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INSIDE:
THIRD INTERNATIONAL CONFERENCE
WATER-HARVESTING AGRISYSTEM
JOJOBA OIL VS. JOJOBA WAX
JOJOBA ECONOMICS



Number 24 September 1978

JOJOBA HAPPENINGS

Editorial Policy

The goal of *Jojoba Happenings* is to disseminate jojoba research and development information around the globe to stimulate further worldwide investigations. To fulfill the *Jojoba Happenings* goal, we actively solicit reader contributions with the hope of offering a worldwide exchange of information.

Commentaries, opinions and discussions of new ideas and suggested directions of jojoba development are welcomed for publication in the "Editorial" section. "Jojoba Reports" are formal or informal discussions of jojoba development and research activities as well as of preliminary research findings presented by researchers, institutions or other persons and organizations. "News and Notes" offers an informal arena within which readers can discuss jojoba economic development, jojoba product marketing and other jojoba activities. Current, annotated bibliographic jojoba references are published in the "Literature Review" section of the newsletter.

No endorsements of jojoba products, efficacy claims or research findings are implied because of publication in *Jojoba Happenings*. This publication is simply a vehicle to present discussions of jojoba programs, products and uses.

Articles, notes or literature citations are most welcome and should be submitted to: Anna Elias-Cesnik, Editor, *Jojoba Happenings*, Office of Arid Lands Studies, University of Arizona, 845 North Park Avenue, Tucson, Arizona 85719 USA.

Anna Elias-Cesnik, Editor

COVER: Design by Mary Ann O'Donnell; Photograph by Wade C. Sherbrooke

JOJOBA HAPPENINGS

September 1978



Residents of San Carlos Apache Indian Reservation selling seed to the San Carlos Jojoba Development Project, Summer 1978.

—Photograph by Sandra J. Turner

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EDITORIAL

THIRD INTERNATIONAL CONFERENCE ON JOJOBA

The Third International Conference on Jojoba will be held September 13-16, 1978, at the University of California, Riverside, California. We should pause, perhaps, to ponder the validity of participating in such a venture, to question its purpose, its goals: Another international jojoba conference—why? We should look first at the history of international jojoba events—purposes, directions and goals.

As an initial step in bringing together existing knowledge on all aspects of jojoba, the First International Conference on Jojoba and Its Uses was held at the University of Arizona, Tucson, Arizona, June 1-3, 1972.

“The purpose of the Conference was to bring together scientists and technologists interested in jojoba and its potentialities for production of useful products. The Conference was aimed toward a full discussion of available information on previous investigations on the plant itself, on chemistry of the seed, utilization of the wax in the seed, problems involved in the collection of seeds and production under cultivation,” according to W.G. McGinnies, Conference Chairman.¹

This statement set the stage for the Second International Conference on Jojoba and Its Uses, held February 10-12, 1976, at Ensenada, Baja California, Mexico. Organized by the joint Mexico-United States international jojoba council, Consejo Internacional sobre Jojoba (CIJO), this Conference expanded the dimensions and broadened international interest in jojoba development and research.

In 1972 and 1976 scientists were optimistic, far-sighted and dedicated to ensuring the economic success of jojoba development. Confidence in the visibility of the plant and its potential products was expressed. These meetings were viewed by many as catalyzing forces that would “project jojoba along the pathway leading to commercialization.”²

¹W.G. McGinnies, Forward to Proceedings of the First International Conference on Jojoba and Its Uses, 1972.

²Noel D. Vietmeyer, Summarizing Remarks of the First International Conference on Jojoba and Its Uses, 1972.

It is this confidence and enthusiasm which sparked a phenomenal worldwide interest in the mysterious plant native to the Sonoran Desert and, what romantics term, its liquid gold. Entrepreneurs have committed equal amounts of toil and treasure to jojoba development, hoping to share in the benefits of developing a profitable renewable natural resource, and reaching to attain the goals set by the first and second jojoba conferences. It is these dedicated individuals who have inspired a third international conference and its theme: jojoba, a crop whose time has come. In the words of D.M. Yermanos, Third International Conference Chairman, “. . . jojoba is no longer a mere botanical curiosity of the Sonoran Desert. It is well on its way to becoming an agricultural reality. The development of jojoba into a new renewable resource is a symbol of creative appropriate technology. Your presence at the Conference will help review and evaluate accomplishments to date and pave the road for another leap forward in the domestication and utilization of jojoba.”³

Another international conference on jojoba—indeed!

Anna Elias-Cesnik

³D.M. Yermanos, Chairman's Message of the Third International Conference on Jojoba, 1978.

JOJOBA REPORTS

**Jojoba Water-Harvesting Agrisystem Experiment,
Papago Indian Reservation, Sells, Arizona
C. Brent Cluff
Water Resources Research Center
University of Arizona
Tucson, Arizona**

INTRODUCTION

The jojoba plant grows in a 4- to 18-inch precipitation zone. In the lesser precipitation zones plants are limited to sites where rainfall is concentrated by arroyos or on alluvial fans at mountain bases (Gentry, 1958). Gentry also has observed the tremendous difference in growth and production between two jojoba plants growing in a 4.3-inch rainfall zone in Joshua Tree National Monument, California. One jojoba flourished near a paved road which served as a watershed and the other, away from the road, was dry and nearly leafless. The author has noticed similar disparities in jojoba growth in the Sahuaro National Monument west of Tucson, Arizona.

Less intense, deeper penetrating winter rains coming near the jojoba flowering season are much more important to plant survival and production than are the more intense, summer convectional rains. Sellers (1960) determined that there is more variability in precipitation totals in winter than there is in summer. The chances are greater for a completely dry winter than for a completely dry summer.

In view of the foregoing information a paper was written in 1972 illustrating how water-harvesting techniques could be used to concentrate precipitation to enhance growth and production of jojoba. Excess runoff water is stored in a reservoir and pumped back to the plants during winter and spring to maximize bean production (Cluff, 1972).

The concept became a reality in 1974 with construction of an approximately one-acre water-harvesting system on the grounds of the Baboquivari High School in Sells, Arizona, on the Papago Indian Reservation. It was a cooperative project between the Papago Indian Tribe, the U.S. Bureau of Indian Affairs, Baboquivari High School and the University of Arizona Water Resources Research Center and Office of Arid Lands Studies. This paper describes the project which was funded primarily by the U.S. Department of Health, Education and Welfare.

SITE SELECTION AND METHOD OF CONSTRUCTION

The site was selected primarily due to its accessibility and ease of maintenance. The soils are somewhat sandier than would have been selected otherwise. There is less than 10 percent clay. The average difference from four soil samples between field capacity and the wilting point was only 2.6 percent. This low soil-moisture holding capacity called for auxiliary storage, particularly during the early years of the project.

It was decided that three leading catchment treatments would be tested for harvesting water to raise jojoba. There are 1) sodium chloride; 2) asphalt-plastic-asphalt-chip (AFAC); and 3) paraffin wax. Consequently, the approximately one-acre catchment was divided into three parts and treatments applied as shown in Figure 1. Each treatment covered a 60-by-270 foot area (16,200 square feet). Each area treated contained two 30-foot wide drainage catchments, each having a row of jojoba plants in the center. Sides were constructed with approximately 10 percent slopes.

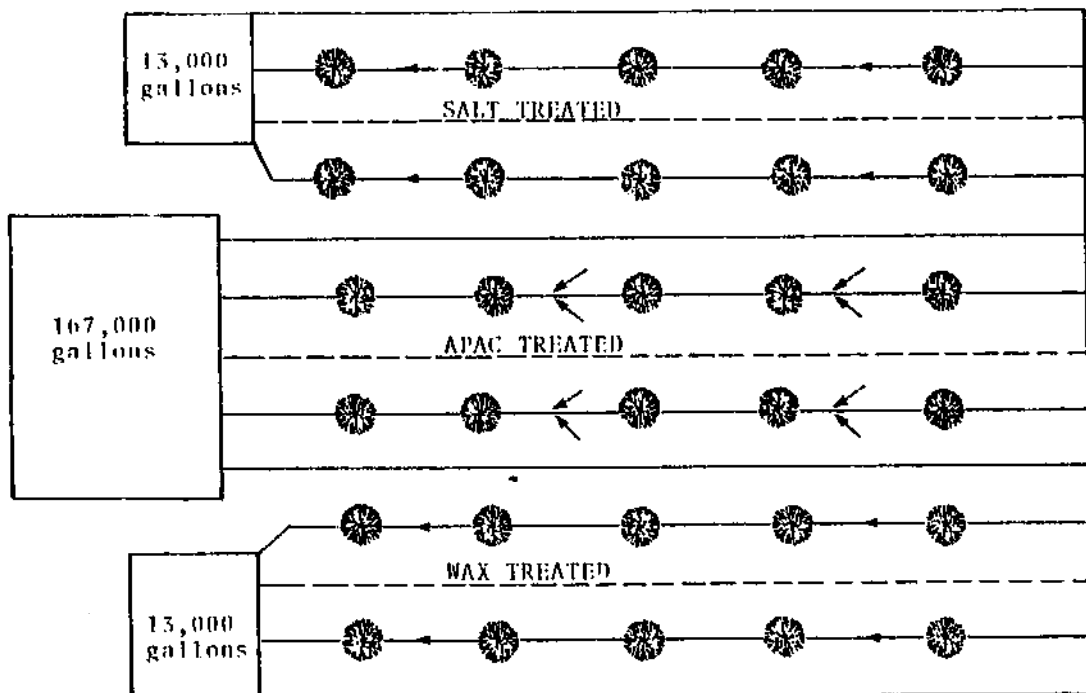


Figure 1. Jojoba Water-Harvesting Agrisystem, Papago Indian Reservation, Sells, Arizona.

The catchments drain into reservoirs. Two small 13,000-gallon reservoirs were constructed primarily to measure runoff flow and to collect water samples. The large reservoir holds approximately 167,000 gallons of water. A pumpback system was installed which consists of a two-inch electric submersible pump and two-inch polyethylene plastic line.* The

*This project predates evolution of the concept of the compartmented reservoir (Cluff, 1977). However, the three reservoirs could be operated as a compartmented-reservoir system.

two small reservoirs are lined with plastic and coated with reinforced mortar. The large reservoir was constructed using the APAC method and polypropylene matting. The sides of the reservoir were coated with reinforced mortar later to help stabilize the banks which have a slope ratio of two vertical-to-one horizontal.

All catchments were prepared in the same way. A road grader was used for shaping. Final smoothing was accomplished with a PTO (power take-off) operated rock rake (Cluff, 1974). Sodium chloride was applied to the catchments at the rate of 5 tons per acre by a conventional fertilizer spreader. The salt was mixed into the soil with the rock rake which also smoothed the surface. Following a 5-inch rainfall catchments were compacted by running a one-half-ton pickup truck back and forth across the surface. This was the final treatment for the salt treated catchments.

The APAC system was laid down on top of the salt treated subgrades, using an asphalt "boot" truck, a dump truck with a chip spreader and a jeep equipped with a plastic dispenser roller.**

The paraffin wax treatment was laid down at a rate of 1.25 pounds per square yard on the salt treated subgrades by personnel from the U.S. Department of Agriculture Water Conservation Laboratory at Tempe, Arizona. Paraffin wax was hand sprayed after being melted in a butane heated, 400 gallon distribution tank. It took about three hours to heat and hand spray the wax. Less time would be required if a regular asphalt "boot" truck and spray bar was used.

A summary of the 1974 estimated cost of the systems is given in Table 1.

PLANTING OF JOJOBA

Each of the three treatment test plots contained two rows for jojoba cultivation. Jojoba was planted in late May 1975 (*Jojoba Happenings*, No. 13). One row of each treatment test plot was planted with potted seedlings raised in the Baboquivari High School Vocational Agriculture Department greenhouse. Seedlings were planted five feet apart in the rows. The second row in each plot was direct seeded with five seeds per hill. Each hill was 2.5 feet apart in the rows. One to three seeds germinated in 50 percent of the hills. The plan was to thin direct seeded plants to one plant per hill with five-foot spacing after plant sex was determined. This thinning rate would have left 324 plants on the 1.12 acres (approximately 290 plants per acre). Natural attrition reduced plant density to an approximate five-foot spacing over most of the test area so that the planned thinning was not needed.

First planting survival rate was relatively high. When summer rains began later in the year, however, many plants drowned because the catchment profiles were nearly level in the lower parts of the wax-treated and, to a lesser extent, on the APAC and sodium-treated plots.

Approximately 200 additional plants were planted in May 1977. These plants, obtained from a commercial nursery, were 6 to 8 inches high and growing in gallon cans. Second planting survival rate was much lower than the initial planting, particularly on the wax treated catchment. This die-off occurred even though the drainage problems had been corrected. High spring-summer temperatures shortly after planting and perhaps insufficient water as well as transplanting disturbance all contributed to the die-off of more than 75 percent in the second planting.

***Installing an APAC catchment is described more fully in Frobel and Cluff (1976). The size of catchment was erroneously stated as being 20,000 square feet in this publication.*

Table 1

**Cost Summary (1974)
Jojoba Water-Harvesting Plantation**

| | | |
|---|------------|------------|
| Catchments (Three 1800 yd ² each) | | |
| Compacted Earth Salt-Treated (CEST) Catchment | \$212.00 | |
| | | \$ 212.00 |
| Asphalt-Plastic-Asphalt-Chip (APAC)-Treated Catchment (4 mil polyethylene plastic) | | |
| Subgrade | 212.00 | |
| APAC | 650.00 | |
| | | 862.00 |
| Wax-Coated CEST Catchment | | |
| Subgrade | 212.00 | |
| Wax | 435.00 | |
| | | 647.00 |
| Storage | | |
| Excavation | 660.00* | |
| | | 660.00 |
| Lining | | |
| Two 13,000-gallon tanks (reinforced mortar coated plastic) | 770.00 | |
| One 167,000-gallon tank (APAC sealed) | 1,110.00** | |
| | | 1,880.00 |
| | | 2,540.00 |
| Fencing | 932.00*** | |
| | | 932.00 |
| Total | | \$5,193.00 |

*These costs are size- and site-dependent.

**These tanks are needed only because it is an experimental facility.

***Fencing costs are size-dependent and would be lower if conventional barbed wire were used instead of woven wire with welded H corner posts and iron pipe gate.

PLANT SURVIVAL AND PRODUCTION

On August 8, 1978, 219 hills contained viable jojoba. The inventory is given in Table 2. Most of the surviving plants appear to be in good condition. Some of the original plantings are 3 to 4 feet high and 4 to 5 feet in diameter. Some 27 plants bore seed for the first time during 1977-1978.

Surviving plants on the salt-treated plot were 109, 65 plants survived on the APAC-treated and only 45 plants on the wax-treated plot survived. Most of the plant mortality on the wax and APAC plots was due to flooding. Photographs taken during fall 1977 are Figures 2 and 3.

Table 2
Inventory of Surviving Jojoba Plants, August 1978
Jojoba Water-Harvesting System,
Sells, Arizona

| | Salt Treated | APAC | Wax Treated |
|--------------------|--------------|-----------|-------------|
| Direct Seeded* | 65 | 42 | 23 |
| Potted Seedlings** | 44 | 23 | 22 |
| Total | 109 | 65 | 45 |

*Planting rate was 108 plants per row, 2.5-foot spacing.

**Planting rate was 54 plants per row, 5.0-foot spacing.



Figure 2. Jojoba Water-Harvesting Agrisystem Sells, Arizona, showing two-year-old plants on salt treated area.

—Photograph by C. Brent Cluff



Figure 3. Jojoba Water-Harvesting Agrisystem Sells, Arizona, showing storage reservoir in foreground.

—Photograph by C. Brent Cluff

DISCUSSION AND CONCLUSIONS

The jojoba water-harvesting agrisystem established at Sells in 1974-1975 has demonstrated potential although a lack of funding curtailed necessary maintenance. Most attrition in the first planting was caused by drowning from ponded water. The high mortality rate of the second planting probably was due to methods used by an inexperienced crew, maintenance and timing of the transplants.

The salt-treated catchments seem to be good for raising jojoba. Salt-treated catchments still effectively shed water and control weeds on catchment slopes. Considerable weed growth has occurred, however, in the drainageways and a suitable herbicide should be used.

The APAC-treated catchments are weathering well except in areas where initial chip treatment was inadequate and in localized areas where runoff has eroded the chip cover.

Wax treatment in the rates applied on this particular soil type does not seem to be long-lasting. Precipitation of 0.05 inches caused runoff on the wax- and APAC-treated plots, but by September 1977 runoff from the wax-treated plot had increased by several factors. Little visual evidence remains that any wax has survived the three years since treatment. Cracking after wax-treatment installation probably caused subsequent erosion of the wax material. It appears that more erosion has occurred in the wax-treated plot than in the salt-treated plot. The water-harvesting efficiency appears to be similar to that of the sodium-treated plot, indicating that the wax treatment controls runoff. Personal communication with Keith Cooley, U.S. Department of Agriculture Water Conservation Laboratory, indicates that perhaps a heavier initial wax treatment would have been more satisfactory.

Assuming that one-half of the 219 plants surviving are female and will produce 10 pounds of seed per plant, the average seed production on the test plot would be about 1,095 pounds. At the current market price of \$1.50 per pound of dry, unhulled seed, the gross return would be \$1,642.50 per acre.

If the plot were replanted to its proposed density of 324 plants with a ratio of one male to five female plants, the potential gross return at today's prices would be \$3,888 per acre.

An updated, computerized design of a salt-treated jojoba water-harvesting agrisystem which includes use of a compartmented reservoir has been described by Cluff and Foster (1978). This design would be more cost effective than the design used at Sells.

In summary, the research results presented herein, together with the growing economic potential of jojoba, indicate that larger installations of jojoba water-harvesting agrisystems are justified.

ACKNOWLEDGMENTS

Special acknowledgments are extended to Dr. Edward Haase, previously with the Office of Arid Lands Studies, and Dr. Gordon Dutt, Department of Soils, Water and Engineering, University of Arizona, for their help in the design and planting stages.

Appreciation is expressed also to Harley Cox, Mike Henry and Frank Molina, Baboquivari High School vocational agriculture instructors, who have supervised maintenance of the project during the past four years.

Finally, the help of the U.S. Bureau of Indian Affairs for furnishing equipment and the U.S. Public Health Service for providing the necessary funds to establish the water-harvesting system is gratefully appreciated.

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Jojoba Oil vs. Jojoba Wax

Anthony J. Verbiscar and Thomas F. Banigan*

Anver Bioscience Design

Sierra Madre, California

We suggest that the oily material obtained by expression or solvent extraction of jojoba seeds be referred to as "jojoba oil," rather than "jojoba wax." We observe several reasons for this clarification. Chemically, jojoba oil is similar in structure to sperm whale oil which is traditionally called "sperm oil." Hydrogenated sperm oil is named spermaceti wax. Hydrogenation of the double bonds of jojoba oil produces a hard semicrystalline material that has properties similar to the common waxes such as carnauba, candelilla, spermaceti and beeswax. It seems consistent that hydrogenated jojoba oil should be referred to as jojoba wax.

To organic chemists the terms oil and wax describe the physical characteristics of a material at normal temperatures. A liquid of relatively high viscosity, high boiling point and slippery feel can be called an oil. Common oils are peanut oil, olive oil, soybean oil, mineral oil, shale oil and petroleum. There are also essential oils of many kinds; we often refer to heavier liquid organic compounds as oils.

A solid or semicrystalline material with a waxy luster and feel is likely to be called a wax. There are plant, insect, animal, petroleum and synthetic waxes. In addition to the previously named waxes, some paraffins, sorbitol esters, polyethylenes, polyethyleneglycols, chloronaphthalenes, stearic acid and other diverse materials are considered waxes.

Several organic chemistry texts note that natural waxes usually are mixtures of high paraffinic hydrocarbons, fatty acids, long chain alcohols or sterols, and esters of these acids and alcohols. For example, beeswax is principally myricyl palmitate but contains cerotic acid plus about 20 percent paraffinic hydrocarbons. Carnauba wax is a mixture of higher molecular weight acids, alcohols and esters. The main constituent of candelilla wax is the hydrocarbon hentriacontane. Esters of a fatty acid and higher carbon alcohols are usually waxes and many natural waxes contain such esters, but all waxes are not esters.

**Work is supported by National Science Foundation grant no. AER 76-23895 A02. Opinions or recommendations expressed herein are those of the authors, and do not necessarily reflect the views of the National Science Foundation.*

The use of the terms jojoba oil, to describe the natural product, and jojoba wax, to describe the hydrogenated material is suggested. Some investigators have used these terms in published research works: J. Wisniak (1977), Jojoba oil and derivatives, *Progress in the Chemistry of Fats and Other Lipids* 15:167-218; Thomas K. Miwa (1978), *Chemical Research on Jojoba Oil Since 1972*, U.S. Department of Agriculture, Northern Regional Research Center, Peoria, and (1976), Hardness test for wax formulations from jojoba wax, paraffin, polyethylene and polypropylene waxes, Second International Conference on Jojoba and Its Uses, Ensenada, Baja California, Mexico, February 10-12.



Jojoba Economics
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Some of the real questions facing prospective growers of jojoba are: What does it cost to produce seed? What is the cost of producing oil? Can I recover my investment?

The following table and figures address these questions to help in the decision-making process. For purposes of these budgets production of seeds starts the fourth year and reaches a constant yield by the 12th year.

The table gives the per-acre break-even price of 470 female plants producing 3 pounds of clean dry seeds per plant. The break-even price includes all fixed and variable costs for establishing, producing and harvesting the seed using mechanical and hand harvesting methods. Hand harvesting cost was set at \$.67 per pound of clean dry seed; thus a person would be paid \$3 per hour by hand harvesting 4.5 pounds of seed per hour.

Figure 1 gives the cost of producing a pound of oil using the break-even prices in the table. Using present technology (hydraulic expeller press) approximately 2.5 pounds of seeds are needed to extract a pound of oil. Cost of extraction is estimated to be \$.50 per pound of oil. Using a mechanical harvester, which is not available now, a pound of oil would cost \$16.48 to produce during the fourth year (see Figure 1). Increased yields by the 12th year would reduce the cost to produce a pound of oil to \$1.82. Hand harvesting would cost less, \$13.78 pound pound, during the fourth year but would only drop to \$3.02 per pound by the 12th year. This means that by the 12th year the break-even price for oil produced from hand harvested seed is 66 percent higher than from mechanically harvested seed.

A producer needs to know if total establishing, producing and harvesting costs can be recovered. If 470 female plants per acre yield 3 pounds per plant and if a pound of clean dry seed sells for \$1.50, mechanically picked seed would pay back all costs by the 10th year (see Figure 2). Hand-harvested seek would pay back all costs and show a profit by the 12th year. If \$1 per pound were the selling price mechanical harvesting would break even by the 13th year (see Figure 3). If hand-harvested seed sold for \$1 per pound investment costs could not be recovered with the given plant density, yield and production, harvesting and processing costs.

Although seeds are selling for \$1 to \$2 per pound in 1978 when demand far exceeds supply, the important question to keep in mind is what will happen in the future? To be competitive in the future (1985-1990) jojoba oil may have to be produced for less.

**Break-Even Price for Jojoba Seed*
(Producing and Harvesting Costs)**

| Year | Dollars Per Pound Mechanical Harvest | Hand Harvest |
|------|---|--------------|
| 1 | no seeds produced | |
| 2 | | |
| 3 | | |
| 4 | 6.39 | 5.31 |
| 5 | 3.25 | 3.06 |
| 6 | 2.11 | 2.22 |
| 7 | 1.61 | 1.87 |
| 8 | 1.26 | 1.56 |
| 9 | .96 | 1.35 |
| 10 | .85 | 1.25 |
| 11 | .60 | 1.04 |
| 12 | .53 | 1.01 |

*470 female plants per acre producing 3 pounds of clean, dry seed per plant

**Price of Jojoba Oil
(3 Pounds Per Plant, 470 Plants Per Acre)**

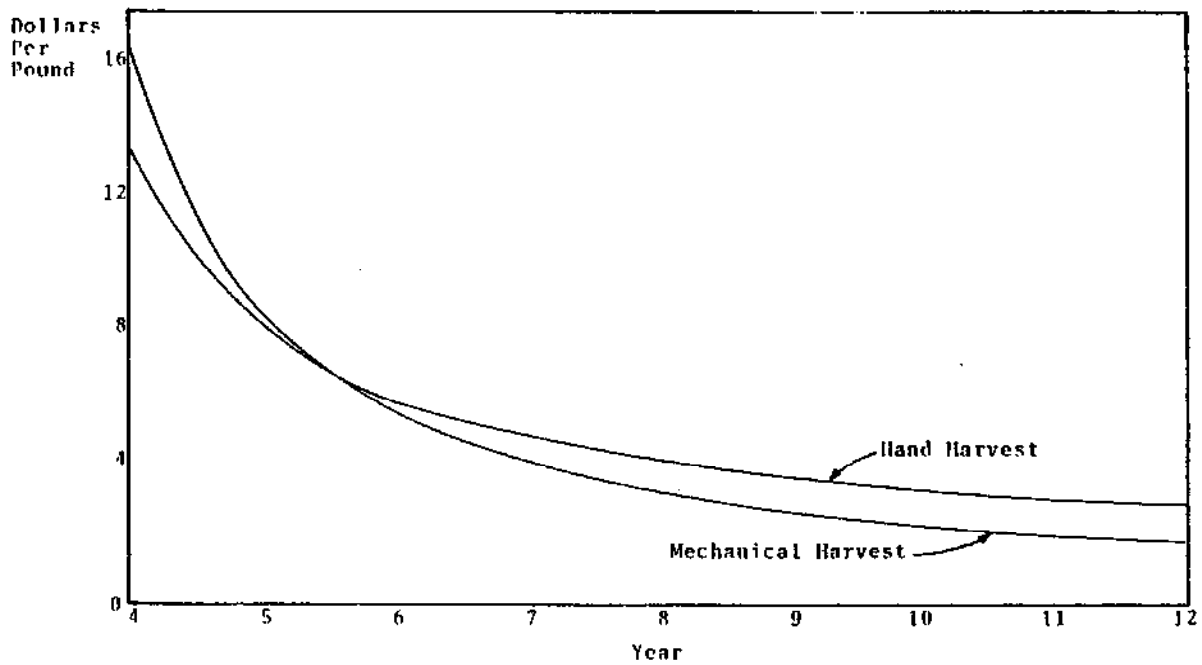


Figure 1

Jojoba Investment Payback
 Seed Price \$1.50 Per Pound
 (3 Pounds Per Plant, 470 Plants Per Acre)

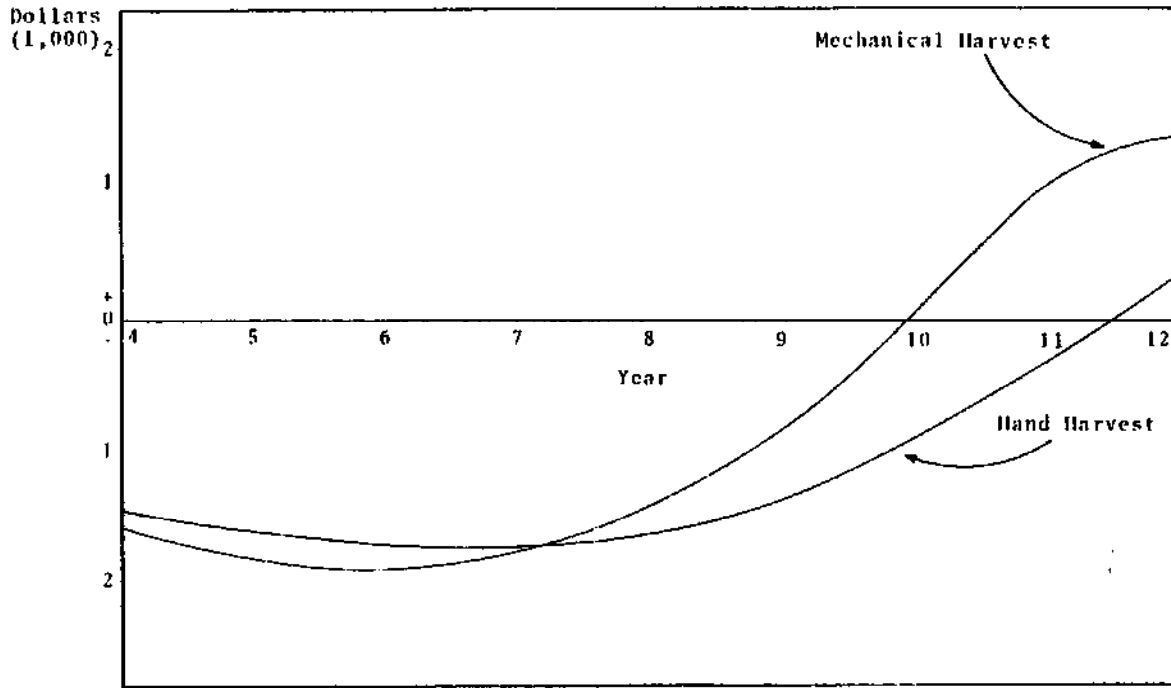


Figure 2

Jojoba Investment Payback
 Seed Price \$1.00 Per Pound
 (3 Pounds Per Plant, 470 Plants Per Acre)

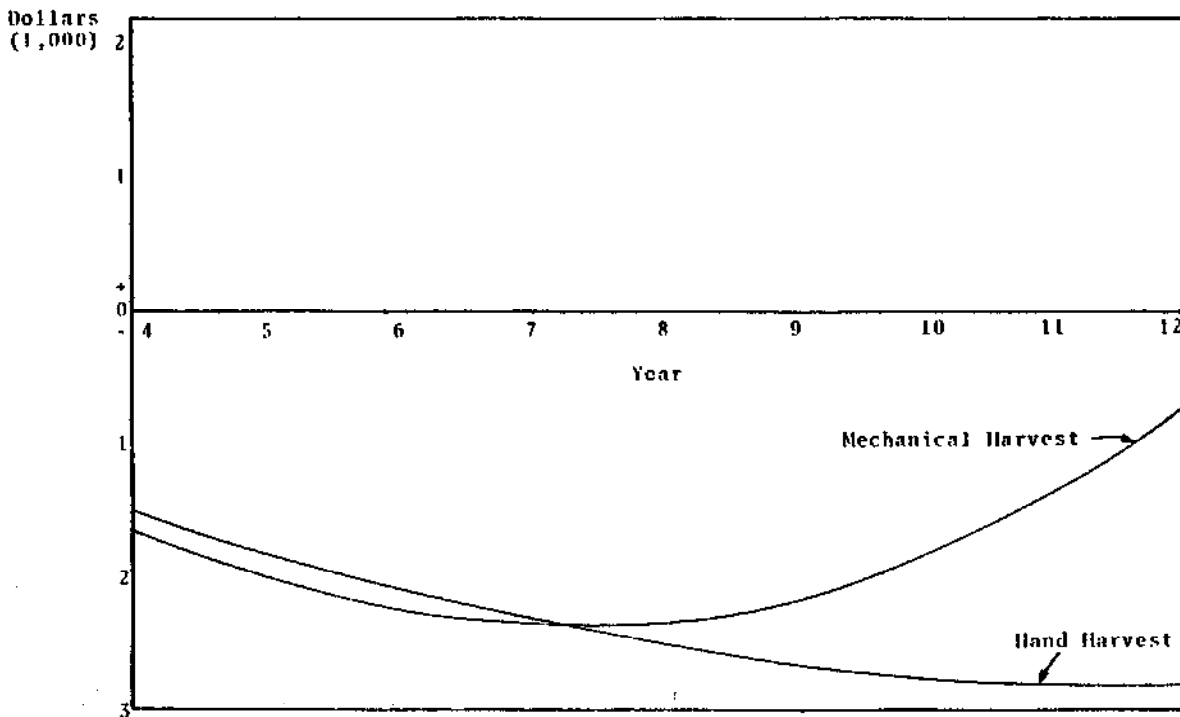


Figure 3

NEWS AND NOTES

New Directions Inspire New Jojoba Happenings Look. The jojoba industry is entering a new era. Dreams and visions of early jojoba researchers to commercialize jojoba now are being realized (see Editorial page 1). Inspired by new directions of the jojoba industry *Jojoba Happenings* has taken on a new look reflecting the renewed hopes and aspirations of today's jojoba enthusiasts. We offer a special thanks to Office of Arid Lands Studies Graphic Artist, Mary Ann O'Donnell, who designed *Jojoba Happenings'* new cover and layout. Your comments are solicited. A.E.C.



Third International Conference on Jojoba. The Third International Conference on Jojoba will take place September 13-16, 1978, at the Holiday Inn, Riverside, California.

Two publications have been prepared in advance of the conference—*Jojoba: General Information and Photographs*, and *A Bibliography of Jojoba: A Crop Whose Time Has Come* (See "Literature Review"). D.M. Yermanos, Conference Chairman has requested all Conference participants submitting papers to prepare typed, "photo-ready" manuscripts of their papers. He hopes to have published the Conference proceedings within weeks after the Conference.

Scheduled activities include a special field tour, social hour and banquet on Wednesday, September 13, followed by 2.5 days of discussions and formal paper presentations.

For Conference information contact D.M. Yermanos, Third International Conference on Jojoba, Department of Plant Sciences, University of California, Riverside, California 92521.



Senate Appropriations Bill Includes Jojoba. U.S. Sen. Dennis DeConcini, D-Ariz., won approval of the Senate Appropriations Committee in August to add more than \$3 million to an appropriation affecting Arizona.

The additional \$3-million appropriation included \$500,000 for jojoba agri-industry development projects. Funds would establish and maintain 20-acre test plots on Indian reservations in Arizona and California. The remaining funds would include projects involving flood control, industrial development and education.



University of Arizona Researchers Visit England and the Netherlands. University of Arizona Office of Arid Lands Studies (OALS) representatives recently visited in England and the Netherlands to discuss potential roles of jojoba in international commercial markets.

OALS researchers William H. Brooks, Research Associate; Kenneth E. Foster, Associate Director; and William G. McGinnies, Director Emeritus, participated in the Royal Geographical Society Symposium, "Sahel Ecology—Possible Improvement?" in May 1978 in London. Papers presented at the Symposium were "Jojoba—Aspects of Its Natural History and Its Potential as an Introduction into the Sahel," William H. Brooks; "Jojoba—Current Agronomic Potential," Kenneth E. Foster and N. Gene Wright; and "The Potential of Guayule in the Sahel," William G. McGinnies.

Other OALS personnel activities included a meeting with the British Parliament House of Commons Overseas Development Committee and testified about using commercially viable desert shrubs and trees in agricultural development programs in arid areas of the world. Meetings also were held with representatives of Minister Agriculture; Tate and Lyle Technical Services, Ltd.; Hunting Technical Services, Ltd.; Imperial Chemical Industries, Ltd.; John Laing and Son, Ltd.; and others.

Pre-proposal discussions regarding jojoba development were held with Unilever Research, Inc., of Zevenaar, Netherlands. OALS and Unilever are negotiating a possible joint venture for development of jojoba in Kenya, Nigeria and Turkey. Unilever also has indicated interest in developing areas in Brazil and Columbia if initial investigations are successful. Cooperative plans to develop an economic feasibility study of jojoba will take place in September 1978 between Mr. J.J.L. v.W. van Doorn, Manager, Unilever Oil Crops, and OALS personnel.

(Information from William H. Brooks.)



Amargosa Desert Valley, Nevada. W.L. Naegele of Las Vegas, Nevada, reported that jojoba is being grown in Nevada's Amargosa Desert Valley. Of 200 seedlings planted by one grower in March 1977, 137 survived the summer and winter of 1977-78. For protection, open-ended, 3-pound coffee cans were placed over each plant from December 15, 1977 until late February 1978. Plants were watered by furrow irrigation a total of five times in 15 months.

Naegele viewed the plants June 20, 1978, and estimated the height of plants to range between 6 to 11 inches. Naegele wrote "The plants appear to be in pretty good shape compared to others I have viewed on a recent trip to California, however, more greyish in color than green."

(Information from W.L. Naegele.)



Jojoba in Costa Rica. Donald Zeaser, director of Costa Rica's Monte Galan Jojoba Research Center is encouraged by jojoba development potential in Costa Rica. A research program will be operating at the Monte Galan experimental station in Liberia, Guanacaste. Initial work will focus on improving propagation techniques and establishing jojoba in large plantations. Additional research will involve developing an understanding of the genetic basis of productivity as the first step in creating a breeding program. Part of the research program will include developing multiple cropping and intercropping with annual crops. Experiments will provide direct support to a neighboring 6,000-acre plantation, Rancho San Rafael.

The research station comprises administrative office, warehouses, a nursery building, a mechanic shop, a laboratory and an employee training center. Soon the training center will offer a comprehensive course in jojoba cultivation and will become a link between the research and development program and the farm operations at Rancho San Rafael. In addition, an oil extraction and protein meal processing plant will be built at this site.

The Center for Food Technology Research (CITA) at the University of Costa Rica will begin testing jojoba meal for human consumption in collaboration with the Monte Galan Jojoba Research Center which will fund the program. CITA was inaugurated in 1974 and is supported by the Costa Rica Ministry of Agriculture and the University of Costa Rica. Its objective is to generate new food stuffs technologically. CITA's pilot plant is fully equipped with oil extractors, driers and food processing machinery. Analyses of the meal, its derived products, composition, nutritive value and acceptance will be performed. Processing meal into a high-protein flour for use in foods such as cereals and breads will begin when the Center receives its first shipment of jojoba seed.

(Information from The Jojoba News, published by the Monte Galan Jojoba Research Center, Apartado 10128, San Jose, Costa Rica.)



Skin Cancer Testing with Jojoba Oil. Tim Symonds, London, England, is seeking information on skin cancer reactions to jojoba oil treatments. In response to Symonds' inquiry Matthew Suffness, Head, Plant and Animal Products Section, U.S. Department of Health, Education and Welfare, wrote ". . . we have not tested jojoba oil in skin cancers because we have no adequate model for skin tumors in small animals. We have tested numerous extracts of jojoba as well as simmondsin and related compounds against our standard tumor model by the intraperitoneal route and have seen no activity. Likewise there was no activity demonstrated when these samples were screened against human cells in culture for their ability to inhibit growth."

(Information from Tim Symonds.)



Jojoba Services International. Barry Atsatt and Jerry Bray have formed a new jojoba seedling production partnership. Jojoba Services International (JSI) serves northern California. The JSI goal is to encourage people to grow jojoba. Moby Jojoba Whale Farm^(tm) seedlings are grown in specially designed recycled papier mache tubes. Whale farm kits (eight to 12 seedlings each) range in price from \$6.00 to \$18. Large acreage orders and detailed

whole farm programs are available upon request. For information and price lists contact Jojoba Services International, P.O. Box 1694, Los Gatos, California 95030, telephone (408) 263-2450 or 353-2496.

(Information from JSI press release.)



Jojoba World Wide Corporation. Don L. Corley reported that Jojoba World Wide Corporation began taking orders for jojoba oil in August. No prices were quoted; however, "Prices will depend on orders placed but will be competitive with current market prices," according to Corley.

(Information from Don L. Corley, 100 North University, Suite No. 114, Fort Worth, Texas 76107, telephone (817) 335-1311.)



Arizona Jojoba Company. The Arizona Jojoba Company is accepting large and small purchase orders for clean, dry jojoba seed collected during the 1978 summer harvest. All seed will be accompanied with data pertaining to its origin and specific local conditions. For seed orders and further information contact: Ron M. Landis, P.O. Box 43214, Tucson, Arizona 85733, telephone (602) 883-7489.

(Information from Arizona Jojoba Company press release.)



Rancho Jojoba Nursery. Since July 1, 1978, jojoba seedlings have been available from Rancho Jojoba Nursery. Seedlings, grown in open-bottom biodegradable containers, cost \$.15 each or \$225 per acre. For information contact Ed or Linda Reindl, Rancho Jojoba Nursery, 11935 Highway 67, Lakeside, California 92040, telephone (714) 561-0751.

(Information from Ed Reindl.)



Desert Whale Jojoba Company. Desert Whale Jojoba Company, established February 1978, is taking orders for jojoba seed harvested from various parts of southern Arizona. For information contact Bob Sloane or Jeff Kazansky, P.O. Box 41594, Tucson, Arizona 85719, telephone (602) 886-6055.

(Information from Desert Whale Jojoba Company representatives.)



California-Grown Jojoba Seeds and Seedlings. Close Orchids-Jojoba Development of El Cajon, California, has jojoba seeds and seedlings for sale. Seeds were harvested from the San Diego area. Seedlings are greenhouse-propagated in a 2-by-2-by-5-inch, open-end containers. For further information contact Close Orchids-Jojoba Development, 1723 Guava Lane, El Cajon, California 92020.

(Information from Close Orchids-Jojoba Development.)



Sunland Jojoba Seed Buying Program. Sunland Jojoba announced on August 16 the completion of its Second Annual Seed Buying Program. The company thanks all participants and pickers for making this year's program the most successful ever.

Sunland seed has been gathered from almost all growing regions of Arizona enabling the company to match the elevation and climate characteristics of seed and seedlings to the customer's plantation site. For further information contact Sunland Jojoba, P.O. Box 204, Skull Valley, Arizona 86338, telephone (602) 442-3809.

(Information from Bob Breen.)



OALS Summer Jojoba Seed Harvest. The Office of Arid Lands Studies (OALS), University of Arizona, contracted with the Koei Perfumery, Ltd., of Tokyo, Japan, to organize and conduct a wild jojoba seed harvest in southern Arizona. Dry, unhulled seed was purchased for \$1.50 per pound at various locations in southern Arizona from July 15 to August 31. Les Rawles, OALS Research Assistant, coordinated the purchase of more than 35,000 pounds of seed during periodic trips to Sells, Winkleman, Marana, Tucson, Superior and Globe, Arizona. Seed will be transported to San Carlos, Arizona, to be pressed at the San Carlos Jojoba Development Project oil pressing facility.

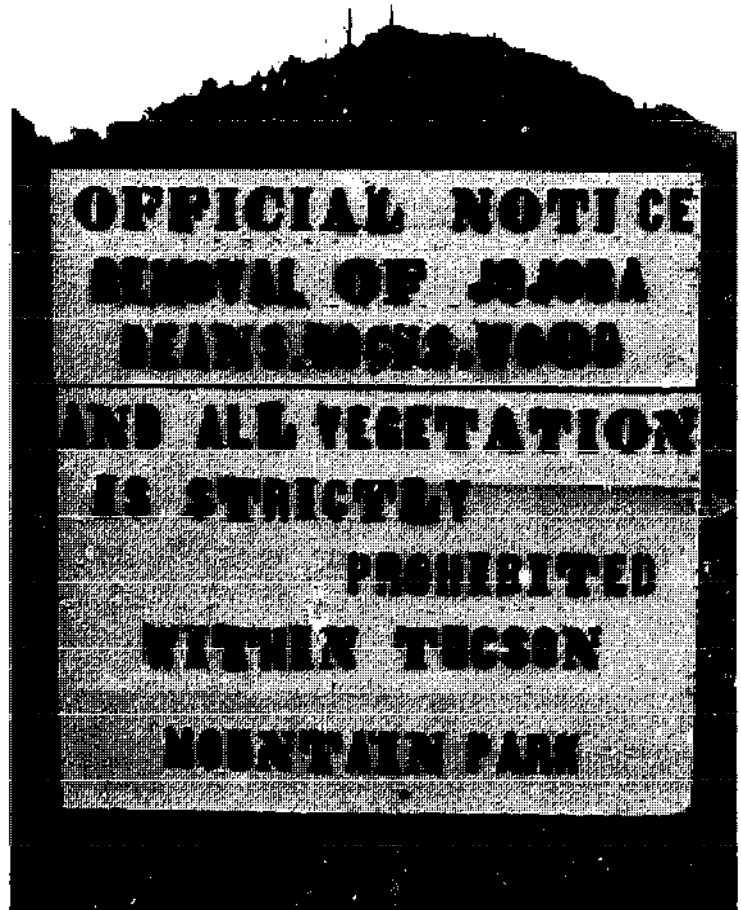
According to Rawles, public response and participation in the wild jojoba seed harvest was greater than anticipated originally. Mild winter temperatures and above average rainfall in southern Arizona contributed to an extraordinarily successful summer harvest.



Native Jojoba Seed Harvest Bodes Ill. Jojoba seed harvesters were out in record numbers this year; however, some unfortunate incidents may bode ill for harvesters in years to come. For example, Tonto National Forest allowed seed harvesting with purchased permits (\$.10 per pound of seed). One Tonto National Forest harvester's efforts were halted when a check to purchase a harvesting permit was returned because of insufficient funds. Consequently seed picked under the harvester's permit were confiscated and later sold for \$.25 to \$.50 per pound. Forest Service officials also reported littering and destruction of native vegetation by other harvesters.

Tucson Mountain Park, near Tucson, Arizona, which does not allow removal of any native rocks or vegetation, found it necessary to post notices specifically prohibiting removal of jojoba seeds from the Park (see photograph below). There were other reports and complaints of an apparent disregard and lack of respect for the environment by careless jojoba harvesters.

Will jojoba seed harvesting be allowed in subsequent years? According to one National Forest official, yes; however, harvesters will experience stricter controls and National Forest rules will be rigidly enforced.



Tucson Mountain Park warning to jojoba seed harvesters.

—Photograph by Wade C. Sherbrooke



LITERATURE REVIEW

Anonymous

1978

Australian plant research to help save sperm whales.
Australia Bulletin 50:7.

Australian jojoba research activities, specifically those of Gerald Halloran and Shaun Coffey of the University of Melbourne School of Agriculture and Forestry, are discussed.

(Reference from Whale Center, Oakland, California.)



Cluff, C.B./Foster, K.E.

1978

Water harvesting agrisystem to grow jojoba on idle farmlands.
Arizona Water Resources News Bulletin 78 (1, 2):1-3.

A water-harvesting jojoba agrisystem for use on abandoned farmland was developed cooperatively by the University of Arizona Office of Arid Lands Studies and Water Resources Research Center. The agrisystem is applied to idle farmland in southern Arizona's Avra Valley with jojoba as a cash crop and a vegetative dust control. Estimated costs and yields based on 1978 figures are given. Includes diagrams and explanations of the Compacted Earth Sodium Treated (CEST) water-harvesting and compartmented-reservoir systems.



Jaeger, E.C.

1941

Desert wild flowers.
Stanford University Press, Stanford. 322 p.

On Page 139 the author gives a brief description of jojoba, its uses and natural history. A line drawing is shown on Page 140.



Kubie, W.L.

1960

Cold-forming lubricants.

U.S. Patent 2,921,874, January 19, 1960.

A cold-forming lubricant for relatively malleable metals consists of a lubricating agent, a reactant and a solvent. Other ingredients consist of a wetting agent, a binder, a parting compound and a leveling compound. The lubricating agent is a fatty acid of ≥ 8 C atoms, or its metal salt or ester. Hydrogenated jojoba oil is considered suitable for use in addition to usual fatty acids, salts and esters. Requirements for the reactants are given.

(Reference from Yaffa Glassman)



Mangold, H.K./Malins, D.C.

1960

Fractionation of fats, oils, and waxes on thin layers of silicic acid.

American Oil Chemists' Society, Journal 37(8):383-5.

Thin-layer chromatography was used for the fractionation of radio-actively labelled lipid derivatives into classes of compounds for the analysis of acetin fats which were obtained from various fish oils. Separation and identification of natural lipids by this technique are described. Procedures for segregation of fats, oils, and waxes into their constituent lipid classes are presented. The resolution, a micro scale, of unusual fatty acids in total acid fractions is isolated after saponification of lipids from vegetable and animal sources is described. Methods are outlined for separating the unsaponifiable fractions obtained from natural lipid mixtures.

Natural products investigated were a) vegetable lipids: jojoba oil (*Simmondsia chinensis*), castor oil (*Ricinus communis*), olive oil (*Olea europaea*), oiticica oil (*Licania rigida*); b) animal lipids: lanolin (*Adeps lanae* U.S.P.), liver oils of soupfin shark (*Galeorhinus galeus*), basking shark (*Cetorhinus maximum*); and ratfish (*Hydrolagus colliei*), and fur seal (*Callorhinus ursina cynocephala*) blubber oil.

(Reference from Yaffa Glassman)



Maxwell, J./Hastings, J.

1978

The supreme bean.

New West 3(12):22-26.

This popular article discusses jojoba's economic and marketing potentials.

(Reference from Peter Childs)



Press, F.

1978

Science and technology: The road ahead.

Science 200(4343):737-741.

This article was adapted from the text of an address delivered by Frank Press, Director of the Office of Science and Technology Policy (OSTP) and Technology Adviser to the President, delivered at the 144th meeting of the American Association for the Advancement of Science (AAAS), Washington, D.C., February 13, 1978. The author supports new research for future agricultural productivity in the United States, and development of agriculture in the Third World (tropics and arid regions). Jojoba is offered as one example of a potentially economically viable commodity crop for arid lands.

(Reference from Noel Vietmeyer)



Soil Conservation Society of America

1973

Landscaping with native Arizona plants.

The University of Arizona Press, Tucson. 194 p.

Natural characteristics of jojoba are described on Pages 108-109. Tables, listed according to major vegetation types, cite jojoba's major land resource area (MLRA), site position, and soil textural class on Pages 37, 41 and 48. Includes a photograph of a mature shrub on Page 109.



Yermanos, D.M.

1978

A bibliography of jojoba: A crop whose time has come.

University of California, Department of Plant Sciences, Riverside. 58 p.

Contains 336 literature citations.



Yermanos, D.M.

1978

Jojoba: General information and photographs.

University of California, Department of Plant Sciences, Riverside. 24 p.

Contains a brief summary, three tables and 27 photographs.



JOJOBA PUBLICATIONS*

Jojoba and Its Uses. An International Conference, University of Arizona, June 1972, Edward F. Haase and William G. McGinnies, Technical Editors. 81 p. Reprinted 1976. Price \$5.00.

Jojoba: A Wax-Producing Shrub of the Sonoran Desert. A Literature Review and Annotated Bibliography, 1974. Wade C. Sherbrooke and E.F. Haase. 141 p. Reprinted 1976. Price \$10.00.

Jojoba: An Annotated Bibliographic Update. Wade C. Sherbrooke, 80 p. Printed 1978. This is a supplement to Jojoba: A Wax-Producing Shrub of the Sonoran Desert. Price \$5.00.

Jojoba Happenings. Quarterly Newsletter. Annual Subscription (accepted on calendar year basis only). Price \$5.00 (4 issues per year).

Jojoba Happenings. Quarterly Newsletter Back Issues; exclusive of current subscription, No. 1, 1972 to date. Price \$2.50 each.

"Estimated Costs and Returns for Producing Jojoba in the Indian Reservations in Arizona and California," by Thomas M. Stubblefield and N. Gene Wright (1977), is a 12-page economic feasibility study containing seven tables of data. It is contained in Jojoba Happenings 19:3-14.

"I'm a Jojoba Nut" Bumper Sticker. Price \$1.00 each.

*Available from:

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University of Arizona
845 North Park Avenue
Tucson, Arizona 85719
(602) 626-1955