University of Idaho
College of Natural Resources

PAIRED PLOT DENSITY TRIALS:
WESTERN LARCH– 4YR RESULTS

MARK KIMSEY
INTERMOUNTAIN FORESTRY COOPERATIVE

41ST ANNUAL TECHNICAL MEETING
MARCH 23, 2021

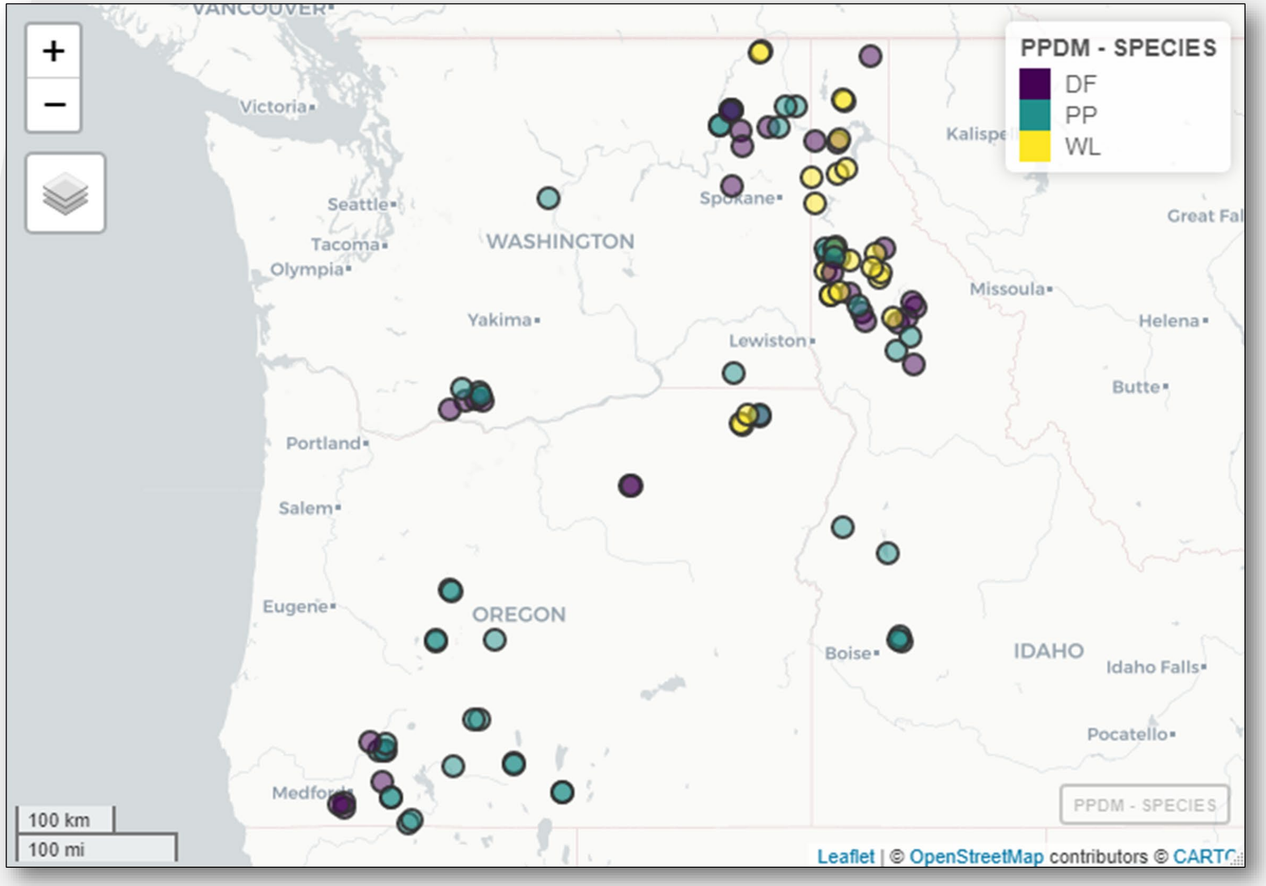
Intermountain Forestry Cooperative

PRESENTATION OVERVIEW

- For PPDM overview, revisit prior PP presentation
- Distribution of WL installations
- 4-Yr Results
- Outcomes and Products

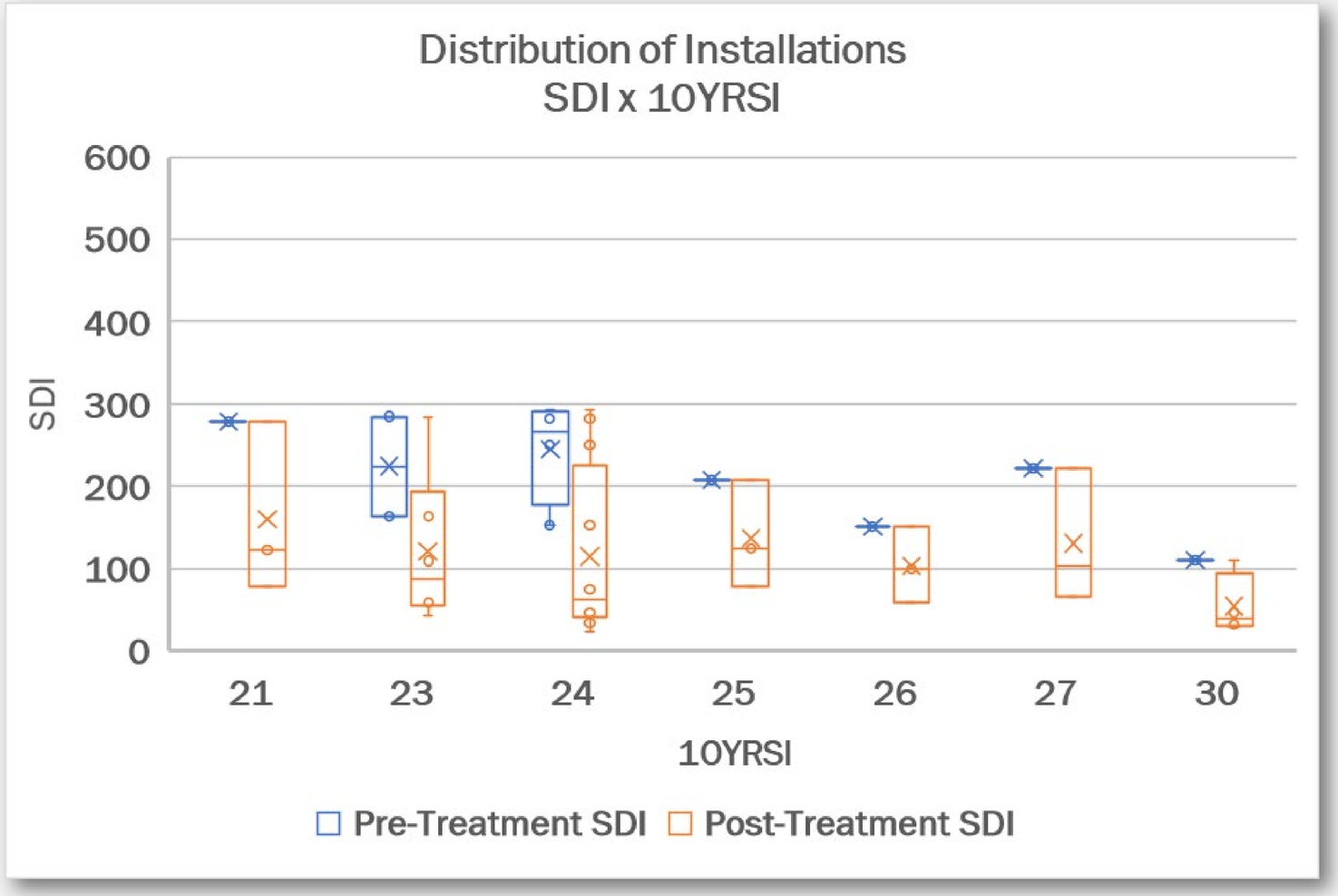
IFC WL PPDM NETWORK

WL INSTALLATIONS ACROSS THE INLAND NORTHWEST



- 23 installations
  - 6Yr measurements (n=0)
  - 4Yr measurements (n=11)
  - 2Yr measurements (n=23)

WL SITE DISTRIBUTION: SDI x SI



WESTERN LARCH THINNING RESPONSE BY:

INDIVIDUAL/CROP TREE – DBH/HT

CROP TREE/STAND – VOLUME

FULL WL REGRESSION MODELS*

TREE & STAND LEVEL

Individual/Crop Tree Growth – DIA and Height

$$DIA/HT_{annual} = \beta_0 + (\beta_1 \text{ x } SI10YR) + (\beta_2 \text{ x } SDI_{Pre\text{-}Trt}) + (\beta_3 \text{ x } SI10YR \text{ x } SDI_{Pre\text{-}Trt}) + (\beta_4 \text{ x } DIA_{Post\text{-}Trt**}) + (\beta_5 \text{ x } SDI_{Post\text{-}Trt}) + (\beta_6 \text{ x } SDI_{Post\text{-}Trt} \text{ x } SDI_{Post\text{-}Trt})$$

Whole Stand/Crop Tree Stand Growth – Volume (cu ft)

$$NetVOL_{annual} = \exp(\beta_0 + (\beta_1 \text{ x } SI10YR) + (\beta_2 \text{ x } SDI_{Pre\text{-}Trt}) + (\beta_3 \text{ x } SI10YR \text{ x } SDI_{Pre\text{-}Trt}) + (\beta_4 \text{ x } QMD_{Post\text{-}Trt}) + (\beta_5 \text{ x } SDI_{Post\text{-}Trt}) + (\beta_6 \text{ x } SDI_{Post\text{-}Trt} \text{ x } SDI_{Post\text{-}Trt}))$$

* *All models fit using SAS 9.4 PROC GLM*

** *Post-treatment implies Yr0 baseline measurements*

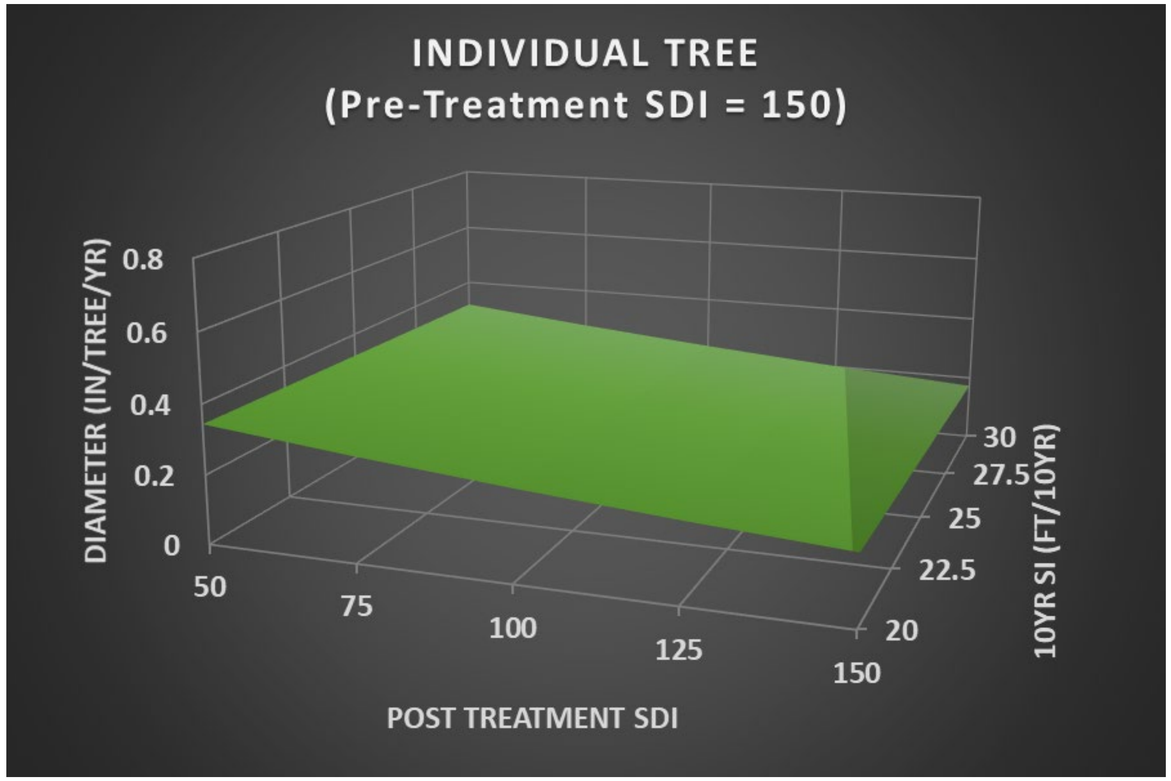
WL RESPONSE MODEL STATISTICS

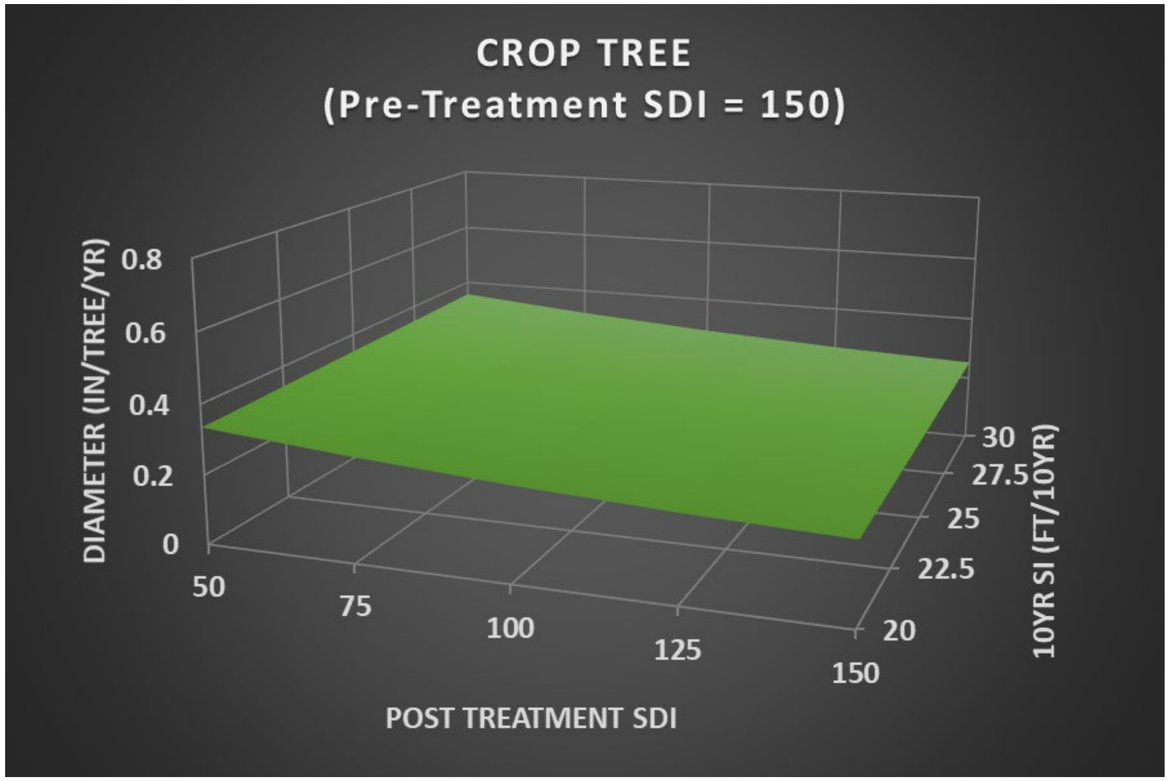
Model	R^2	RMSE	F-Value	Pr>F
Ind Tree – DIA (in)	0.81	0.05	23.8	<0.0001
Ind Tree – HT (ft)	0.61	0.29	7.0	<0.0001
Crop Tree – DIA	0.63	0.06	9.65	<0.0001
Crop Tree – HT	0.41	0.33	3.2	0.0169
Crop Tree Stand – NetVol (cu ft)	0.75	0.28*	13.3	<0.0001
Whole Stand – NetVol	0.80	0.35*	18.1	<0.0001

* *Not back transformed, values roughly equivalent to 25 cu ft/ac/yr*

DBH RESPONSE SURFACE

INDIVIDUAL VS CROP TREE – INITIAL LOW-DENSITY STAND

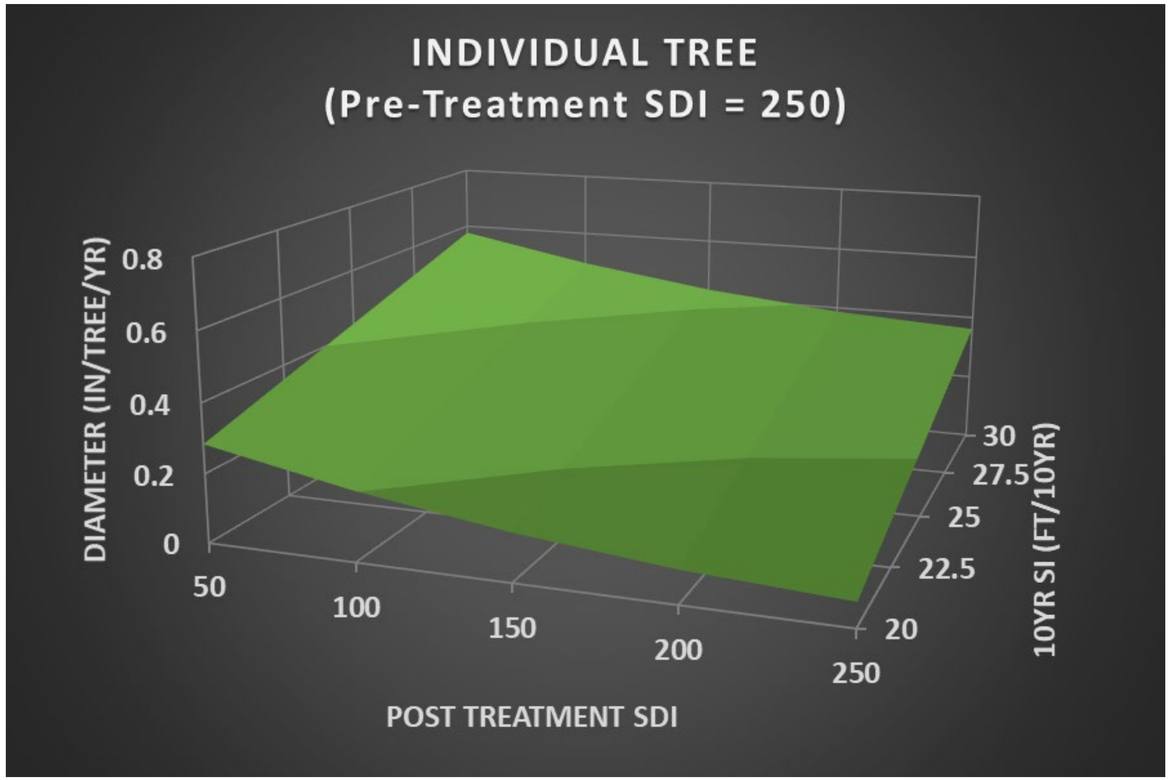


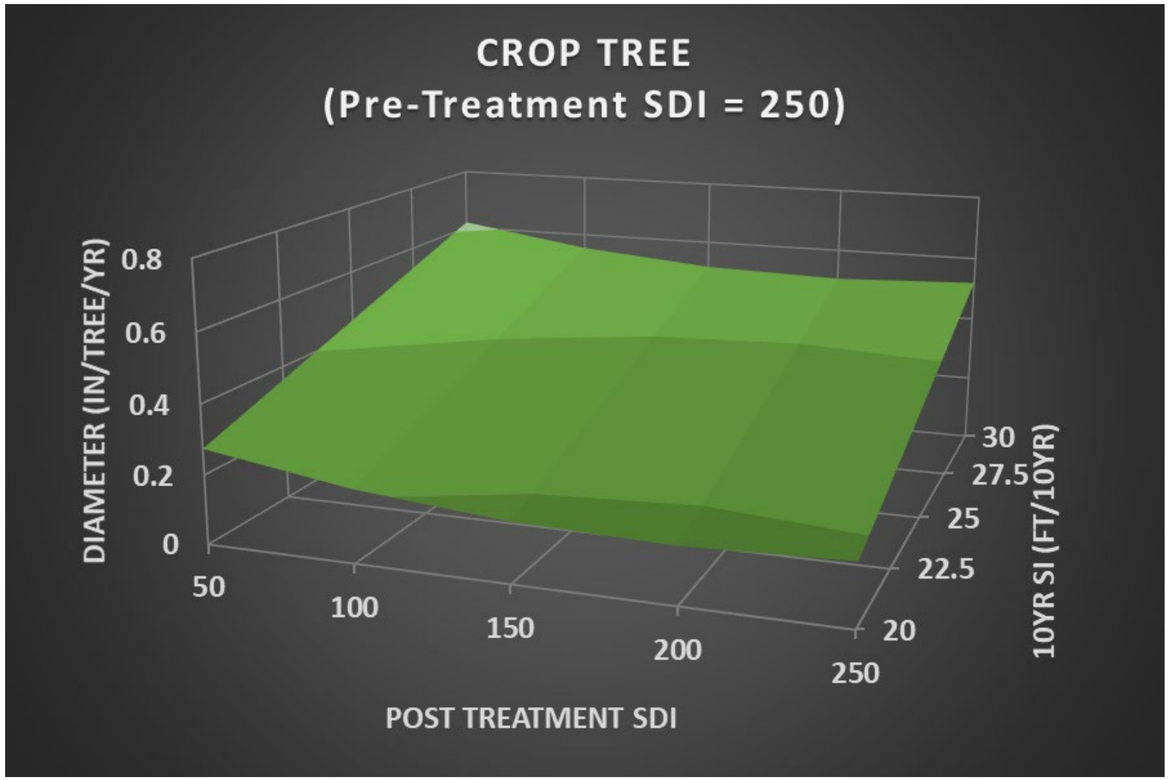


NOTE: To convert SDI to BA, multiply by 0.5454

DBH RESPONSE SURFACE

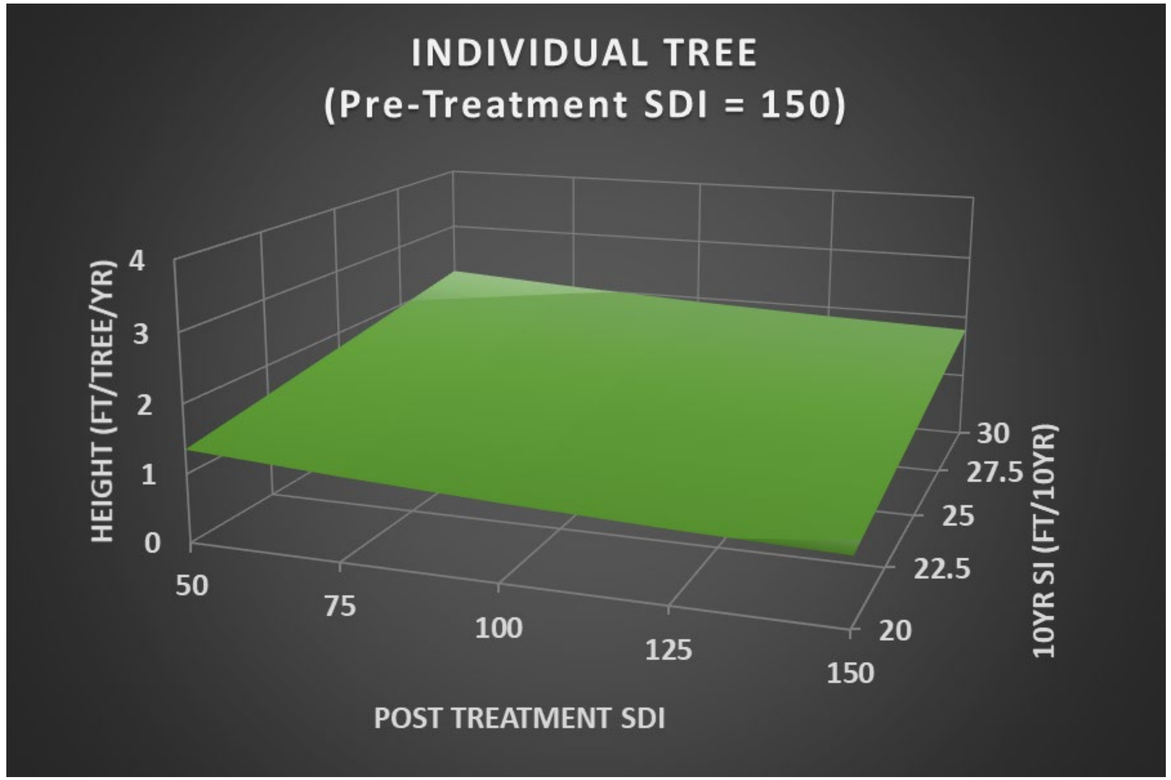
INDIVIDUAL VS CROP TREE – INITIAL HIGH-DENSITY STAND

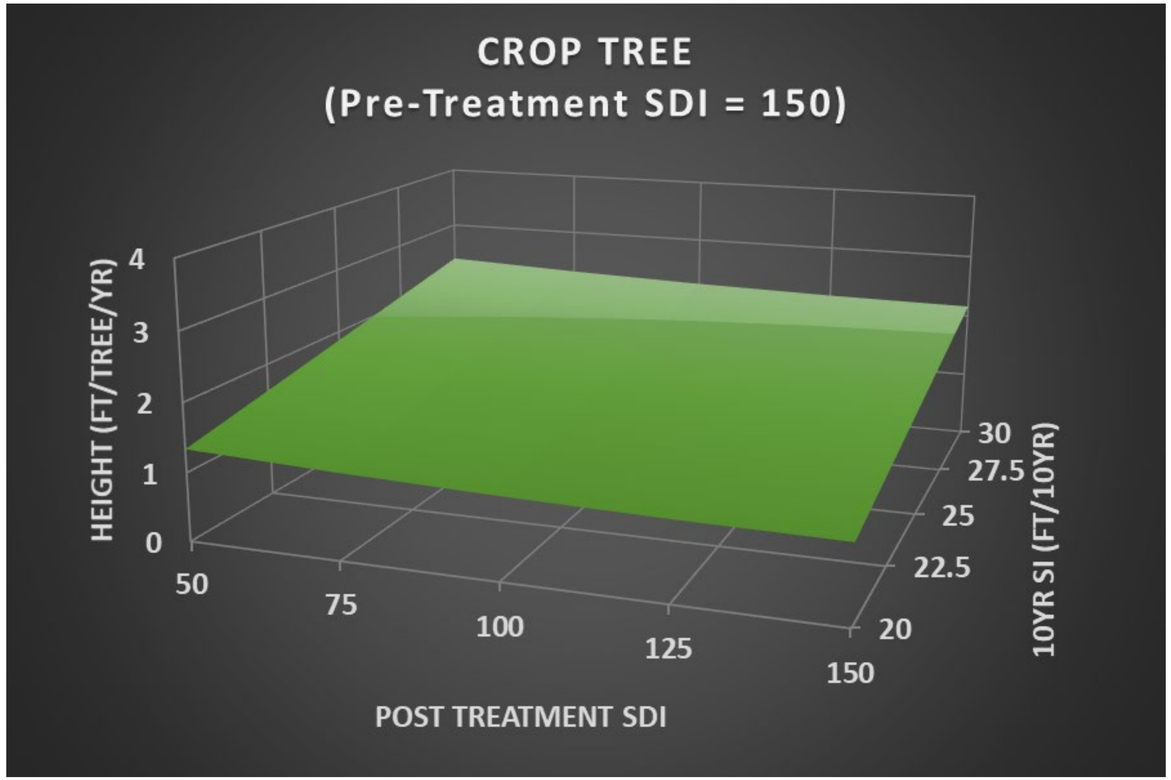




HEIGHT RESPONSE SURFACE

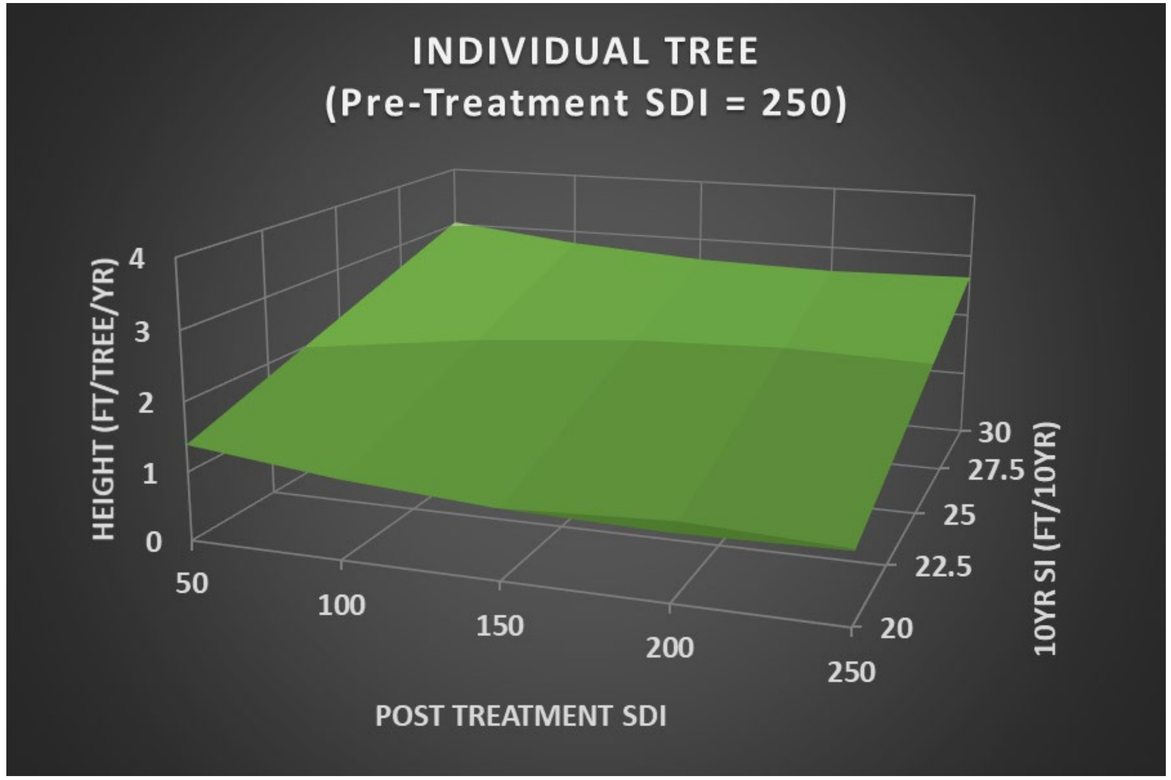
INDIVIDUAL VS CROP TREE – INITIAL LOW-DENSITY STAND

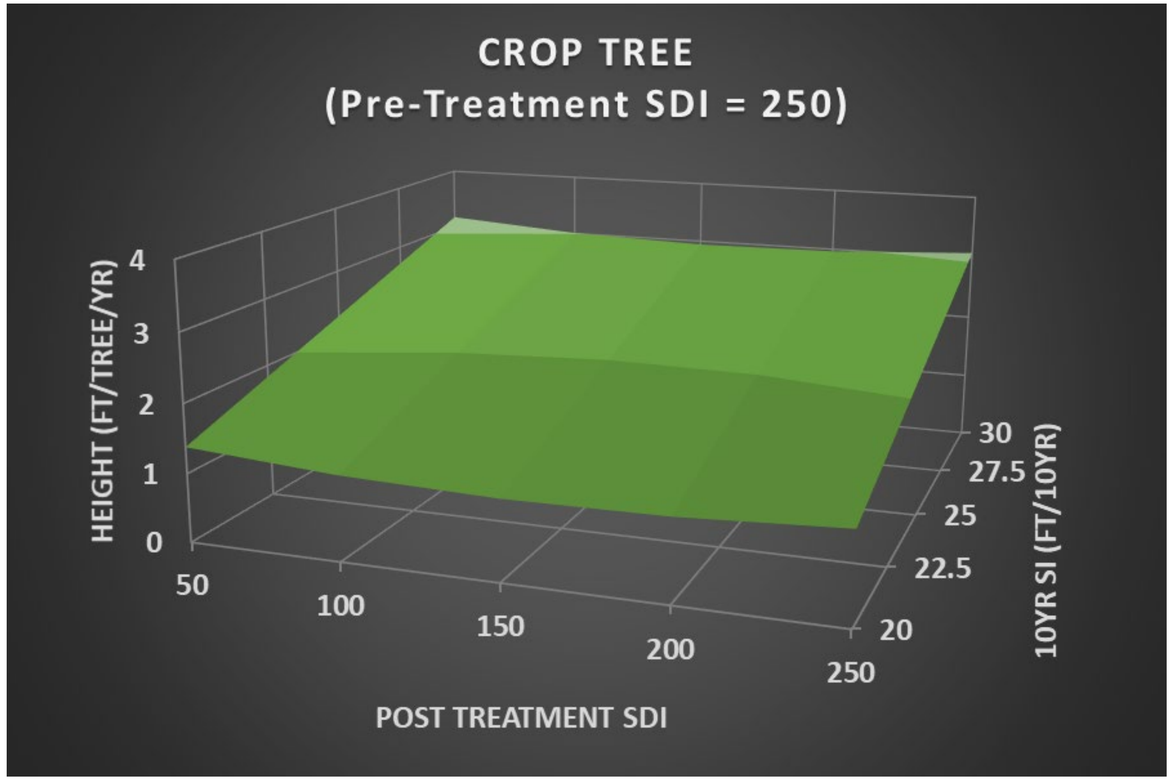




HEIGHT RESPONSE SURFACE

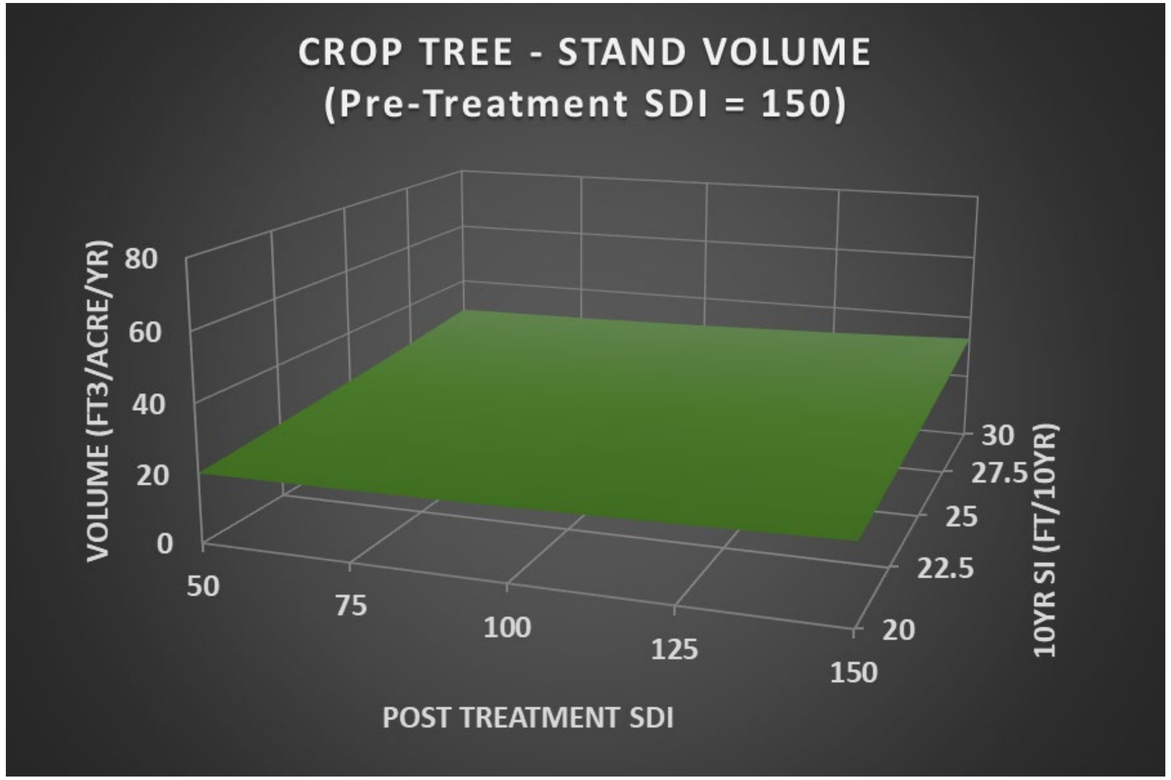
INDIVIDUAL VS CROP TREE – INITIAL HIGH-DENSITY STAND

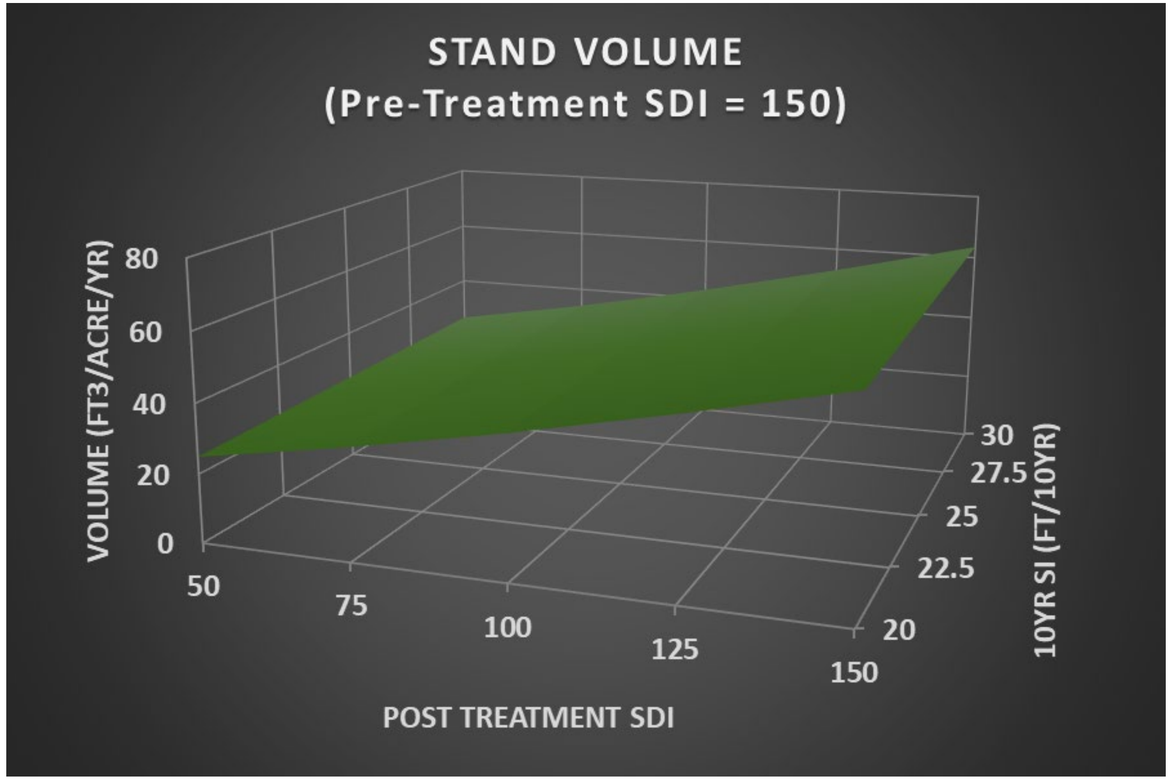




STAND VOLUME RESPONSE SURFACE

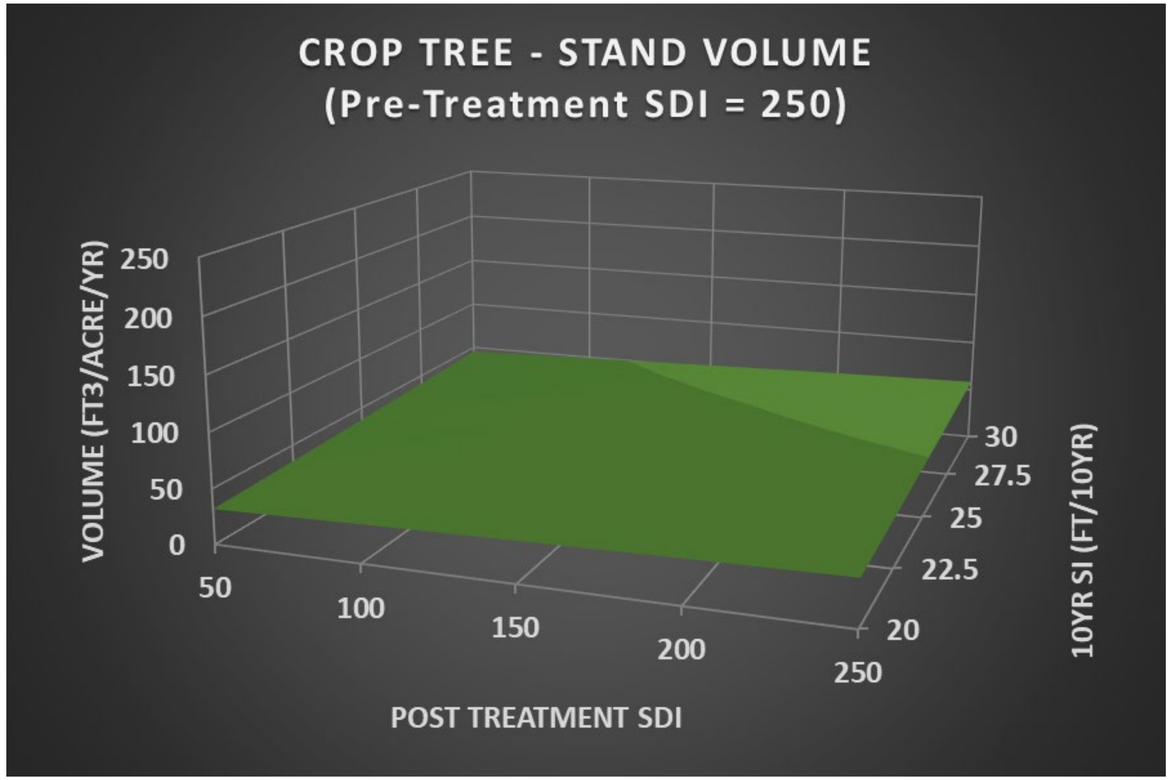
CROP TREE VS WHOLE STAND – INITIAL LOW-DENSITY STAND

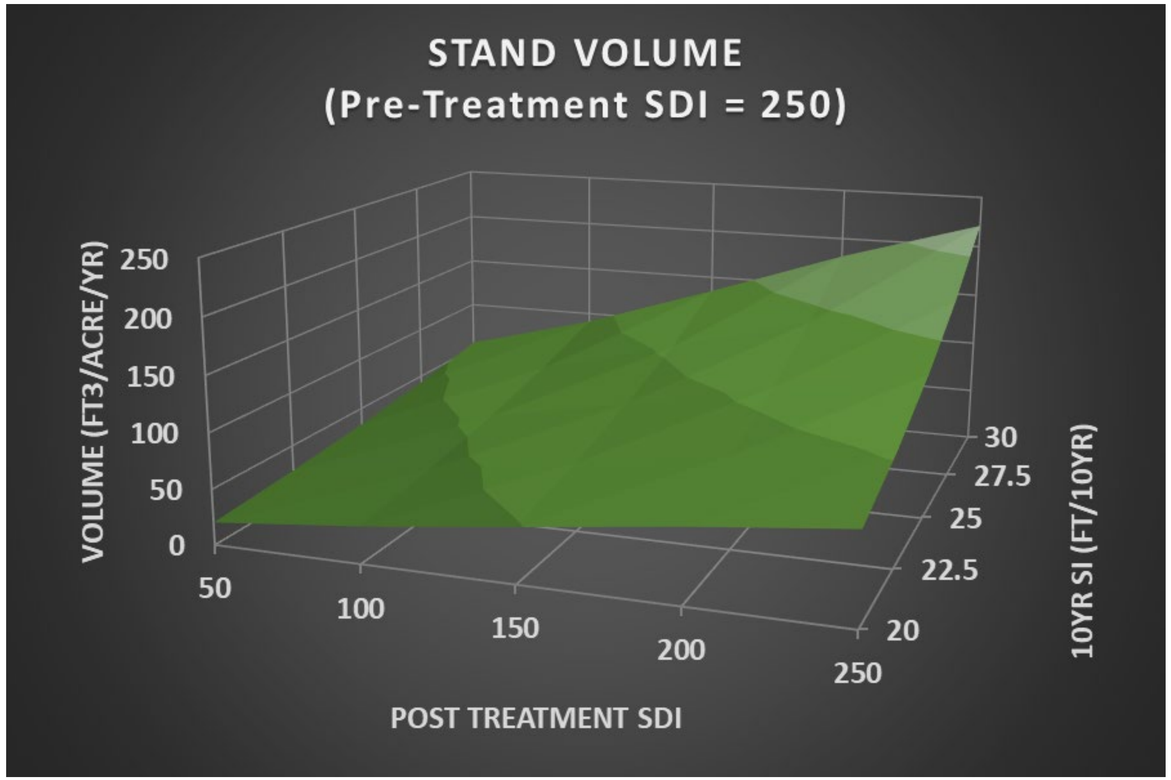




STAND VOLUME RESPONSE SURFACE

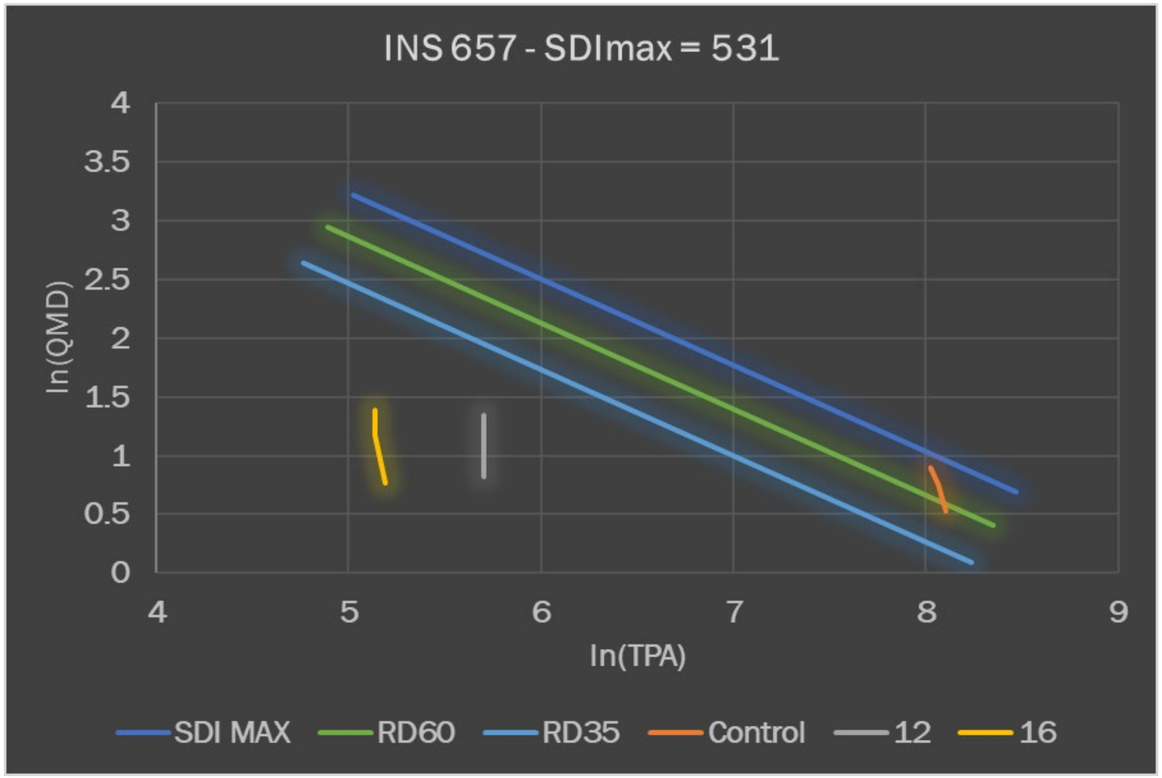
CROP TREE VS WHOLE STAND – INITIAL HIGH-DENSITY STAND



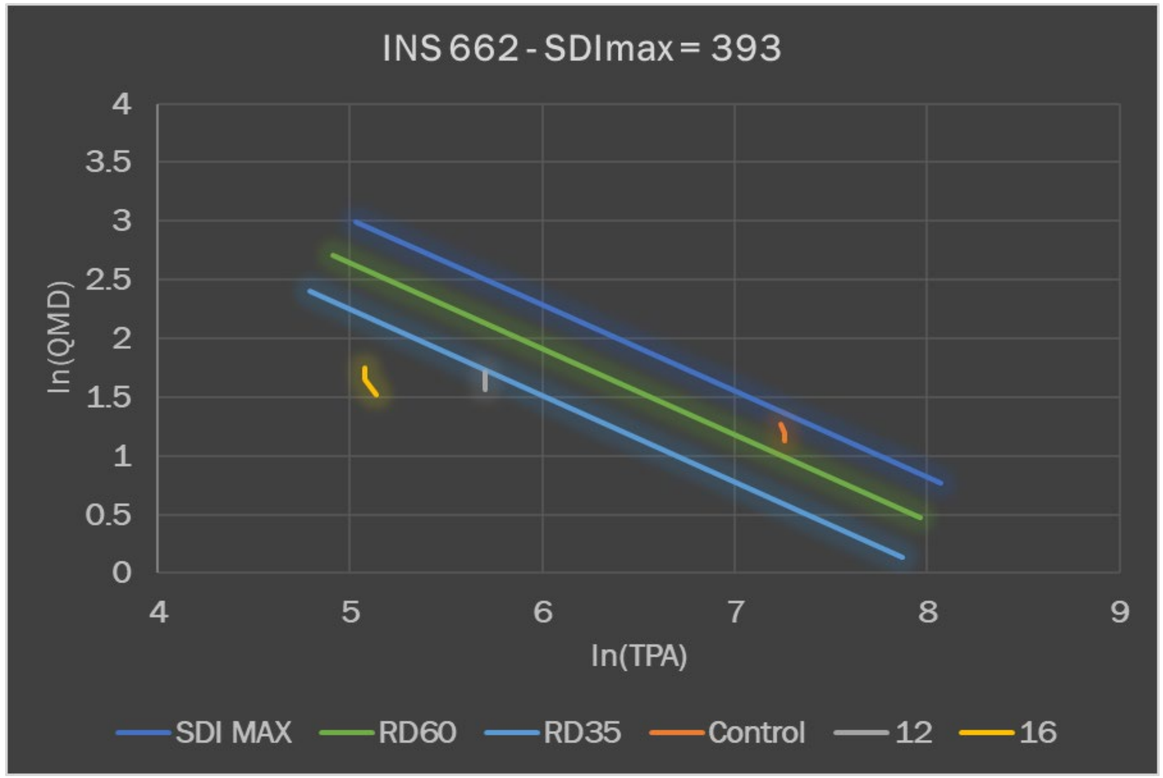


VALIDATING SDIMAX MODELS

"DENSITY MANAGEMENT DIAGRAM"



HR9SM, near Samuels, ID



Corp Line, near Dworshak Reservoir, ID

SUMMARY

BROAD OUTCOMES TO DATE

- Similar DIA results as seen with PP:
  - WL DIA growth increment response in initial low-density stands (<150 SDI) was driven primarily by thinning intensity, not by site type
  - DIA growth increment in initial high-density stands (>150 SDI) was affected both by thinning intensity and by site type – average tree and crop tree response patterns were similar at higher thinning intensities; however, crop trees outperformed the average tree at higher post-treatment densities
- Height growth increment was not greatly affected by thinning across site types; however, there was a strong interaction between initial stand density and site type
- Unlike PP, WL did not see height suppression on “lower” productive sites at “higher” stand densities (>150 SDI)

SUMMARY

BROAD OUTCOMES TO DATE

- Site type did not express itself in volume response across low density stands (<150 SDI)
- As pre-treatment SDI exceeded 150 SDI, there was a very significant interaction with site type on volume response
- Crop tree volume response in initial high-density stands dominated stand response across low productivity site types and/or in aggressive thinning regimes
- Highly productive site types showed a greater capacity to carry more crop and non-crop tree volume than low-productivity sites
- IFC SDI_{MAX} WL model is overall predicting relevant maximums, and tracking mortality in unthinned stands
  - Tracking to assess future over/under predictions

CONCLUDING STATEMENTS

THE FUTURE OF PPDM

- Validate SDImax models
- Validate G&Y models
- Develop growth and mortality multipliers by site quality, stand density, and species composition
- Calibrate G&Y software packages for thinning response by site/species
- Develop silvicultural guidelines for targeting optimal timing window and thinning to maximize growth response on crop trees while minimizing mortality