NOTES ON THE ACEITUNO TREE (SIMARUBA GLAUCA DC.) AND ITS ADAPTATION AS A VEGETABLE OIL CROP[1]

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THE ACEITUNO TREE (*Simaruba glauca* DC.) first came to the attention of H. de Sola e Hijos about the end of 1939, or beginning of 1940, when engaged in erecting a plant for crushing oil seeds for the manufacture of edible and soap oils in El Salvador. This plant was designed for crushing cotton seed, sesame and peanuts, for the manufacture of salad and cooking oils.

With the outbreak of war between the USA and Axis powers, imported fats, especially tallow, from the USA became scarce and difficult to obtain, and at that time a search was begun for any oil-bearing fruits or seeds produced in El Salvador. Many were tried, such as Zapote (*Calocarpum mammosum* L.), Tempate (*Jatropha curcas* L.), etc., and at that time our attention was called to the fact that, for many years in the past, the fat derived from the kernels of *S. glauca* had been used in the manufacture of a domestically produced crude soap. On further investigation it was borne out that the fat pressed from the kernels of *S. glauca* was suitable for the manufacture of laundry soap, as a partial substitute for beef tallow, and supplies began to be collected. After further trials it was found that this fat produced a white, bland, solid product which had all the appearances and seemed to perform at least as well as standard commercially known and popular brands of shortening on the U. S. market. Accordingly, full tests were then made by Dr. Michael Lauro, M. S., J. S. D., Consulting Chemist of New York, U. S. A., by sending him the necessary material and the results proved to be entirely

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[1] Notes made up from a talk given at the American Horticultural Society meeting (Caribbean Section) held at Escuela Agrícola Panamericana, Zamorano, Honduras, from April 1st. to 6th, 1955.

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satisfactory. The chemical analysis is given in Table I. A full scale biological test was made as shown on Table II.

From that date on, collection of aceituno kernels was intensified and has reached a peak, to date, of nearly one million pounds per year. These kernels have a total oil content of 62% dry basis. The kernels are pressed out in Anderson Expellers in the usual standard manner, similar to the procedure for cotton seed. Due to the relatively high oil content and low fiber content, plus the present imperfect procedure of conditioning the kernels for extraction, the presscake still contains approx. 10 — 12% oil, it is, therefore, then put through a small solvent extraction plant with tricloroethylene. The final presscake contains approx. 1% oil. The crude oil is handled much the same as other vegetable oils; namely, it is neutralized by a weak alkali solution, then washed, dried, bleached, filtered and deodorized. After deodorization, the oil is run over an Albright-Nell Chill roll at about — 12°C. and is pumped into containers ranging from drums of about 400 lbs. to individual carton cups of 1 lb. content, and is ready for the consumer.

It is pertinent to remark that in the manufacture of this edible fat no hydrogenation is required, and the final product remains firm up to temperatures of 27 — 28°C. This is because the various glycerides in the oil have a rather narrow range of critical melting point. This means that in climates such as in El Salvador, it can be marketed without any need for further refrigeration. At ordinary room temperature, the product will stand solid indefinitely. The keeping quality of this product, marketed under the trade name of Manteca Vegetal "NIEVE" extends to well over six months, with no refrigeration, as borne out by many trials carried out under controlled conditions, and in differing climates. When shipped in railway cars, to sea level and extremely high temperatures (up to about 40°C.) the product has remained stable, and although partially liquified, rapidly resumes its solid characteristic when brought back to atmospheric conditions under 27°C. This product has been successfully marketed in El Salvador during the last ten years and its demand has steadily exceeded its supply.

The presscake resulting from the milling operation is highly bitter and toxic to humans and animals. It contains, however, a very high percentage of protein, which reaches 64% by weight. In view of this, and having in mind the possibilities of using this material as a high quality cattle feed, investigators are trying to isolate and determine the nature of the bitter and toxic element(s), and to find uses for this element(s), as well as to find a safe test that may justify going into detoxifying, debittering operations on an industrial scale.

The aid of the Instituto Agropecuario Nacional laboratories in Guatemala was enlisted, and through grants-in-aid arrangements, work has been going on under the direction of Dr. Merriam Jones, Chemist, with the collaboration of Dr. Robert L. Squibb, Animal Nutritionist. First, tests were carried out to ascertain the value and digestibility of the edible product derived from aceituno nuts. The results of this work were published in the Journal of Nutrition, in a paper entitled "The Digestibility of Six Tropical Fats as Determined on Rats" by Squibb, at al., and may be summarized as follows:

Dr. Jones and associates isolated the bitter toxic element in the presscake. The empirical formula is $C_{22}H_{36}O_9$. The bitter and toxic factors can be removed from the presscake by extraction with water but this method is not regarded as commercially feasible. There is also the ever present danger of mistakes which might be catastrophic under industrial conditions with a product for animal feeding.

The extracted factor after purification was submitted to the National Research Council, which in turn made it available to several investigating agencies and pharmaceutical concerns. The acetate of the bitter factor was also submitted. Reports to date give foundation for hopes that this compound may be of some value as an amoebicide.

In the interim, aceituno presscake has been used with spectacular success as an organic fertilizer. On corn, with no selection, and under normal average conditions in El Salvador, lands fertilized with about 5 tons per manzana[1]

[1] 1 manzana = 1.73 acres.

of presscake, have given yields of over 100% more than check plots. On coffee, sugar cane and cotton, results likewise have been most encouraging. To date, the entire output of the aceituno cake of our plant has been returned to the soil as fertilizer for different crops. Taking the usual coefficient of one unit Nitrogen equal to 6.25 protein, one can safely say that normal aceituno presscake contains approx. 10% Nitrogen. Being bound in organic matter the N release is gradual, which is favourable in most tropical cultivated crops.

During World War II the search was on for antimalarials in view of shortages arising from the difficulties of obtaining quinine from the Far East and an extract from the bark of *S. glauca* was found to contain one of the most active antimalarial principles, but of doubtful therapeutic adaptation, in competition with many other sources of plant material. More recently tests are being carried out on aceituno presscake as a possible source of an active, specific amoebicide and arrangements have already been made to go ahead on a modified program for further investigation on a pilot plant scale with aceituno presscake.

The aceituno tree occurs, according to Cronquist [3] from Cuba and the West Indies and from Mexico South to Costa Rica on the Central American mainland. In El Salvador it occurs from sea level to about 3,500 feet elevation, but reports have been had of trees at elevations up to 5000 feet in Guatemala. The tree seems to do well on denuded, eroded lands, although it has already been proven that it responds well to cultivation practices and better soils and climatic conditions. It is significant that most of the supplies gathered every year in El Salvador, come from the regions east of the Río Lempa, especially the Departments of San Miguel, La Unión and Morazán, but this may be due to the fact that these areas are less populated than others in the country and also because the soils do not permit of profitable cereal and coffee culture. This tree may be termed a "roadside" tree since it is found growing wild espe-

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[2] Lloydia Vol. 10. N° 3. Sept. 1947. "Survey of Plants for Antimalarial Activity". Table I, Page 172.

[3] Arthur Cronquist. Bulletin of the Torrey Botanical Club. Vol. 71. N° 3. pp. 226-234, May 1944.

cially abundant along roadsides. The inference is that seeds are tossed along roads and highways by people, especially about May third which marks the traditional ceremonial day of the Cross, when habitually and by custom each small home or farm erects a small cross in its patio and decorates it with fruits and flowers. At this time of the year the aceituno is in full crop and the fruits, colourful in themselves, are used profusely in the decoration of the cross.

During the year of 1950 a large scale program was carried out by H. de Sola e Hijos for reforestation with this tree and accordingly, nurseries were set out and seedlings were distributed throughout the country free of charge to whomsoever might be interested. The summary of distribution by Departments is as follows:

SUMMARY OF DISTRIBUTION

Departament of	San Miguel	97,860
	La Unión	8,409
	Morazán	15,237
	Usulután	44,770
	Cabañas	2,495
	San Vicente	1,000
	San Salvador	3,000
	Santa Ana	1,657
	La Paz	2,330
	Sonsonate	9,760
	La Libertad	2,442
	TOTAL	188,966

Experience has shown that a very small percentage of these trees have been cared for and survived. Notable exceptions to this have been the continued interest of Mr. Edgar P. Thompson, Divisadero, Department of Morazán, and the Alvarez family, at El Potosí, Department of Santa Ana, who have maintained much interest in the planting of aceituno on their properties. However, this experience has been of value and can be said to have drawn attention to the importance of the tree to the small or large Salvadorean farmer. At that time little, if anything, was known of the varietal aspect of the tree or its distribution of sexes, and it may well be a happy circumstance that not many farmers have today stands of any consideration, for along about 1953-1954 it

was noticed that the tree far from being dioecious, as it was supposed to be, was actually polygamo-dioecious or possibly heterogamous.

On H. de Sola e Hijos plantations, located over several regions of the country, the experience has been that of a total of 42,606 trees, about 52% are non-productive trees, i. e. they bear only male flowers, and in some instances hermaphroditic flowers have been found on the branches of some trees, otherwise bearing male flowers. There is some doubt as to whether there may be a change going on in the distribution of the sexes and the point has been raised as to whether what we know as male flowers may not in fact be perfect or hermaphroditic flowers in arrested stages of sexual development. In any case, it is fairly evident that when aceituno seeds are planted, no more than 50% of the seeds can be expected to produce female or bearing trees. For this reason, it is important now that the necessary steps be taken to find the right technique that may enable the planter to pre-determine sex in the nursery, or, failing this, to undertake a large scale grafting or budding program in his nursery. The first mentioned problem is probably one of long term investigation to be handled by the geneticist, whilst the second one may be solved by the practical plantsman. However, it will first be necesary to establish clonal gardens of selected varieties and of proven high yielding material. This implies, of course, that varieties be identified and classified, all of which has not yet been achieved. The agronomic and horticultural aspects of the plant, then, have yet to be studied, besides the genetic and entomological considerations which also must be closely followed.

Much helpful advice, and a greater understanding of the flower morphology of aceituno, was given by the Centro Nacional de Agronomía and the original program for a complete investigation of the problem was drawn up by them. The present program of investigation is being carried out by the firm of H. de Sola e Hijos.

Out of all of these incognita, we are attempting to draw up a systematic program of investigation and this will be in the hands of Mr. Robert P. Armour, Horticulturist, formerly of the United Fruit Company's Lancetilla Experimental Station, Tela, Honduras, who will head up this long range program.

The aceituno tree, with its many advantages; its adaptability to many environments, including poor soil; its possible use as a tool in any reforestation program in Tropical America; its valuable edible oil from the kernel of the fruit; its fertilizer value in the presscake, and with the possibility of added values in the presscake as animal fodder and the use of the toxic bitter element in the presscake as either an insecticide or specific medicinal, presents then an admirable challenge to any investigador or group interested in Tropical America, its lands, land use and economic and social problems. It may well become a tree of great importance in our economies, and could be a factor in changing the fat balance in Latin America, from one of shortages due to poor distribution to one of plenty in our own back yards, and thence, once having satisfied our growing demands for more and more fats in our diet, be sent as an exportable surplus from young Tropical America to the Old World.

TABLE I

CHEMICAL ANALYSIS

Free Fatty Acids (Oleic)	0.06%
Iodine Value (Wijs)	53.8
Saponification Value	191
Unsaponifiable Matter	0.40%
Index of Refraction at 25°C.	1.4556
Titer	47°C.
Smoke Point	280°F (138°C.)
Congealing Point (Setting Point)	20°C.
Melting Point-Softening Point	25°C.
Closed Capillary	27.2°C.
Color (Lovibond) Liquid	10 Yelow — 0.8 Red
Solid	Snow White
Flavor	Very good, bland
Texture	Excellent
Plasticity	Excellent
Stability (Swift Test)	100 hours
Peroxide Value as rec'd	2.6
(After two (2) months)	2.7
Accelerated Test (3 hours at 105°C) Equivalent to at least six (6) months age	3.7
Conclusion	Excellent Keeping Qualities.

New York,
Jan. 31st. 1946.

TABLE II

BIOLOGICAL TEST

METHOD OF ASSAY: Twenty rats were fed a balanced diet containing 10% of the test material for 30 days. The animals were weighed every 7 days and weight changes noted.

RESULTS:

Animal	Initial Weight	Final Weight	Weight Gained	Test Material Consumed
1	144 gms.	170 gms.	26 gms.	26.1 gms.
2	156 „	188 „	32 „	27.8 „
3	120 „	170 „	50 „	25.8 „
4	150 „	190 „	40 „	27.8 „
5	140 „	176 „	36 „	24.9 „
6	142 „	168 „	26 „	25.6 „
7	134 „	190 „	56 „	33.5 „
8	146 „	178 „	32 „	33.5 „
9	150 „	184 „	34 „	27.3 „
10	140 „	196 „	56 „	30.0 „
11	142 „	184 „	42 „	32.4 „
12	156 „	190 „	34 „	27.9 „
13	152 „	200 „	48 „	35.2 „
14	140 „	180 „	40 „	27.7 „
15	140 „	182 „	42 „	30.0 „
16	122 „	150 „	28 „	19.7 „
17	210 „	220 „	10 „	23.9 „
18	138 „	140 „	2 „	17.0 „
19	100 „	186 „	86 „	35.0 „
20	144 „	152 „	8 „	49.3 „

When the test material was fed to 20 rats whose average weight was 143.3 gms. at the rate of 203 gms. per kilogram per month, there was an average weight increase of 36.4 grams.

CONCLUSION: Manteca Vegetal Nieve when fed as outlined above, was found to be non-toxic.

New York,
Jan. 31st. 1946.