JOJOBA BEATS COTTON, BUT YOU HAVE TO WAIT A WHILE

by Thomas M. Stubblefield and N. Gene Wright*

Once upon a time, the jojoba bush, with its wax-bearing seeds, was going to save the sperm whale from destruction while giving gainful employment to Arizona Indians.

Early schemes called for the Indians — Apaches in particular — to gather the nut-like seed by hand from wild plants and the liquid wax extracted would be used to replace sperm oil as a lubricant for machinery run at high temperature. It would also have a place in cosmetics and the manufacture of candles.

Thus would jojoba, native to the Sonoran desert, be benefactor to economy and ecology.

Indeed, the plant could be a real boon, but our calculations, based on experience gained by the University of Arizona's Office of Arid Land Studies with gathering seed in the wild suggest that the hand-harvesting of wild plants will not turn any sort of profit.

If jojoba is to pay, it may have to be irrigated, cultivated, grown in plantations, and subjected to the same sort of breeding improvement that other commercial crops have undergone.

This will take time and sizable investment of capital, but there is the chance that mature jojoba could one day pay an Arizona grower five times as much per acre as he can make from cotton while using one quarter the amount of water. Given this promise, it is small wonder that commercial ventures are afoot in California and Haiti, or that the San Carlos Indians are proceeding with the planting of acres of jojoba and hope for a government grant of several millions to put the scheme to work on a large scale.

What we have attempted to show is the return that can be expected based on cost and seed price. What would be the return, based on price for clean, dry seed at 50 and 75 cents per pound where the crop is hand-harvested and where it is machine-harvested?

While we know that jojoba responds to water and fertilizer in greenhouse and lath house conditions, we need more data on the degree of responsiveness. We also wish we had more information on the cost of harvesting, although our estimates were made on the best data available from our own agricultural engineers and from current commercial field operations in Arizona and other states where crops are irrigated.

To begin with, we estimate that it will take $700 per acre to bring a new area into production. Our best information shows that, for most efficient use of farm machinery, plants from cuttings should be spaced about five feet apart in rows, with ten feet separating the rows. To plant with the greatest ease, the field should be surveyed and staked before planting.

Costs here are based on fall or spring planting with a total of 875 plants per acre — 750 females and 125 males.

In our 1974 budget for raising the plants we estimated jojoba might require four acre feet of water annually, but there are indications that this may be too much, so we estimate two acre feet for this re-

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vision, and that figure might be even less, considering that jojoba grows where the rainfall may average less than 10 inches per year.

Our irrigation costs are based on current costs of $35 per acre foot in east central Arizona. Irrigation and ditch labor amounted to $3 per hour, bringing that cost to $6 per acre foot of water since it takes two hours to apply each acre foot of water.

Trickle irrigation could eliminate the expense of irrigation labor, but the cost — $500-$700 per acre — is high, and we don't know just how well the system will perform.

Included in the costs are mechanical cultivation and chemical control of weeds. Two applications of weed control are provided for as are three mechanical cultivations the first year, two cultivations in years two through five and one cultivation each succeeding year.

We estimate a loss to death of two percent annually and to keep production optimum, dead plants would have to be replaced.

Experience in California and Israel shows that pruning is desirable for plantation plantings, and our cost for this chore is based on practice in commercial fruit production. It should take about two minutes per plant during years one through three, about three minutes per plant in years four through eight, and about four minutes for succeeding years.

In addition, we built in miscellaneous costs including bookkeeping, office, telephone, pickup truck, and rent value of the land. Based on commercial farm operations in Arizona, supervision and management were assigned a cost of $12 per acre, variable farm overhead $15 per acre, and rent value $20 per acre.

The cost of harvesting presented us with one of our biggest unknowns. Mechanical harvesting costs were arrived at after consultation with engineers who have had experience in developing harvesters such as might be used to gather the jojoba seed. It should cost about $98 per hour to operate such a machine, and take about one hour to cover one acre.

We estimate that each acre would be machine-harvested twice, regardless of yield, so the cost per acre for the machine harvest is $196. Plants are expected to produce by the fourth year, hitting full production by year twelve.

Harvesting by hand is very nearly prohibitively expensive. Picking an estimated 15,000 pounds of seed per acre (double the weight of the hulled, dried, and cleaned seed), 1000 workers would be needed to finish an acre in an hour, picking at the rate of 15 pounds per hour. At a wage of $3 per hour, the cost of hand-harvesting is $3,000 per acre. If half that many workers were used, doubling the number of hours, the cost for harvest remains the same, comparing most unfavorably with the cost of $196 for machine harvest over a two-hour period.

Our budget is based on 10 pounds of dry beans per plant starting the twelfth year, and is consistent with production estimates in Israel. Cost for hulling and cleaning a pound of green seed should be 2.5 cents per pound.

The various returns for hand and machine-picked jojoba selling at either 50 cents per pound of dried seed, or 75 cents per pound are as follows:

1. Hand-harvested, selling at 50 cents per pound: Costs outrun returns through all years (Table 1).

2. Hand-harvested, selling at 75 cents per pound: Costs mount through the sixth year (Table 2). The eighth year's revenue was enough to repay that year's costs and by year 12 there is a profit of $892 above all costs incurred during years 1 through 12. Profit following year 12 amounts to $1,937 per acre.

3. Mechanically harvested, selling at 50 cents per pound: Costs mount through year five (Table 3). By year seven, returns are greater than cost and by year eleven there is profit above all costs incurred during the first nine years. Net return to the enterprise increases through year twelve thanks to the increase in production per plant. Net return after year twelve levels off at $2,716 per acre.

4. Mechanically harvested, selling at 75 cents per pound: Costs mount through the fifth year (Table 4). By year six the revenue is great enough to start repaying part of the cost incurred during the first five years. By year nine, all costs have been paid back for a return of $1,661 per acre. The return here, after production has leveled out, comes to $4,591 per acre. That is approximately five to six times what the current return is per acre of cotton in central Arizona.

Before all of this can happen, though, a method for machine harvesting will have to be found, and an all-out effort needs to be made to develop high-yielding plants. A plant producing large seeds would also be helpful. Jojoba seed now varies from 350 seeds per pound to 1,000 or more.

Jojoba may yet be the salvation of the sperm whale, but only production and development on a large scale is likely to provide the keys to unanswered questions.

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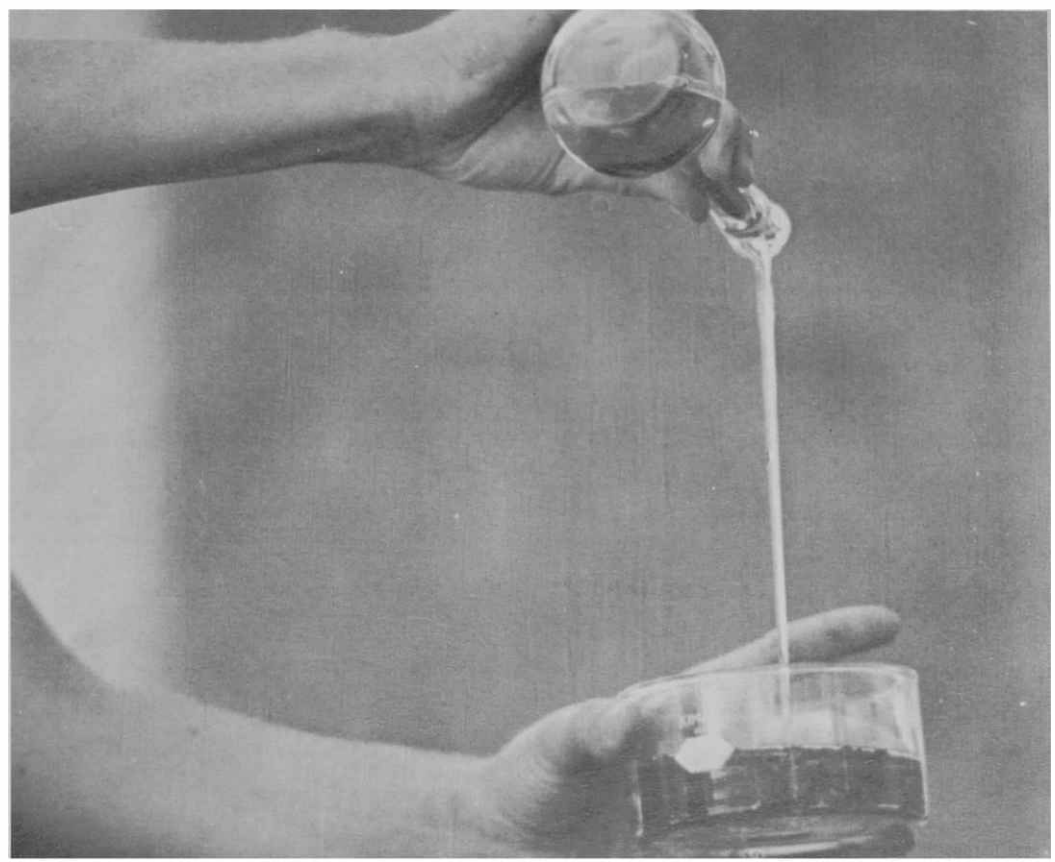

Liquid Jojoba wax may one day lubricate many types of machinery.

Table 1. JOJOBA DEVELOPMENT COSTS PER ACRE EAST CENTRAL ARIZONA — 1976

Operation	Year 1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th	13th
Land Development Cost	700												
Land Preparation	30												
Layout and Plant @ $.30/plant	262												
Plants, 875 @ $1.25 each	1094												
Water, @ $35/AF	70	70	70	70	70	70	70	70	70	70	70	70	70
Irrigation and ditch labor @ $6/AF	12	12	12	12	12	12	12	12	12	12	12	12	12
Chemical weed control @ $6 per app.	12	12	12	12	12	12	12	12	12	12	12	12	12
Cultivation @ $5 per cultivation	15	10	10	10	10	10	10	10	5	5	5	5	5
Fertilization and application @ $.45 per unit of N	20	20	20	20	20	20	20	20	20	20	20	20	20
Plant replacement @ $2.50 per plant	45	45	45	45	45	45	45	45	45	45	45	45	45
Pruning and disposal	110	110	110	165	165	165	165	165	218	218	218	218	218
Supervision and Management	12	12	12	12	12	12	12	12	12	12	12	12	12
Variable Farm Overhead	15	15	15	15	15	15	15	15	15	15	15	15	15
Rent Value of Land	20	20	20	20	20	20	20	20	20	20	20	20	20
Subtotal	2417	326	326	381	381	381	381	381	429	429	429	429	429
Accumulative Subtotal	2417	2936	3497	4158	4844	5528	6204	6871	7577	8276	8968	9652	10328
Interest @ 8%	193	235	280	333	387	442	496	550	606	662	717	772	826
Total Production Costs	2610	3171	3777	4491	5231	5970	6700	7421	8183	8938	9685	10424	11154
Hand Harvest @ $.38/pound	0	0	0	152	456	798	1140	1482	1524	2166	2508	2850	2850
Clean and Handle Seed @ $.025/pound	0	0	0	20	60	105	150	195	240	285	330	375	375
Total Costs	2610	3171	3777	4663	5747	6873	7990	9098	10247	11389	12523	13649	14379
Revenue @ $.50 per pound	0	0	0	200	600	1050	1500	1950	2400	2850	3300	3750	3750
Costs to be Carried Forward	2610	3171	3777	4463	5147	5823	6490	7148	7847	8539	9223	9899	10629

Table 2. JOJOBA DEVELOPMENT COSTS PER ACRE EAST CENTRAL ARIZONA — 1976

Operation	Year 1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th	13th
Land Development Cost	700												
Land Preparation	30												
Layout and Plant @ $.30/plant	262												
Plants, 875 @ $1.25 each	1094												
Water, @ $35/AF	70	70	70	70	70	70	70	70	70	70	70	70	70
Irrigation and ditch labor @ $6/AF	12	12	12	12	12	12	12	12	12	12	12	12	12
Chemical weed control @ $6 per app.	12	12	12	12	12	12	12	12	12	12	12	12	12
Cultivation @ $5 per cultivation	15	10	10	10	10	10	10	10	5	5	5	5	5
Fertilization and application @ $.45 per unit of N	20	20	20	20	20	20	20	20	20	20	20	20	20
Plant replacement @ $2.50 per plant	45	45	45	45	45	45	45	45	45	45	45	45	45
Pruning and disposal	110	110	110	165	165	165	165	165	218	218	218	218	218
Supervision and Management	12	12	12	12	12	12	12	12	12	12	12	12	12
Variable Farm Overhead	15	15	15	15	15	15	15	15	15	15	15	15	15
Rent Value of Land	20	20	20	20	20	20	20	20	20	20	20	20	20
Subtotal	2417	326	326	381	381	381	381	381	429	429	429	429	429
Accumulative subtotal	2417	2936	3497	4158	4744	5120	5239	5079	4666	3932	2851	1396	429
Interest @ 8%	193	235	280	333	379	410	419	406	373	314	228	112	34
Total Production Costs	2610	3171	3777	4491	5123	5530	5658	5485	5039	4246	3079	1508	463
Hand Harvest @ $.38/pound	0	0	0	152	456	798	1140	1482	1824	2166	2508	2850	2850
Clean and Handle Seed @ $.025/pound	0	0	0	20	60	105	150	195	240	285	330	375	375
Total Costs	2610	3171	3777	4663	5639	6433	6948	7162	7103	6697	5917	4733	3688
Revenue @ $.75 per pound	0	0	0	300	900	1575	2250	2925	3600	4275	4950	5625	5625
Costs to be Carried Forward	2610	3171	3777	4363	4739	4858	4698	4237	3503	2422	967	892*	1937*

*Profit

Table 3. JOJOBA DEVELOPMENT COSTS PER ACRE EAST CENTRAL ARIZONA — 1976

Operation	Year 1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th	13th
Land Development Cost	700												
Land Preparation	30												
Layout and Plant @ $.30/plant	262												
Plants, 875 @ $1.25 each	1094												
Water, @ $35/AF	70	70	70	70	70	70	70	70	70	70	70	70	70
Irrigation and ditch labor @ $6/AF	12	12	12	12	12	12	12	12	12	12	12	12	12
Chemical weed control @ $6 per app.	12	12	12	12	12	12	12	12	12	12	12	12	12
Cultivation @ $5 per cultivation	15	10	10	10	10	10	10	10	5	5	5	5	5
Fertilization and application @ $.45 per unit of N	20	20	20	20	20	20	20	20	20	20	20	20	20
Plant replacement @ $2.50 per plant	45	45	45	45	45	45	45	45	45	45	45	45	45
Pruning and disposal	110	110	110	165	165	165	165	165	218	218	218	218	218
Supervision and Management	12	12	12	12	12	12	12	12	12	12	12	12	12
Variable Farm Overhead	15	15	15	15	15	15	15	15	15	15	15	15	15
Rent Value of Land	20	20	20	20	20	20	20	20	20	20	20	20	20
Subtotal	2417	326	326	381	381	381	381	381	429	429	429	429	429
Accumulative Subtotal	2417	2936	3497	4158	4888	5316	5373	5030	4302	3111	1420	429	429
Interest @ 8%	193	235	280	333	391	425	430	402	344	249	114	34	34
Total Production Costs	2610	3171	3777	4491	5279	5741	5803	5432	4646	3360	1534	463	463
Harvest Costs @ $98/hour	0	0	0	196	196	196	196	196	196	196	196	196	196
Clean and Handle Seed @ $.025/pound	0	0	0	20	60	105	150	195	240	285	330	375	375
Total Costs	2610	3171	3777	4707	5535	6042	6149	5823	5082	3841	2060	1034	1034
Revenue @ $.50 per pound	0	0	0	200	600	1050	1500	1950	2400	2850	3300	3750	3750
Costs to be Carried Forward	2610	3171	3777	4507	4935	4992	4649	3873	2682	991	1240*	2716*	2716*

*Profit

Table 4. JOJOBA DEVELOPMENT COSTS PER ACRE EAST CENTRAL ARIZONA — 1976

Operation	Year 1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th	13th
Land Development Cost	700												
Land Preparation	30												
Layout and Plant @ $.30/plant	262												
Plants, 875 @ $1.25 each	1094												
Water, @ $35/AF	70	70	70	70	70	70	70	70	70	70	70	70	70
Irrigation and ditch labor @ $6/AF	12	12	12	12	12	12	12	12	12	12	12	12	12
Chemical weed control @ $6 per app.	12	12	12	12	12	12	12	12	12	12	12	12	12
Cultivation @ $5 per cultivation	15	10	10	10	10	10	10	10	5	5	5	5	5
Fertilization and application @ $.45 per unit of N	20	20	20	20	20	20	20	20	20	20	20	20	20
Plant replacement @ $2.50 per plant	45	45	45	45	45	45	45	45	45	45	45	45	45
Pruning and disposal	110	110	110	165	165	165	165	165	218	218	218	218	218
Supervision and Management	12	12	12	12	12	12	12	12	12	12	12	12	12
Variable Farm Overhead	15	15	15	15	15	15	15	15	15	15	15	15	15
Rent Value of Land	20	20	20	20	20	20	20	20	20	20	20	20	20
Subtotal	2417	326	326	381	381	381	381	381	429	429	429	429	429
Accumulative Subtotal	2417	2936	3497	4158	4788	4908	4408	3238	1392	429	429	429	429
Interest @ 8%	193	235	280	333	383	393	353	259	111	34	34	34	34
Total Production Costs	2610	3171	3777	4491	5171	5301	4761	3497	1503	463	463	463	463
Harvest Costs @ $98/hour	0	0	0	196	196	196	196	196	196	196	196	196	196
Clean and Handle Seed @ $.025/pound	0	0	0	20	60	105	150	195	240	285	330	375	375
Total Costs	2610	3171	3777	4707	5427	5602	5107	3888	1939	944	989	1034	1034
Revenue @ $.75 per pound	0	0	0	300	900	1575	2250	2925	3600	4275	4950	5625	5625
Costs to be Carried Forward	2610	3171	3777	4407	4527	4027	2857	963	1661*	3331*	3961*	4591*	4591*

*Profit