

Walnut Production on Marginal Soils

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Summary:

This hedgerow trial continues to produce high yields of top quality walnuts under marginal soil conditions. Production of both varieties tested, Chandler and Howard, is consistently much higher using Paradox rootstock versus NC Black. Slip plow soil tillage has not been shown to benefit tree size, crop yield or quality. Chandler yields were substantially higher than Howard for 2000 and Paradox rooted trees outproduced NCB trees by 48-100%.

Objective:

The objective of this trial is to investigate the feasibility of producing English walnuts on lower class soils (Class II-IV) using a program of drip irrigation, slip plow tillage, frequent fertilization and a tight hedgerow planting system.

Procedures:

Nursery grafted trees were planted in March of 1986 as a hedgerow, 12 feet between trees in the row and 18 feet between the rows, giving 202 trees per acre in a north-south row orientation. Prior to planting, half of the plot was slip plowed to a depth of 5-6 feet at intervals of 10 feet in a north and south direction. The soil comprises two types as

classified by the US Department of Interior Bureau of Reclamation: the majority of the area consists of the Kimball series (Class III-IV), a gravelly sandy loam underlain by a dense clay layer at depths of 18 to 36 inches, and about 30% of the area consists of the Arbuckle series (Class II), a deep gravelly sandy loam. Four treatments were replicated six times in two soil treatment blocks; one area was slip plowed and second area was unmodified. The treatments were Howard ctv. on Northern California Black rootstock, Howard on Paradox Hybrid rootstock, and Chandler ctv. on Northern California Black, and Chandler on Paradox Hybrid.

Howard trees grafted onto Paradox were unavailable at the time of planting, so Paradox seedlings were planted for this treatment and then grafted to the Howard cultivar in April, 1987. Cisco and Franquette ctvs. trees were planted as pollenizers in the perimeter row surrounding the two-acre trial area.

The trees are drip irrigated using evapotranspiration (ETc) calculations based on the nearby CIMIS weather station, and received monthly nitrogen applications via drip lines. Initially the trees were irrigated with a single drip line with four 4 liter per hour emitters per tree. In response to unacceptable vigor in the early years, a second drip hose was added in 1991, which doubled the number of emitters per tree and increased the wetted soil area. The drip lines were positioned 4 feet from the trunks on each side of the tree rows compared to the single hose placed directly beside the row. Potassium sulfate, K_2SO_4 is applied beneath the emitters at 2 lbs per tree (600 lbs per acre.) yearly after harvest.

The trees were pruned by hand for the first 3 years to develop a fruiting wall using a modified central leader framework. Beginning in the 4th dormant season both the east and west sides of the hedgerows were mechanically hedged at 4 feet from the trunk and also topped to remove about one half of the past seasons top shoot growth. This regime continued yearly until March of 1993. At that time yearly alternate side mechanical

hedging began by pruning only one side of the hedgerow. All east sides of the hedgerows were dormant pruned one year and all west sides the next. Moderate mechanical topping was continued yearly as needed to stimulate shoot growth up to the desired tree height of 18-20 feet. Since 1995 only selected plots with trees shorter than the desired height have been topped (mainly trees on NC Black). Thus, the more vigorous plots, which had achieved the desired height, received no further topping since the 9th dormant season.

Results & Discussion:

Tree size measurements show larger trunk circumference values for both cultivars when grown on Paradox compared to NC Black. These differences are dramatic and easily seen each year during the development of the orchard. Records kept on mechanical topping also support these measurements as topping was required only on NC Black trees after 1995 to stimulate canopy extension to the desired height. Paradox rooted trees had achieved the desired height by that time.

Rootstock

Yield results show a substantial and consistent yield advantage for the Paradox Hybrid rooted trees compared to production on NC Black rootstock. This holds true for both cultivars under both soil conditions. Also notable is the consistency of this Paradox advantage over twelve consecutive years (1989-2000). (See Table 2) The difference in yield between the two rootstocks for 2000 is the greatest ever measured in this test. Howard/Paradox production was almost double that of Howard/NCB, while Chandler/Paradox outproduced Chandler/NCB by 48 %. (Table 1)

Cultivar

The accumulative yields of Howard and Chandler cvs are nearly equal in this test. Chandler production at this site is among the

highest in the state for a Chandler hedgerow (D. Ramos personal communication). Interestingly, Howards are known to yield better in response to alternate year hedging while Chandler prefers longer intervals between hedging for fruiting. However, our hedging practice has been to cut one side in each middle each year compared to the more commercial practice of cutting both sides in alternate middles. The method used here may allow more even light penetration into every middle each season verses alternating seasons of more intense radiation into alternate middles. Here, both adjacent sides of the fruiting walls receive more consistent light. Whether this could help explain the high yield of Chandler in this hedgerow location is unknown. But, both Howards and Chandlers grow for only two seasons before hedging removes fruiting positions.

Slip Plow Effects

The effect of slip plowing in this trial is unclear as the plowed areas are not randomized within the non-plowed plots. Only rough comparisons can be made from this side-by-side test. Limited soil investigations done in 1996 with backhoe pits showed deeper and more extensive rooting beneath slip plowed trees. The slip plow successfully mixed these two layers in continuous channels down the tree rows. However, trunk growth measurements and average yields show no advantages to the slip plowed treatment. It should be noted that soil conditions vary significantly within the trial area, in general this area is Class II-IV soil. Approximately 30 percent of the test area consists of the Arbuckle series, a gravelly, sandy loam to a depth of 3-6 feet. The Kimball series covers the majority of the area with a similar sandy loam texture on the surface but only to a depth of 18 – 36 Inches where a dense clay layer limits deeper rooting (as confirmed in the soil pits).

Lack of tree response to slip plowing may be due to a combination of factors: use of high frequency (2-3 times/week) drip irrigation,

monthly fertilization and simply the small tree size in this hedgerow planting. Further, 30% of the area was without stratification so soil mixing should not be beneficial here. And finally, current slip plow recommendations include a diagonal pass of the plow in addition to the main direction. Here the machine traveled only North-South. But, again our visual observations of the rootzones showed increased rooting in the plowed area but still yield was not improved.

yield or crop quality in drip irrigated walnut hedgerow plantings. This trial continues to produce high walnut yields under marginal soils, comparable to yields obtained in hedgerows planted to prime soils. Yield and kernel quality will continue to be monitored in this planting.

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Microirrigation

Shoot growth and canopy development slowed to unacceptable levels in the test area during the 4-5th growing seasons. Apparently, irrigating with a single drip hose resulted in over saturation of the limited rootzone, exclusion of soil oxygen and reduced tree vigor. A second drip line was added during the 6th growing season, which doubled both the water application rate and the wetted soil area. This allowed a switch to alternate day or longer irrigation intervals. Shoot growth increased greatly and returned to acceptable levels following this change.

Other

The row width used here has proven too close for commercial use. Under these soil conditions, row spacing should be increased to 20 feet for Howard and 22 feet for Chandler to avoid machinery difficulties. Distance down the row is less important in a fruiting wall; 12-15 feet would seem appropriate.

Conclusions:

Fifteen years of field evaluation of walnuts on marginal soil has concluded that: 1) yields of 3.5 tons/ac (in-shell) are attainable under these substandard soil conditions, 2) Paradox hybrid rootstock outyields Northern California Black by 30%, 3) kernels of high commercial quality can be produced, and 4) slip plow soil modifications may not improve tree growth,

Table 1

Yields 2000
Lbs/ac

Howard NCB	3596
Howard Paradox	6985
Chandler NCB	5843
Chandler Paradox	8655

TABLE 2

Nickels Hedgerow Yearly and Accumulative Yields (lbs/acre)													
Variety	4th	5th	6th	7th	8th	9th	10th	11th	12th	13th	14th	15th	Cumulative
	'89	'90	'91	'92	'93	'94	'95	'96	'97	'98	'99	'00	
Howard on Paradox	404	1,085	2,343	4,308	5,476	5,680	5,290	4,822	7,393	4,972	7,186	6,985	55,944
Chandler on Paradox	571	979	2,498	3,434	4,883	5,053	6,243	4,479	7,551	4,349	7,662	8,655	56,357
Howard on Black	387	976	1,901	3,051	3,770	3,961	3,680	3,448	5,373	3,487	5,000	3,596	38,630
Chandler on Black	457	757	1,901	2,562	3,647	3,815	4,185	3,203	5,175	3,051	5,592	5,843	40,189