Asparagus Irrigation Studies

evidence indicates asparagus on sedimentary soil can utilize about 20″ of irrigation in addition to a normal 16″ rainfall

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Frequency of irrigation in relation to yield of asparagus on sedimentary soil was the subject of an eight-year experiment at Davis.

Before 1930, the major part of the asparagus production in California was confined to the Sacramento–San Joaquin Delta area where the peat and peat-sediment soils have a permanent water table of from 3′ to 8′ below the soil surface. However, because old asparagus land can not be replanted where there has been a buildup of Fusarium wilt during the life of the original planting—as has occurred in many Delta plantings—there has been a shift to the San Joaquin area. A major portion of suitable land in the Delta area has been, or is, in asparagus and as the industry is forced to move to the upland the absence of a high water table causes irrigation—amount and frequency—to become a problem.

Long-Term Experiment

The eight-year experiment was initiated with a planting of one year old asparagus of a strain of the Washington variety. Six treatments replicated six times were arranged in a Latin square. The plots consisted of three rows each 30′ long. The roots were planted 8″ deep, 1′ apart in the row. The space between rows was 6′. Guard rows separated the plots.

To establish the crop, all plots were given the same irrigation treatments the first year. The following year, differential irrigation treatments were established to maintain soil moisture through various levels of availability for the cutting and vegetative seasons.

After the first year, the dry plots—Treatment *A*—were not irrigated. The wet plots—Treatment *B*—were irrigated when approximately half of the available moisture was used from the soil permeated by roots. The intermediate plots—Treatment *C*—were irrigated when most of the available moisture had been used by the plant. Under Treatment *D* the plots were kept dry during the cutting season and wet in the vegetative season. In Treatment *E* the cutting season was dry and the vegetative season was intermediate. In Treatment *F* the cutting season was intermediate and the vegetative season, wet.

The differential treatments during the cutting season were unnecessary because the soil moisture was in the upper half of available moisture range due to winter rainfall. So, essentially, the three irrigation treatments prevailed only during the vegetative season.

The spears were harvested when they were approximately 4½″ or more above the soil surface. They were trimmed to 7″ in length, counted and weighed. Termination of the season varied from year to year, depending on age of the bed and the general appearance of the spears.

Rainfall and Irrigation

The first year of the experiment the annual rainfall was 31.5″ as compared to the normal of 16.3″. Rainfall the second season was also well above normal resulting in a temporary or perched water table about 6′ below the soil surface in the first spring after the study was started. The perched water table was caused by a heavy compact bluish clay layer at the 14′–16′ depth. Thus a huge reservoir of water was stored in at least a part of the root zone, and it was evident from frequent soil sampling that roots of the asparagus plant in the dry plots utilized all the available moisture to the depth of the bluish clay layer—14 feet. By the second spring the water table had receded to a depth of 10′, and a few months later, had entirely disappeared from the soil profile.

The perched water table probably accounts for the high yields in the first and second years of the dry plot, and the mean weight of spears for the same two years.

The number of inches of water applied to the treatments *B*, *C*, *D*, *E*, and

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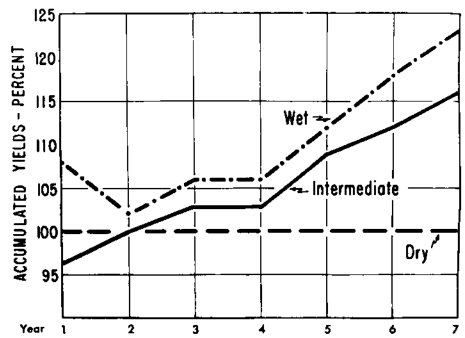
Accumulated yields irrigated asparagus expressed as percent of dry treatment.



Rainfall and Irrigation
Applied during the vegetative season of asparagus for various irrigation treatments

Treatment	No. irrigation	Year 1	2	3	4	5	6	7	Mean
					Rainfall—inches				
A	0	31.5	21.2	17.8	15.5	15.5	15.4	12.7	18.5
					Irrigation water, depth inches				
B	4	19.4	20.1	17.1	19.4	17.1	21.3	17.6	18.9
C	2	12.8	11.2	10.5	15.5	11.8	15.5	13.5	13.0
D	4	19.2	20.1	17.1	19.4	17.1	21.3	17.6	18.8
E	2	12.8	11.2	10.5	15.5	11.8	15.5	13.1	12.9
F	4	19.1	20.1	17.1	19.4	17.4	21.3	17.6	18.8

The Effect of Differential Irrigation on Asparagus

Treatment	Harvest season	Growing season	Total yield/plot (lbs.)	Mean wt./spear (gms.)	Mean no. spears/plant	Yield	Mean wt./spear
A	Dry	Dry	448.8	21.3	15.0	B–A**	B–A**
B	Wet	Wet	548.3	26.1	14.4	B–C	B–C*
C	Inter.	Inter.	511.8	24.2	14.3	B–D	B–D
D	Dry	Wet	547.5	25.6	14.6	B–E	B–E**
E	Dry	Inter.	515.0	23.9	14.7	B–F	B–F
F	Inter.	Wet	551.0	24.6	15.3	C–A**	C–A**
	L.S.D = 5%		39.2	1.48			
	1%		53.5	1.80			

** Significant difference at the 1% level.
* Significant difference at the 5% level.

OLIVE

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they produced the largest yields, although in comparison with yields from trees on some of the rootstocks, not significantly so.

Significant yield differences among the various rootstocks were, generally, a reflection of differences in tree size and were less pronounced with the Sevillano scion variety than with Mission and Manzanillo.

Fruit size—in the Manzanillo and Sevillano varieties—was greater for trees on their own roots than on other rootstocks. Only in some comparisons were such differences significant. In the Mission variety, fruit size showed little variation among the rootstocks. In all three varieties the weight of the pit was little influenced by the rootstock.

In all three scion varieties, two rootstocks—*O. verrucosa* and *O. ferruginea* —caused a significant reduction in length-width ratios in comparison with fruit from trees on most of the other rootstocks. Fruit from own-rooted trees of the Manzanillo and Sevillano varieties was not significantly different in shape from that on the other stocks. However, in Mission, fruit from own-rooted trees had a greater length-width ratio—significantly so in some comparisons—than fruit from trees on other rootstocks.

Shotberry production—with all rootstocks—was the greatest by far in the Sevillano variety, followed by Manzanillo, then Mission. In Sevillano and Mission, the occurrence of shotberries was greatest—the differences being significant in most comparisons—when *O. verrucosa* and *O. ferruginea* were the rootstocks. Shotberry production in Manzanillo seemed to have little relation to the rootstock used.

There seemed to be no consistent relationship between rootstock and rate of fruit maturity, except in the Manzanillo variety, where the three *Olea* species as rootstocks significantly delayed the rate of fruit maturity.

In determinations of the percentage of potassium, calcium, magnesium, sodium, phosphorus, and nitrogen in the dry matter of leaves of the three scion varieties studied, no consistent relationships appeared between any of the rootstocks and the mineral nutrient level of the trees.

Although differences in individual tree growth were encountered with clonal stocks, this effect was much more evident with seedling rootstocks.

Seedlings of the Ascolano variety—which itself has a vigorous tree growth when used as rootstocks—proved to have a rather uniformly dwarfing influence on all three varieties, but much more so on Manzanillo than Mission or Sevillano. The clonal stock, Oblonga, had a pronounced dwarfing effect on Manzanillo and somewhat less on Mission, but an invigorating influence on Sevillano.

It is apparent that the behavior of each scion-rootstock combination must be tested individually. Any given influence of a rootstock on the vigor of one variety can not necessarily be expected to hold true for another scion variety.

In commercial olive production there are situations where either a dwarfing or an invigorating rootstock would be useful. In the Tulare County olive district especially, the trees are vigorous and tend to grow excessively tall, making picking difficult and slow, resulting in high harvesting costs. Under such conditions, a dwarfing stock would be of great benefit. Smaller trees, planted closely together, may give higher yields per acre and have much lower harvesting costs. On the other hand, in some areas it is often difficult to obtain adequate tree growth. In such cases, the use of invigorating rootstocks should prove to be very desirable.

Some individual seedlings used as rootstocks in the present study have shown dwarfing effects and some have had an invigorating influence. Cuttings taken from suckers arising from such selected seedling rootstocks have been rooted and grafted. Large-scale tests of such trees are now underway to determine if these stocks will have consistently dwarfing or invigorating effects so that they can be developed as clonal rootstocks for commercial use.

Effect of Rootstock on Tree Size After 4 years' Growth. Sevillano Scion Variety. Corning and Lindsay. Average of 10 Trees.

Rootstock	Trunk cross-section area	
	Corning	Lindsay
Own Root cuttings	8.4 sq cm	72.5 sq cm
Oblonga cuttings	13.0	92.0
Armstrong A-12 cuttings	13.9	86.4
Redding Picholine seedlings	15.1	95.2
Mission seedlings	8.6	113.9
Olea verrucosa seedlings	11.3	95.7
Olea ferruginea seedlings	8.2	79.2
Olea chrysophylla seedlings	13.3	114.0
Olea sylvestris seedlings	...	109.4
Difference required for significance at:		
—1% level	11.6	40.1
—5% level	8.7	30.2

Effect of Rootstock on Tree Size and Yields of Three Olive Scion Varieties After 8 Years' Growth. Winters. Average of 5 Trees.

Rootstock	Sevillano		Mission		Manzanillo	
	Trunk cross section sq. cm.	Yields 4 yr. aver. lbs. per tree	Trunk cross section sq. cm.	Yields 4 yr. aver. lbs. per tree	Trunk cross section sq. cm.	Yields 4 yr. aver. lbs. per tree
Own root cuttings	285	67	542	140	365	86
Oblonga cuttings	376	50	251	85	202	31
Redding Picholine seedlings	456	50	252	58	...	20
Mission seedlings	418	62	236	51	312	44
Frantojo seedlings	345	49	410	85	302	46
Chemlali seedlings	369	51	374	72	243	40
Ascolano seedlings	220	53	204	49	88	15
Olea verrucosa seedlings	184	30	184	44	112	36
Olea ferruginea seedlings	279	40	226	42	192	41
Olea chrysophylla seedlings	341	21	260	49	266	31
Difference required for significance at:						
—1% level	269	34	168	41	149	39
—5% level	200	25	125	31	111	29

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ASPARAGUS

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F—in addition to the rainfall—are given in the upper table on page 8. The intermediate irrigation treatment was considered to be about the amount of water growers would apply, while the wet plots probably received more water than is usually applied. The results as shown in the lower table and in the graph on page 8 indicated that both the intermediate and wet treatments had significantly higher yields than the dry plots. The difference in yield between the intermediate and wet plots was not significant at the 5% level but approached significance. The difference in mean weight per spear between the intermediate and wet plots was significant at the 5% level. However,