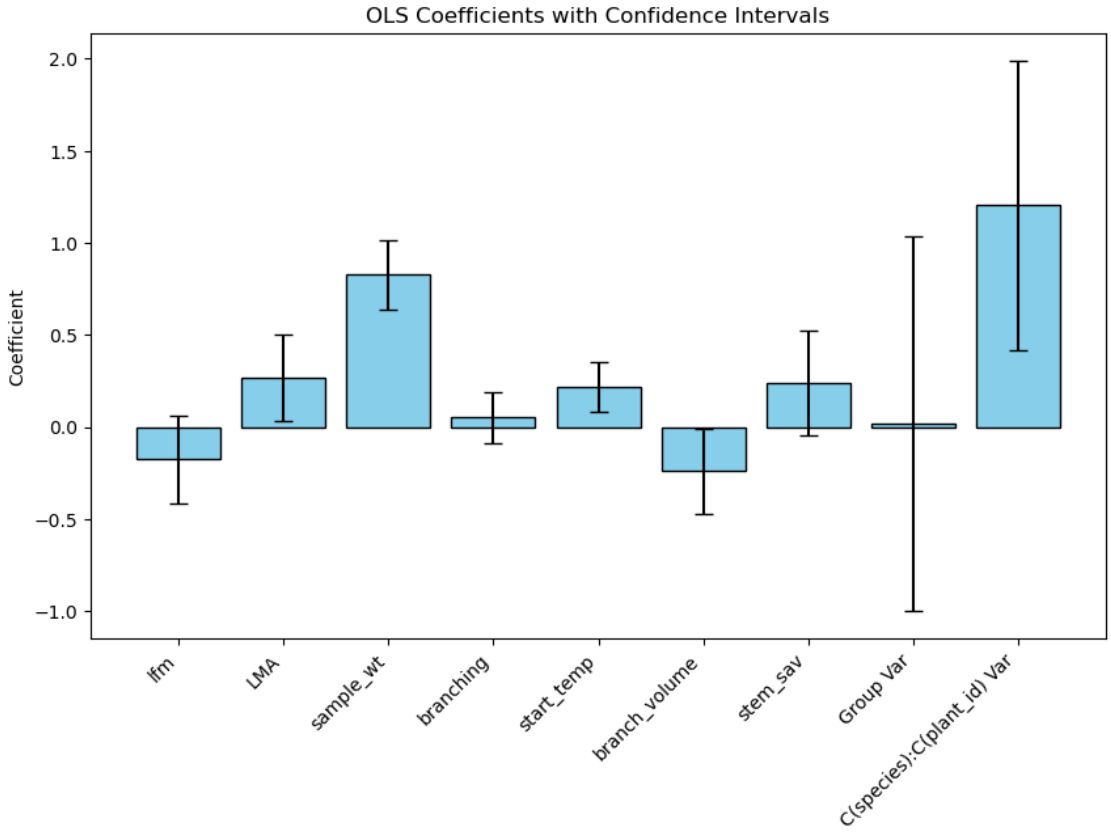
```
branching                    0.084
start_temp                   0.233    0.065  3.591 0.000  0.106  0.359
branch_volume               -0.219
stem_sav                     0.130    0.015  8.429 0.000  0.100  0.160
Group Var                    0.001
C(species):C(plant_id) Var   0.320    0.215
=================================================================
```



Mixed Linear Model Regression Results

```
=================================================================
Model:              MixedLM   Dependent Variable:   heat_flux_change
No. Observations:   158       Method:               ML
No. Groups:         7         Scale:                0.2431
Min. group size:    8         Log-Likelihood:       -149.5988
Max. group size:    37        Converged:            No
Mean group size:    22.6
-----------------------------------------------------------------
                    Coef.  Std.Err.   z    P>|z| [0.025 0.975]
-----------------------------------------------------------------
Intercept           -0.003    0.098 -0.034 0.973 -0.195  0.188
```

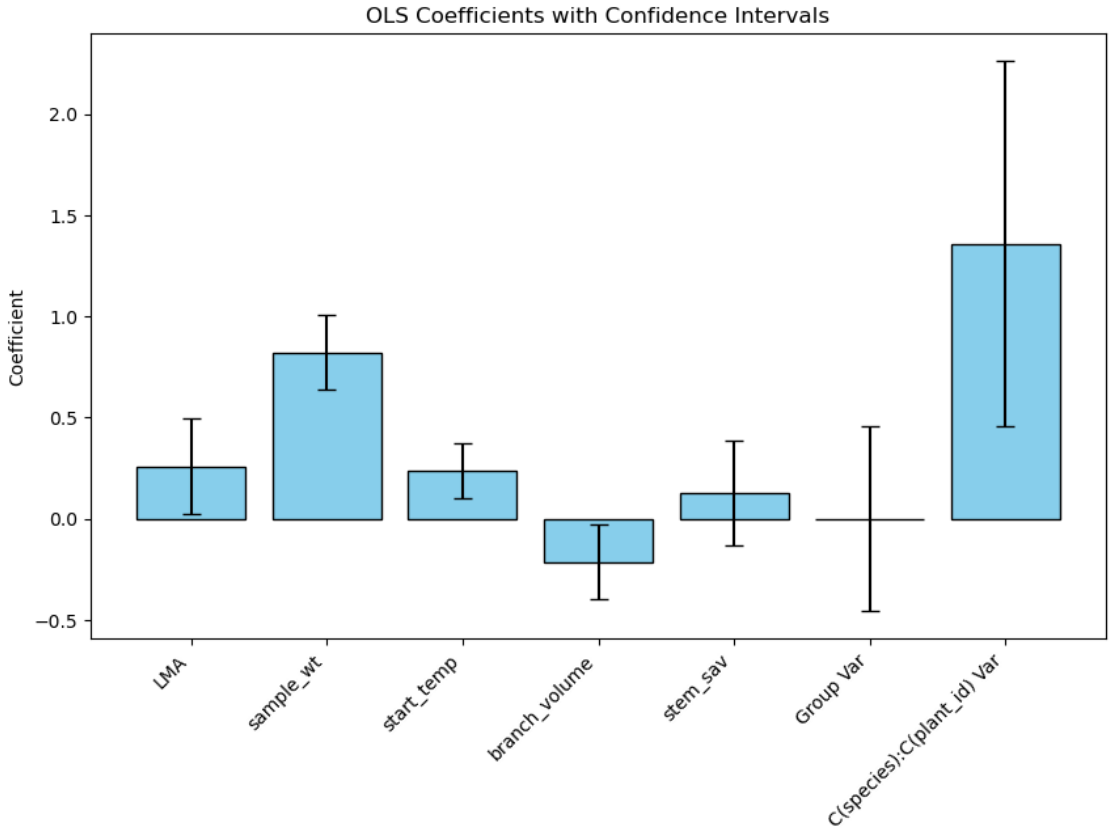
lfm	-0.175	0.122	-1.431	0.152	-0.415	0.065
LMA	0.268	0.120	2.236	0.025	0.033	0.502
sample_wt	0.828	0.096	8.615	0.000	0.640	1.016
branching	0.052	0.071	0.729	0.466	-0.088	0.191
start_temp	0.219	0.068	3.228	0.001	0.086	0.351
branch_volume	-0.239	0.118	-2.032	0.042	-0.469	-0.008
stem_sav	0.238	0.145	1.645	0.100	-0.046	0.522
Group Var	0.005	0.256				
C(species):C(plant_id) Var	0.293	0.197				



Mixed Linear Model Regression Results

Model:	MixedLM	Dependent Variable:	heat_flux_change
No. Observations:	158	Method:	ML
No. Groups:	7	Scale:	0.2431
Min. group size:	8	Log-Likelihood:	-151.6062
Max. group size:	37	Converged:	Yes
Mean group size:	22.6		

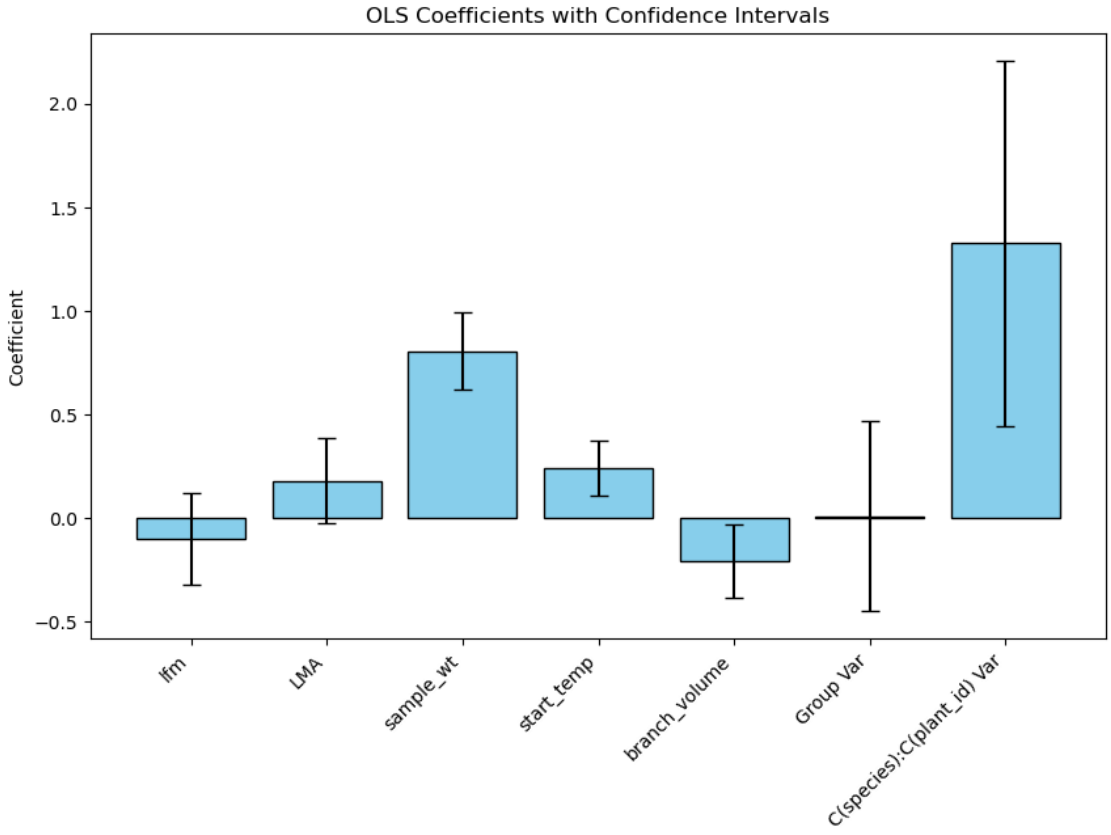
	Coef.	Std.Err.	z	P>|z|	[0.025	0.975]
Intercept	-0.019	0.101	-0.187	0.851	-0.217	0.179
LMA	0.257	0.120	2.143	0.032	0.022	0.493
sample_wt	0.822	0.095	8.653	0.000	0.636	1.008
start_temp	0.237	0.069	3.417	0.001	0.101	0.373
branch_volume	-0.214	0.094	-2.270	0.023	-0.398	-0.029
stem_sav	0.126	0.131	0.957	0.339	-0.132	0.383
Group Var	0.000	0.115				
C(species):C(plant_id) Var	0.330	0.227				



Mixed Linear Model Regression Results

Model:	MixedLM	Dependent Variable:	heat_flux_change
No. Observations:	158	Method:	ML
No. Groups:	7	Scale:	0.2444
Min. group size:	8	Log-Likelihood:	-151.6172
Max. group size:	37	Converged:	Yes
Mean group size:	22.6		

	Coef.	Std.Err.	z	P>|z|	[0.025	0.975]
Intercept	-0.024	0.095	-0.249	0.804	-0.210	0.163
lfm	-0.103	0.112	-0.920	0.358	-0.324	0.117
LMA	0.178	0.106	1.687	0.092	-0.029	0.386
sample_wt	0.804	0.096	8.356	0.000	0.615	0.993
start_temp	0.240	0.068	3.549	0.000	0.108	0.373
branch_volume	-0.212	0.090	-2.354	0.019	-0.389	-0.036
Group Var	0.002	0.116				
C(species):C(plant_id) Var	0.324	0.222				

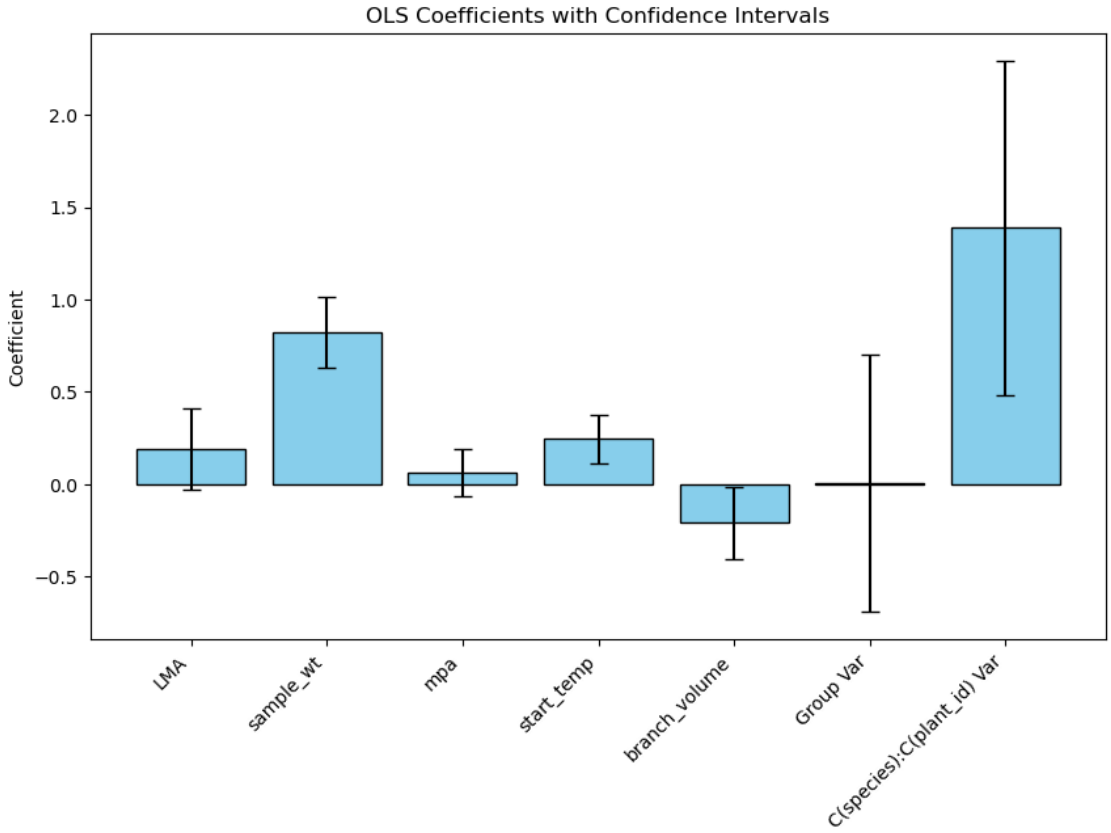


Mixed Linear Model Regression Results

Model:	MixedLM	Dependent Variable:	heat_flux_change
No. Observations:	158	Method:	ML
No. Groups:	7	Scale:	0.2419
Min. group size:	8	Log-Likelihood:	-151.6798
Max. group size:	37	Converged:	Yes

Mean group size: 22.6

	Coef.	Std.Err.	z	P>|z|	[0.025	0.975]
Intercept	-0.023	0.102	-0.221	0.825	-0.223	0.178
LMA	0.190	0.112	1.696	0.090	-0.030	0.409
sample_wt	0.821	0.098	8.360	0.000	0.628	1.013
mpa	0.065	0.066	0.992	0.321	-0.064	0.194
start_temp	0.245	0.068	3.600	0.000	0.112	0.379
branch_volume	-0.207	0.099	-2.091	0.037	-0.402	-0.013
Group Var	0.001	0.174				
C(species):C(plant_id) Var	0.335	0.227				

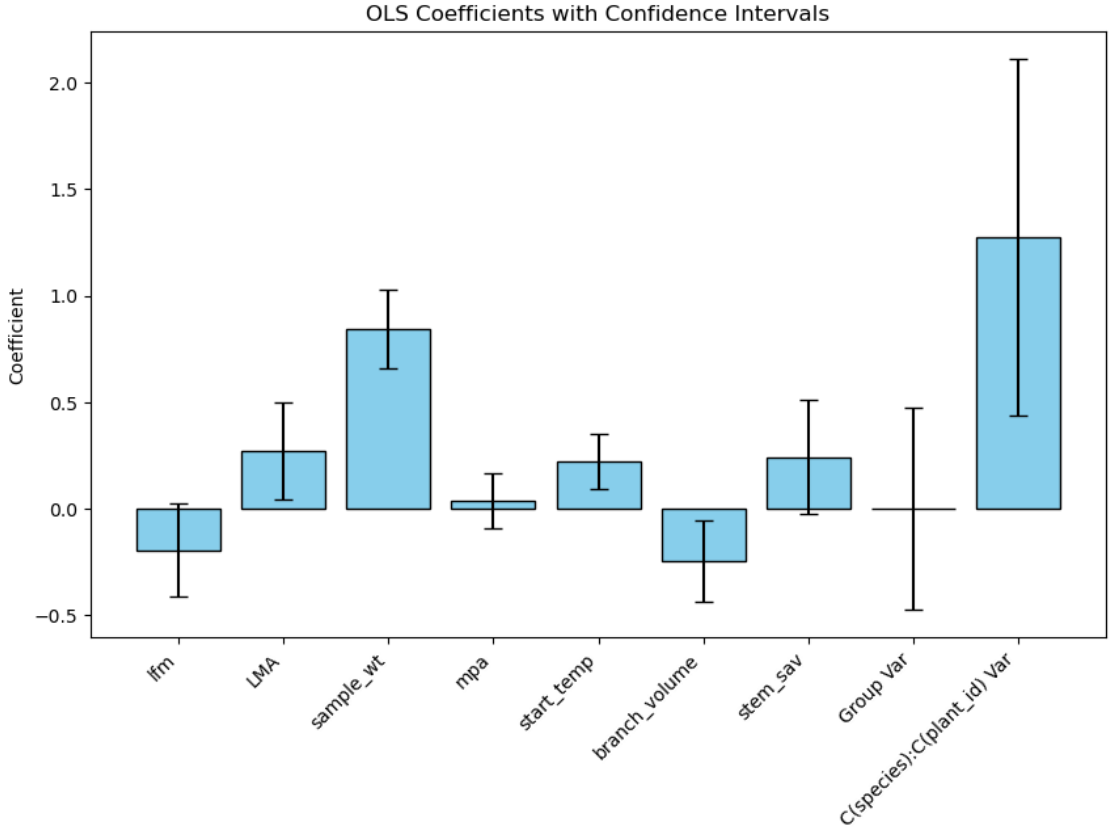


Mixed Linear Model Regression Results

Model:	MixedLM	Dependent Variable:	heat_flux_change
No. Observations:	158	Method:	ML
No. Groups:	7	Scale:	0.2410
Min. group size:	8	Log-Likelihood:	-149.6815

Max. group size: 37 Converged: Yes
Mean group size: 22.6

	Coef.	Std.Err.	z	P>|z|	[0.025	0.975]
Intercept	-0.005	0.092	-0.050	0.960	-0.186	0.176
lfm	-0.194	0.112	-1.728	0.084	-0.413	0.026
LMA	0.273	0.116	2.349	0.019	0.045	0.500
sample_wt	0.844	0.094	9.006	0.000	0.661	1.028
mpa	0.039	0.066	0.583	0.560	-0.091	0.169
start_temp	0.221	0.067	3.317	0.001	0.091	0.352
branch_volume	-0.243	0.097	-2.496	0.013	-0.433	-0.052
stem_sav	0.244	0.138	1.772	0.076	-0.026	0.514
Group Var	0.000	0.118				
C(species):C(plant_id) Var	0.307	0.209				

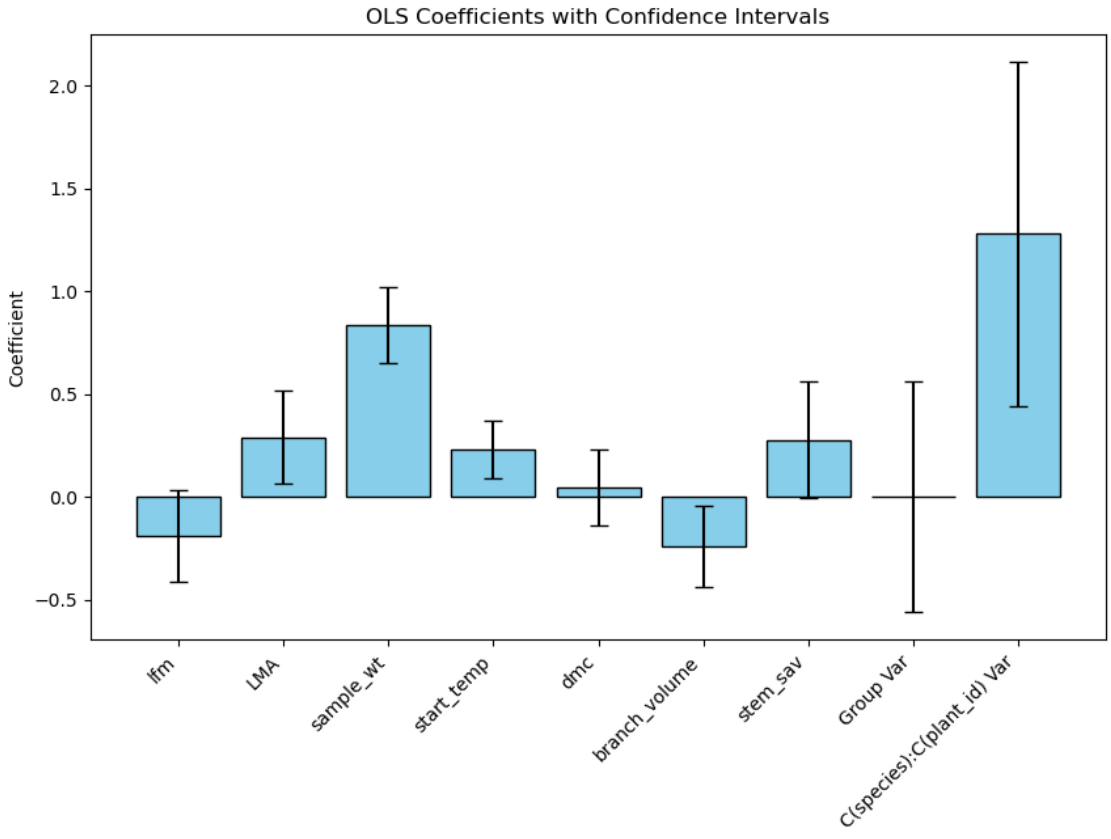


Mixed Linear Model Regression Results

Model: MixedLM Dependent Variable: heat_flux_change

No. Observations:	158	Method:	ML
No. Groups:	7	Scale:	0.2411
Min. group size:	8	Log-Likelihood:	-149.7401
Max. group size:	37	Converged:	No
Mean group size:	22.6		

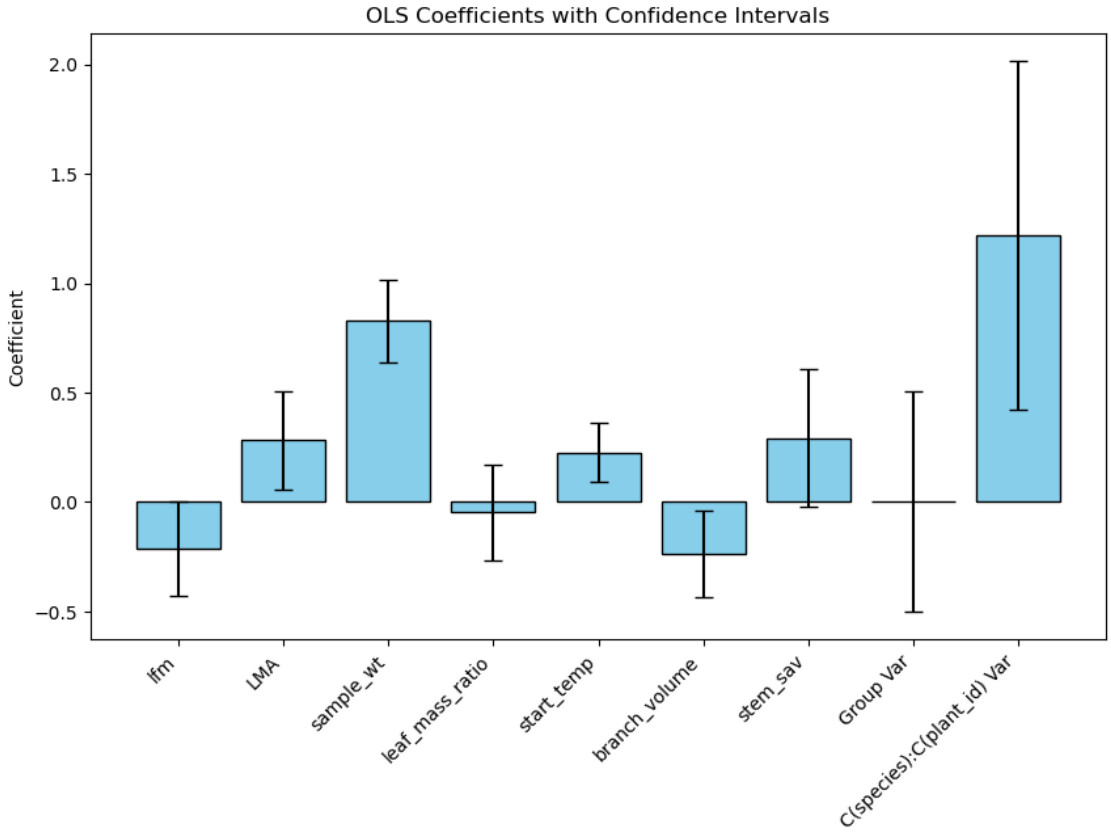
	Coef.	Std.Err.	z	P>|z|	[0.025	0.975]
Intercept	-0.005	0.094	-0.054	0.957	-0.189	0.179
lfm	-0.193	0.114	-1.694	0.090	-0.416	0.030
LMA	0.289	0.116	2.494	0.013	0.062	0.515
sample_wt	0.833	0.094	8.888	0.000	0.649	1.017
start_temp	0.231	0.071	3.265	0.001	0.092	0.370
dmc	0.044	0.095	0.463	0.644	-0.142	0.229
branch_volume	-0.242	0.102	-2.379	0.017	-0.441	-0.043
stem_sav	0.277	0.143	1.938	0.053	-0.003	0.558
Group Var	0.000	0.140				
C(species):C(plant_id) Var	0.308	0.210				



Mixed Linear Model Regression Results

Model:	MixedLM	Dependent Variable:	heat_flux_change
No. Observations:	158	Method:	ML
No. Groups:	7	Scale:	0.2438
Min. group size:	8	Log-Likelihood:	-149.7790
Max. group size:	37	Converged:	No
Mean group size:	22.6		

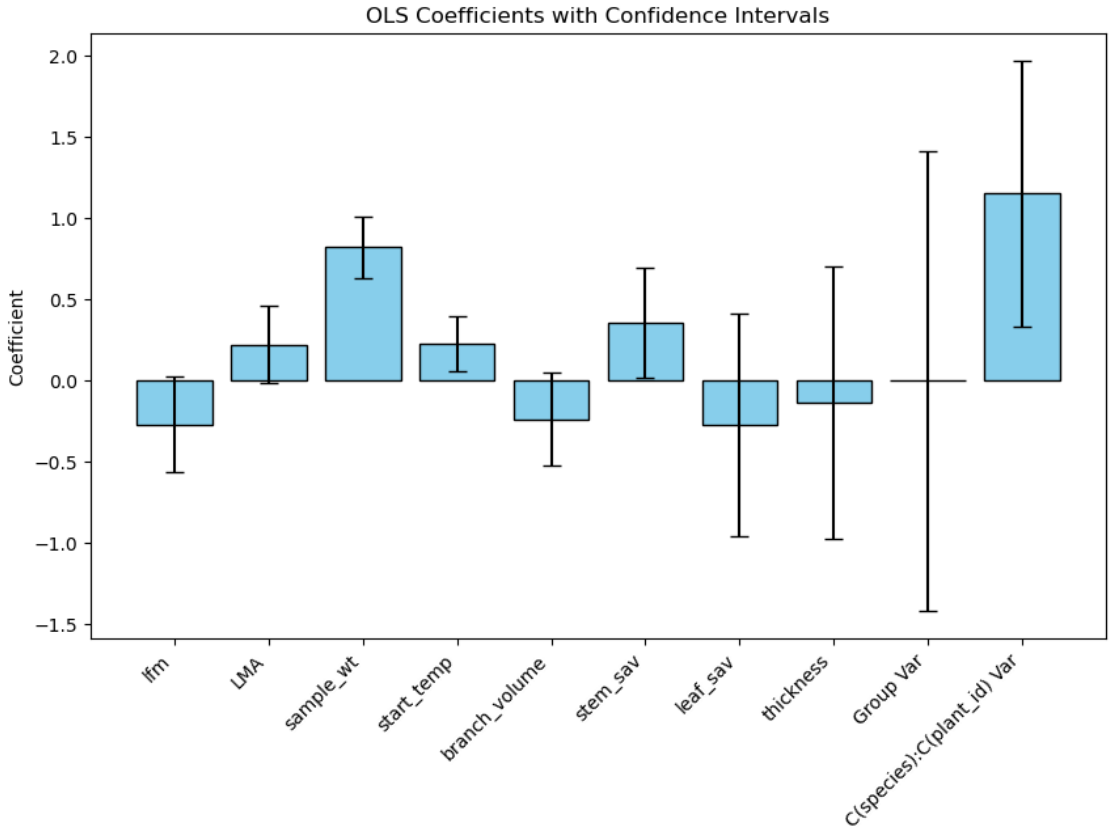
	Coef.	Std.Err.	z	P>|z|	[0.025	0.975]
Intercept	-0.004	0.093	-0.047	0.963	-0.187	0.178
lfm	-0.212	0.109	-1.939	0.053	-0.426	0.002
LMA	0.282	0.114	2.471	0.013	0.058	0.506
sample_wt	0.827	0.097	8.574	0.000	0.638	1.017
leaf_mass_ratio	-0.048	0.111	-0.427	0.669	-0.266	0.171
start_temp	0.226	0.069	3.295	0.001	0.092	0.360
branch_volume	-0.236	0.101	-2.344	0.019	-0.434	-0.039
stem_sav	0.292	0.160	1.824	0.068	-0.022	0.607
Group Var	0.001	0.127				
C(species):C(plant_id) Var	0.297	0.200				



Mixed Linear Model Regression Results

Model:	MixedLM	Dependent Variable:	heat_flux_change
No. Observations:	158	Method:	ML
No. Groups:	7	Scale:	0.2442
Min. group size:	8	Log-Likelihood:	-148.8046
Max. group size:	37	Converged:	Yes
Mean group size:	22.6		

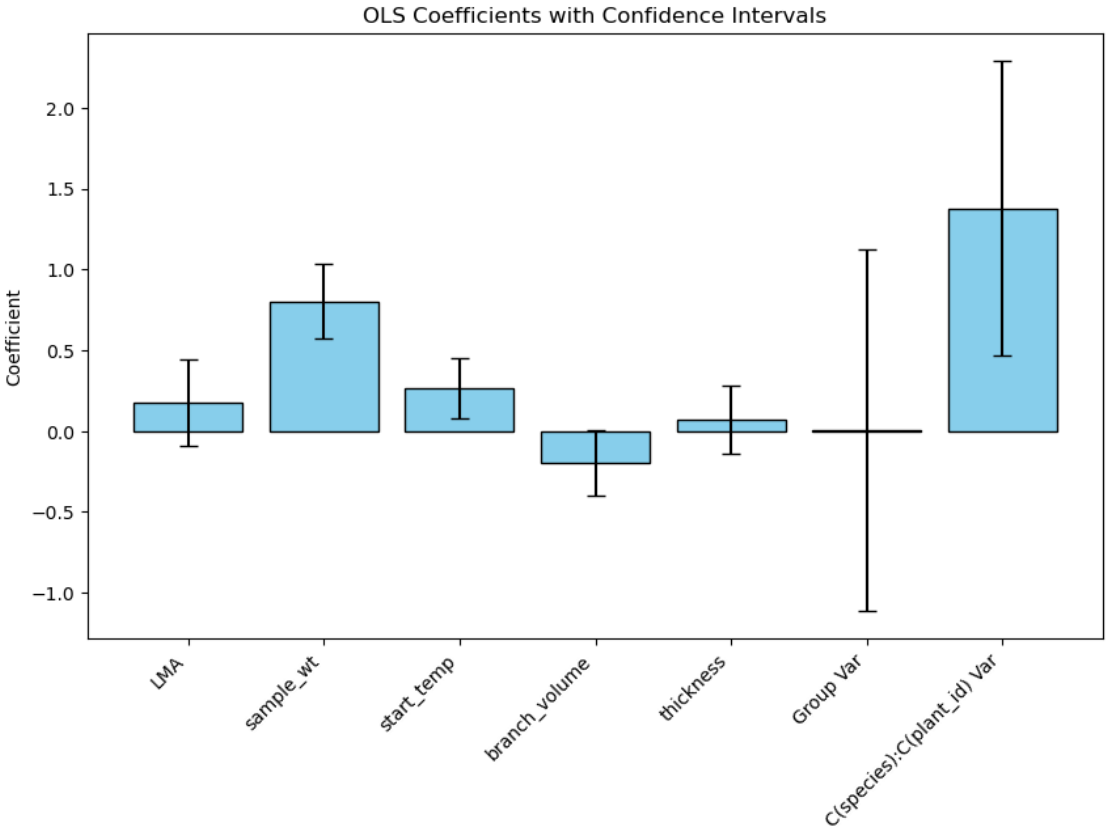
	Coef.	Std.Err.	z	P>|z|	[0.025	0.975]
Intercept	-0.003	0.098	-0.033	0.973	-0.196	0.189
lfm	-0.268	0.152	-1.770	0.077	-0.565	0.029
LMA	0.223	0.122	1.832	0.067	-0.016	0.461
sample_wt	0.824	0.097	8.538	0.000	0.635	1.014
start_temp	0.226	0.087	2.593	0.010	0.055	0.396
branch_volume	-0.236	0.147	-1.602	0.109	-0.524	0.053
stem_sav	0.356	0.172	2.063	0.039	0.018	0.694
leaf_sav	-0.275	0.350	-0.785	0.433	-0.960	0.411
thickness	-0.132	0.428	-0.308	0.758	-0.971	0.707
Group Var	0.000	0.357				
C(species):C(plant_id) Var	0.282	0.206				



Mixed Linear Model Regression Results

Model:	MixedLM	Dependent Variable:	heat_flux_change
No. Observations:	158	Method:	ML
No. Groups:	7	Scale:	0.2428
Min. group size:	8	Log-Likelihood:	-151.8356
Max. group size:	37	Converged:	Yes
Mean group size:	22.6		

	Coef.	Std.Err.	z	P>|z|	[0.025	0.975]
Intercept	-0.023	0.113	-0.204	0.838	-0.245	0.199
LMA	0.178	0.135	1.312	0.189	-0.088	0.443
sample_wt	0.802	0.117	6.857	0.000	0.573	1.031
start_temp	0.267	0.094	2.832	0.005	0.082	0.451
branch_volume	-0.197	0.105	-1.879	0.060	-0.403	0.009
thickness	0.073	0.107	0.679	0.497	-0.137	0.283
Group Var	0.001	0.281				
C(species):C(plant_id) Var	0.334	0.229				


OLS Coefficients with Confidence Intervals
Coefficient
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
LMA
sample_wt
start_temp
branch_volume
thickness
Group Var
C(species):C(plant_id) Var