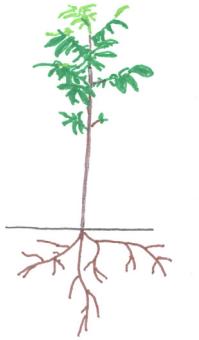


Nitrogen Fertilization of YOUNG TREES

Application Timing

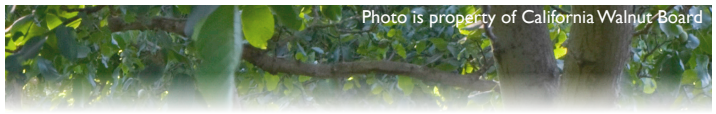
Fertilizer is best applied to young trees in mid-spring and early summer. Late applications (after August) should be avoided to prevent late fall growth which could be susceptible to freeze injury. Furthermore, N not taken up by leaf senescence is subject to leaching during the winter. Nitrogen fertilizer can be applied in the dry form or in the irrigation water. Avoid applying near the trunk.

Application Rates

The lower rates refer to fertile soils and when N is applied through the drip or microsprinkler irrigation systems.

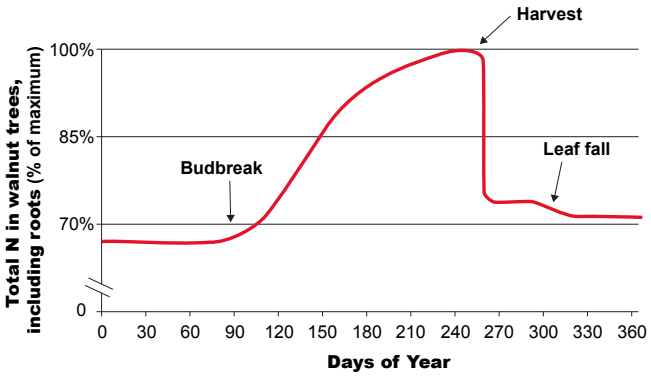
	Nitrogen Application Rates		
Tree Age	lb./A	lb./tree[1]	oz./tree
First Season	10-20	0.2-0.3	2-5
Second Season	25-50	0.4-0.8	6-12
Third Season	50-100	0.8-1.5	12-25
Fourth Season	63-125	1.0-1.9	16-31
Fifth Season	75-150	1.2-2.3	18-37

[1] The application rates/tree are based on a planting density of 65 trees/A.



Walnut Nitrogen Uptake and Partitioning

Seasonal N Uptake



About 40 lbs N is removed from the orchard per ton of in-shell walnuts harvested.

Information regarding walnut fertility management, including soil and leaf analysis, placement, fertilizer source, phosphorus and potassium are available at:

http://apps.cdfa.ca.gov/frep/docs/guidelines.html

SELECTED REFERENCES

Anderson, K.K., Grant, J., Weinbaum, S.A., Pettygrove, S., 2006. Guide to efficient nitrogen fertilizer use in walnut orchards. University of California, Agriculture and Natural Resources. Publication 21623.

Weinbaum, S.A., Murooka, T.T., Gatlin, P. B., Kelley, K., 1991. Utilization of fertilizer N by walnut trees. The Walnut Marketing Board of California. Walnut Research Reports 1991, 317-334.

Weinbaum, S. van Kessel, C., 1998. Quantitative estimates of uptake and internal cycling of 14N-labeled fertilizer in mature walnut trees. Tree Physiology 18, 795-801.

FERTILIZER RESEARCH AND EDUCATION PROGRAM
FREP

WALNUT NITROGEN Fertilization Guidelines

Online nutrient guidelines for walnut and other crops, as well as relevant references, are available at:

apps.cdfa.ca.gov/frep/docs/guidelines.html

The information in this pamphlet is based on research funded by the Fertilizer Research and Education Program, California Dept. of Food and Agriculture, and from other sources.

Daniel Geisseler and William R. Horwath, Department of Land, Air and Water Resources, UC Davis, gathered and organized the guideline information through FREP research contract 11-0485.

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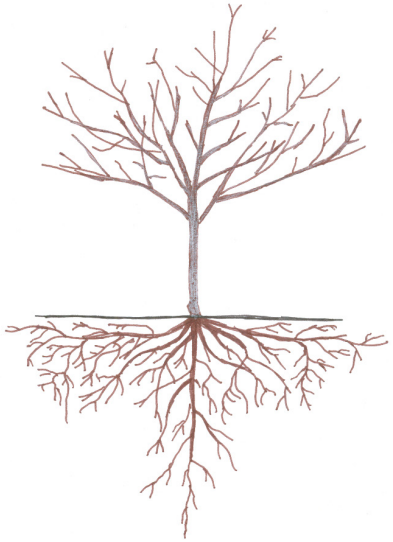


Nitrogen Fertilizer Application DORMANCY (WINTER)

Planning Annual Applications

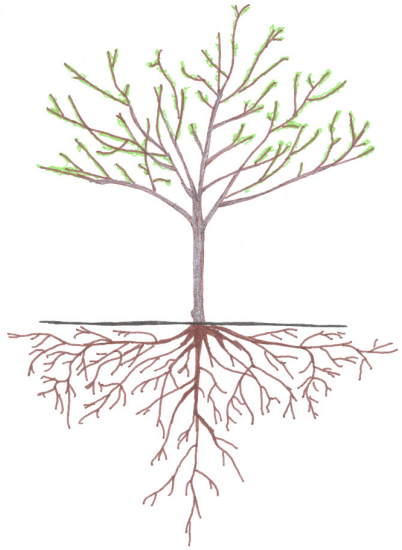
The required annual N application rate depends on the expected yield. **About 40 lbs N is removed from the orchard per ton of in-shell walnuts harvested.** An additional 20% (8 lbs N/acre) may be lost from the tree in the abscised leaves and prunings. Furthermore, the N stored in the woody tree parts increases by approximately 15 lbs N/acre per year.

Application Rates

Annual Nitrogen Application Rates Based on Yield and N Use Efficiency of the Irrigation System

Nut Yield	N Removal	Fertilization N Required (lb. N/A)	
Tons/A	lbs./A	Split Broadcast	Fertigation
1	48	86	68
1.5	72	129	101
2	96	171	135
2.5	120	214	169

The amount of fertilizer N required not only depends on yield, but also on other N sources available and the efficiency with which the fertilizer N is used by the trees. Irrigation water can be a significant source of N. Twenty seven pounds of N/acre are applied with one acre-foot of water containing 10 ppm nitrate-N. Part of the N in organic amendments and cover crops is also available and needs to be taken into account.



Nitrogen Fertilization at BLOOM (SPRING)

Splitting Applications

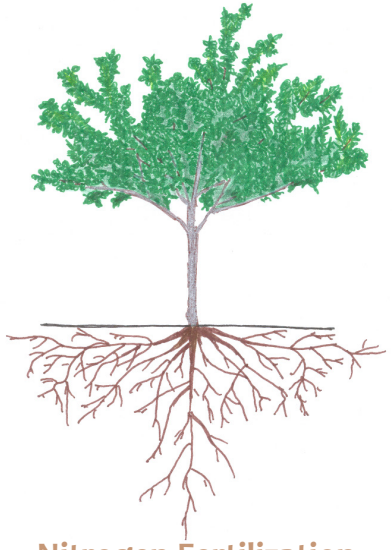
Virtually no N is taken up during winter. Earlier studies conducted in Tehama County suggested large overwinter losses of fall-applied N. Nitrogen uptake is still low in early spring, as more than half the N needed during bloom spur leaf expansion is derived from storage in perennial tissue. N uptake is greatest from between the onset of shoot growth and the latter stages of nut fill, which roughly corresponds to the period from early April to late July/early August.

Approximately 60% of the annual N demand is derived from N redistributed from woody tree parts. For this reason, the exact time of application may not be as crucial as it is for annual crops, as long as the fertilizer is applied during a period of active uptake. However, N should not be applied after late June or early July to ensure that it is available before nut fill is complete.

With about 80% of the N in the fruits taken up before mid-June, most N needs to be applied between March and June/July.

For more information about N management in walnuts and references, please access:

http://apps.cdfa.ca.gov/frep/docs/guidelines.html



Nitrogen Fertilization during FRUIT DEVELOPMENT (SUMMER)

Application Rates and Time

The N not applied in spring is applied during the summer. Nitrogen should not be applied after late June or early July to ensure that it is available before nut fill is complete.

Application Mode

When fertigation is possible, the most efficient way to apply N is in small amounts between the onset of shoot growth and nut fill. This practice has been shown to be very beneficial to the health of the trees, while reducing N losses.

Surface-applied dry or liquid urea and ammonium fertilizer must be incorporated as soon as possible to prevent ammonia volatilization losses. Fertilizers are best applied in the herbicide strip along the tree rows and not broadcast over the entire area. Fertilizer is best applied in bands 12 to 18 inches wide under the trees along the row. The bands need to be within the wetting zone of the irrigation system.

Leaf Analyses

The N concentration in leaves generally decreases during the growing season. The least change occurs from late June through July. This is the time when leaf samples should be taken. Leaf nutrient concentrations also depend on the location of the leaf in the canopy.

July leaf N concentrations below 2.1% suggest N deficiency, while 2.3-2.8% N are adequate.

The critical values refer to a tree. In contrast, the results from leaf analyses refer to the average of all trees sampled in the orchards with some trees being below and others above the average. For this reason it is important to divide an orchard into uniform blocks where the variability between trees is small.