TRG Walnut Inventory and Growth Projection Methods

Inventory

In 2018, 2021, 1/20th acre plot data were collected across the various walnut plantation properties. During inventory typical biometric measurements are taken on trees within plots including diameter at breast height (DBH), taken at 4.5 ft above the ground to the nearest 1/10th of an inch. If a tree was not at least 4.5 ft tall at the time of inventory no DBH was recorded. In addition to DBH, total heights (TH) to the nearest foot were taken on all trees within the plots. Tree quality Index (TQI) was also assessed. This indicates if a tree has significant defects which may impact its growth and the products that could be produced. A "1" would indicate a tree free of major defects, a "4" would indicate a tree with major defects such as sweep, crook, knots, rot, or other damage. In each year the inventory data is summarized to the stand level where applicable. In some cases, not every stand has been sampled, in which case collections of stands are averaged into tract level averages, and those are applied to stands without did not have plots conducted on them due to their size, spatial edits, etc. If a stand has a stand or tract level average applied, can be found in the "inventory source" field in the inventory summary data. Inventory data was conducted to have complete coverage of the properties but has not been conducted in recent years (2022-2025). The 2018 data reflect stands that have not received a pre-commercial thinning (PCT), while the stands measured in 2021 have received a PCT. (See Appendix I for data dictionary of data attributes for "Black Walnut Stand Baseline Inventory 2024.csv").

In addition to these annual inventories, continuous forest inventory (CFI) plots were also remeasured annually from establishment in 2018. These CFI plots cover a smaller area of the plantations compared to the annual inventories; however, CFI plots are critical for assessing productivity of the plantations and are a critical component of long-term assessment. Data from these plots has been utilized to inform modeling inputs, and the effects of treatments on productivity, such as PCT. (There are numerous reports describing these plot measurements and findings.). Many of the same measurements described above occurred in both inventories.

Growth Projection

To project the data forward, stands are grown forward, meaning how much more diameter, height, and basal area is estimated to be accumulated, as well as what the standing densities will be is estimated using a model. The projection to age 15 utilized recent CFI plot data to determine the age 15 diameter distribution. The diameter growth was determined by calculating the annual mean growth of stands previously fertilized. The mean fertilized diameter growth rate was calculated as 0.75 inches annually. The growth rate was kept constant across all DBH classes, due to the limited number of permanent plot re-measurement cycles and the small diameters from which the growth was determined. To see what the estimated diameter distributions were, please see the "Diameter Distribution by Stand.pdf" which depicts each stand's diameter distribution at the time of inventory and estimated by projection at age 15.

PCT was simulated on the age 15 diameter distributions by reducing the trees per acre to 250 +/- 5 trees per acre if not previously completed. If the inventory data at age 15 reflects a TPA estimate of 300 or less PCT was not simulated. The PCT simulation was done with an AFM developed thinning algorithm which weights the removal by diameter class. Trees are removed from all diameter classes to simulation operational applications accounting for

8702 Red Oak Blvd., Ste. C, Charlotte, NC 28217 | **Phone:** 704.527.6780 | **Fax:** 704.527.1245 | americanforestmanagement.com

spacing requirements, the algorithm favors trees in smaller DBH classes, while the larger DBH classes have fewer trees removed. It is unlikely that all stands would receive a PCT at age 15, likely it would be done at a younger age, but age 15 was selected as a proxy for earlier PCT treatments. If the trees per acre was less than 250, then no PCT was simulated for that stand.

Once the PCT is completed, if possible, at age 15, the diameter distribution is grown using stand table projection methodology assuming a constant basal area growth rate of 5%. Growth projections were designed to simulate stand management going forward, including thinnings to maintain stocking targets and optimize tree growth. Thinnings were triggered when a basal area threshold was met and then thinned back to a target basal area using the same thinning algorithm described previously (favor removing smaller diameter trees, maintaining larger trees). All thins less than age 26 were triggered at a basal area of 105 with a residual target of 80, thinnings between 27 and 34 were triggered at 115 square feet of basal area with a target of 95, and no thinnings were simulated after age 34. The stand and thinned yields were calculated in Doyle board feet and cubic feet. These projections were updated annually and reflect a theoretical growth scenario to estimate future potential. As the plantations continued to grow these projections could be adjusted based on observed growth rates and stand histories (actual thinning, disturbances, etc).

Appendix I

Appendix I: Black Walnut Stand Baseline Inventory 2024 attributes

Attribute	What
Stand_Key	Stand identification information
cruise_year	The year the stand was cruised
cruise_age	The age of the stand at the time of inventory
dom_ht	The estimated height of the dominant trees at the time of inventory
species	The species, mostly black walnut,
avg_dbh	The average diameter at breat height for the stand
avg_ht	The average height of the trees in the stand
tpa	trees per acre of the stand
ba	The basal area of the stand
inventory_source	If the inventory is based on plots within the stand or the average for the tract
si	The site index of the stand
num_plots	The number of plots conducted on the stand
ba.sd	The standard deviation of the basal area estimate
ba.se	The standard error of the basal area estimate
ba.se.perc	The standard error of the basal area estimate as a percent of the mean
ba.lcl95	The lower estimate of the 95% confidence interval
ba.ucl95	The upper estimate of the 95% confidence interval
ba.cv	The coefficient of variation for basal area; (SD/mean)*100
GIS Area	The estimated area of the stand according to GIS software
Land Use	The current use of the land
Tract	The tract the plantation is in
Stand	The stand number where the plantation is located

*For "Black Walnut Diameter Distribution Baseline Inventory 2024.csv" the attributes are largely the same, however because it's a diameter distribution, the stand is broken up by DBH class. So there will be multiple DBH Values for each Stand, along with trees per acre reflecting the number of trees in each diameter class.

**For "Walnut YE…..csv" datasets the attributes are largely the same, they just reflect the stand grown forward from their respective inventory year to 2024 (this uses the growth projection methodology described previously to the estimated conditions in 2024). The note above for diameter distribution applied to the "…YE_Stand_DD…" data