TRADITION, USES AND BIODIVERSITY OF ROCKET (*ERUCA SATIVA*, BRASSICACEAE) IN ISRAEL[1,2]

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Yaniv, Zohara; Schafferman, D. *(Dept. of Genetic Resources and Seed Research, A.R.O., The Volcani Center, Bet Dagan, Israel)* **and Amar, Z.** *(Dept. of Eretz Israel Studies, Bar-Ilan University, Ramat-Gan, Israel).* TRADITION, USES AND BIODIVERISTY OF ROCKET (*ERUCA SATIVA*, BRASSICACEAE) IN ISRAEL. *Economic Botany 52(4):394–400. 1998.* Eruca sativa *(rocket) is a native plant of Israel, documented in the old literature. A survey was conducted of the old literature of ancient Israel, including Jewish, Classical and Islamic sources up to the Middle ages. It was found that rocket was used as a garden crop and spice. It was also known as a medicinal plant and was used as an aphrodisiac, for eye infections, and for digestive and kidney problems. It is important to note that special attention was given in the old times to biodiversity within the rocket species. In the light of its high erucic acid content, native accessions were collected and evaluated as a potential future source of industrial oil. Ten accessions of* Eruca sativa *were cultivated in Bet-Dagan experimental farm during the 1995/96 growing season. Physiological as well as chemical parameters were recorded. Erucic acid (C 22:1) and eicosenoic acid (C 20:1) contents varied from 33 to 45% and from 7.3% to 9.8%, respectively. Special attention was given to the expressed biodiversity among the accessions and its relation to their origins.*

TRADITION, USAGES ET BIODIVERSITÉ DE ROQUETTE (*ERUCA SATIVA*, BRASSICACEAE) EN ISRAEL. Eruca sativa *(Roquette) est une plante endemique (native) en Israel, documentée dans la littérature ancienne. Une recherche de la littérature ancienne d'Israel comprenant des source juives, classiques et islamiques a été effectuée. Il s'est avéré que la roquette était utilisée comme plante de jardin et de condiment. Elle a été connue comme plante médicinale et utilisée comme aphrodisiaque, contre les infections des yeux et pour des problèmes digestifs et rénaux. Il est important de noter l'attention spéciale accordée dans les temps anciens à la biodiversité parmi les espéces de roquette. Tenant compte de sa haute contenance en acide erucique, des accessions natives ont été collectées et évaluées comme future source potentielles d'huile industrielle. Dix accessions* d'Eruca sativa *ont été plantées α la ferme expérimentale à Bet Dagan durant la saison de culture 1995/96. Des paramètres physiologiques et chimiques ont été enregistré. Les teneurs en acide erucique (C22:1) et en acide eicosenoique (C20:1) ont varié de 33 à 45% et de 7.3 à 9.8% respectivement. Une attention speciale a été acordée a la biodiversité exprimée dans les accessions et sa relation a ses origines.*

Key Words: Biodiversity; ethnobotany; rocket; seed-oils.

The name rocket (*Eruca sativa*) is well documented in the old literature of the Holy Land. It is called "Euzomon" in Greek, meaning good broth, for its flavoring qualities. In old Hebrew is called "Gargir" from which the Arabic "gargir" is derived. Most scientists agree that this is the garden vegetable mentioned in the Bible (King II 4:39–40) as "Oroth" (Feliks1976; Löw 1924: 491; Zohary 1982: 101).

Many sources are mentioned in the Mishna and the Talmud (a Jewish manuscript from the first-fifth centuries) about rocket's uses in the Holy Land during the Hellenistic period, as a spice, a food and a medicine. Josephus, the historian of the first century mentioned the plant in his description of the hat of the high priest (Josephus, Ant. III. 174, see Thackeray 1961).
The latest botanical monographers (Tutin 1964) and horticulturists (Akeroyd 1995) consider Rocket as *Eruca vesicaria* (L.) Cavanilles subsp. *sativa* (Mill.) Thellung with *E. sativa* Mill. in synonymy.

As part of an extensive effort to preserve the

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species of *Eruca sativa* in Israel a two-aspect research study was conducted: 1. the old literature of the Holy Land was searched in order to find evidence for the use and cultivation of Rocket during the Middle Ages; 2. native accessions of *Eruca sativa* were collected and their biodiversity was studied by comparing some chemical and physiological properties with those of some European lines.

Materials and Methods

Seed Collection

Seeds of *Eruca sativa* were collected from the wild, as part of a large on-going project of Crucifer collection in Israel.

Seeds were collected by two different expeditions led by two leading botanists: "Mattatia"—seeds were collected from two sites in the Jordan Valley representing the Saharo-Arabian region (based on the phytogeographical map of Israel (Plitmann et al. 1983: 15; Zohari 1996); b. "Yair"—seeds were collected from four sites in the Mediterranean region. At least 3 plants were collected from each site and seeds were kept separately for further research (Elber et al. 1989).

Oil quantity and fatty acid composition of the seeds were analyzed using the methods described by Yaniv et al. (1991).

Seed Introduction

Four seed samples of *Eruca sativa* from different botanical gardens were received in our genebank and used in the cultivation tests: Line No. 1/96 from Berlin Botanical Gardens; Germany; Line Nos. 2/96 and 6/96 from Turin Botanical Garden, Italy; Line No. 16/95 from Bari, Italy.

Cultivation

Ten lines (four introductions and six native accessions) of *Eruca sativa* were cultivated at the Bet Dagan Experimental Station. Each accession was replicated four times. Seeds of each accession were sown on Dec. 3. 1995 in 2.4 m2 plots consisting of four rows, with 30 cm between rows. Basic fertilization was done at the time of soil preparation, at a rate of 100:100:50 N:P:K. Treflan (2.5 kg/ha) was used as a herbicide. Irrigation was applied until seedling establishment. Date of emergence was Dec. 14. 1995.

Plants were harvested at seed maturity during the month of May 1996 (between 8 and 26 May), circa 150 days after emergence. Oil quantity and fatty acid analysis were conducted as described by Yaniv et al. 1991.

Lipid Extraction

Seeds were dried overnight at 50°C and ground into powder in a Moulinex coffee grinder. Five grams of powder were mixed with 100 cc petroleum ether (40°–60°C), and the lipid fraction was extracted in a Soxhlet apparatus for 16 h at 60°C. The solvent was evaporated, and the lipid fraction residues were weighed.

Direct Transesterification from Seeds

Seeds (200mg) were dried overnight at 50°C and ground into powder with mortar and pestle, after which 0.3 cm3 of dichloromethane and 2.0 cm3 of 0.5 N sodium methoxide (MeONa) were added. The tube was shaken and heated for 30 min at 50°C. The reaction was stopped by adding 5.0 cm3 of water containing 0.1 cm3 of glacial acetic acid.The esterified fatty acids were extracted with 2.0 cm3 petroleum ether (40°–60°C). The clear fraction was kept at −20°C until further analysis. Samples of 2.0 mm3 were injected into the gas-chromatograph for fatty acid analysis.

Gas Chromatography of Methylated Fatty Acids

A Megabore column (DB-23, 0.5 (m film thickness, 30 m × 0.54 mm, J&W Scientific) was used in a gas-chromatograph equipped with a flame ionization detector (Varian, model 3700 GC) and an automatic area integrator (3390A HP). The flow rate of N2 was 30 cc/min and the oven temperature was raised from 135 to 200(C, programmed at a rate of 4(C/min. The following fatty acids were identified by comparison with known standards (Supelco): C16:0, palmitic; C18:0, stearic; C18:1, oleic; C18:2, linoleic; C18:3, linolenic; C20:1, eicosenoic; and C22:1, erucic acid.

Results and Discussion

Traditional Uses

Table 1 summarizes the various uses of rocket in ancient Israel from Biblical times to the Middle ages. The relevant references are mentioned in Table 1 and cited fully in the bibliography. Classical sources cited for comparison are indicated in Table 1 with an asterisk.

TABLE 1. SOURCES FOR APPLICATIONS AND USES OF *ERUCA SATIVA* (ROCKET) FROM BIBLICAL TIMES TO THE MIDDLE AGES.

Period (Century)	Application							
	Eye infections	Aphrodisiac	Salad green & spices	Biological control	Deodorant & cosmetic uses	Digestion & kidney functions	Dog bites	Biodiversity
Biblical	Kings II							
I–III	Pliny*	Dioscorides* Galen*	Dioscorides* Mishnah, (Ma'asrot 4,8) Tosephta, (Shavit 2,9)	Mishnah, (Sheviit 9,1)		Dioscorides*		Mishnah, (Ma'asrot 4,8 Sheviit 4,8) Tosephta (Sheviit 2,9) Dioscorides*
III–V	Rabbi Yohana R. Huna (Talmud bavli) (Yoma 18b)							
V–VIII	B. Yoma 18b	B. Yoma 18b	B. Aroven 28b					B. Yoma 18b
VIII–XII		Harkavy			al-Tamimi			Meyerhof & Sabhy Ibn al-Awwam
XII–XVI		al-Qazwine	Tanhum Hayerushalmi Asali	al-Qazwine	Maimonides Ibn Wahsiyya Ibn al-Baytar		Dawud	Ibn Wahsiyya

Rocket in the Treatment of Eye Infection

Oroth, the biblical name for rocket means light. Rabbi Yohanan tells us that Oroth clears the eyes (Talmud, third century CE). Rabbi Huna recommands gargir for eye treatment (Talmud, third century CE). Evidence from Pliny in Rome (Jones1887: 49) supports the same use in southern Europe.

Rocket as an Aphrodisiac

Rocket was known as an aphrodisiac throughout ancient times. Both Dioscorides and Galen (Gunther 1959; Kühn 1826: 72) recommanded eating seeds for increasing semen production. Galen warned gainst its sharp taste and a possible headache and recommended eating seeds mixed with other foods.

In the Jewish literature we find the same indications for increasing semen production: in the Talmud (B. Yoma 18b) and in the Rabbinical literature of the tenth century of Irak (Harkavy 1887: 215). al-Qazwine of the thirteenth century indicated that eating seeds with honey will stimulate sexual desire. (al-Qazwine 1981: 244).

Rocket as a Salad-Green and a Spice

Rocket has been known since the first century CE as a salad-green and as a spice—the seeds were used as mustard seeds. According to Dioscorides (Gunther 1968: 181) the seeds were used immersed in milk. In the Jewish Mishnah of the same period it is mentioned that Rocket was used as a pepper substitute. The seeds were crushed and the paste was used to flavor meat . (Talmud, B. Aroven 28b). During the thirteenth century CE it was eaten in Israel as a vegetable named "gargir" and mentioned by Tanhum Hayrushalmi (meaning—from Jerusalem) (Toledano 1961: 84). In 1391, a sacred moslem document from Jerusalem was found with a list of a dead man's belongings, including a container called "Gergir". (al-Asali 1983: 34).

Rocket as a Deodorant and for Cosmetic Uses

Rocket is mentioned for cosmetic uses by al-Tamimi, a Jerusalem physician of the tenth century. He wrote that eating Rocket on an empty stomach prevents sweat smells (Ibn al-Baytar, 1875: 160). Maimonides and Ibn Wahsiyya recommanded using the ground seeds as a cream on the face for the treatment of acne. Eating the seeds or spreading their ground powder under the arms has a deodorant effect.

Rocket as a Digestion-Aid and Kidney Mulfunction

Mentioned by Dioscorides in the first century.

Rocket and Dog-Bites

Mentioned by Dawud (1935: 106) in the Middle Ages. A decoction is prepared for protecting against dog-bites.

Biological Control

In the literature of the thirteenth century (al-Qazwine 1981: 244) there is an indication of the practice of biological control—Rocket seeds were sown together with other garden vegetables in order to inhibit pest development.

Biodiversity in Tradition

It is interesting to note that in the ancient literature the concept of differentiating between native plants and cultivated plants, and the effect of the origin of the germplasm on the quality of the plants is quite developed. Dioscorides, first century (Gunther1968: 181) has a remark about the pungency of the wild type. In the Jewish reference of Mishna (first century, Sheviit 9,1,) the wild type is called "a wild seed" to differenciate it from the more important cultivated greens, and in the medical literature of the Middle Ages various accessions of Rocket are described (Meyerhof and Sobhy 1937) and instructions for cultivation are included. (Clement-Mullet 1865: 301; Fahd 1995)

Biodiversity in Field Experiments

Data regarding some physiological parameters of 10 lines of *Eruca sativa* cultivated at Bet-Dagan Experimental Station are summarized in Table 2. This table illustrates the biodiversity expressed within the lines. In spite of uniform sowing and emergence dates, (see Materials and Methods) there was a significant variability in the onset of flowering and of ripening. There were differences of 27 days between early and late flowering types, and of 18 days between early and late ripening. It is interesting to note that the "Yair" native accessions (3/96,20/96,21/96,22/96) were the earliest to flower and to ripen. The "Mattatia" collection lines were closer to the European lines, both in flowering and ripening dates and in seed color. Seed

TABLE 2. FLOWERING AND RIPENING TIMES OF 10 LINES OF *ERUCA SATIVA* CULTIVATED AT THE BET—DAGAN EXPERIMENTAL STATION (1995/96)

Line no.	Origin	No. of days from emergence to: Flowering	Ripening	Seed color	1000—seed weight (g)
1/96	Germany	*77 c**	163 b	light brown	1.55 d
2/96	Italy	73 bc	163 b	light brown	1.47 e
6/96	Italy	71 d	163 b	light brown	1.80 b
16/95	Italy	88 d	163 b	light brown	1.30 f
14/96	Israel-Matt.	74 bc	163 b	light brown	1.72 c
18/96	Israel-Matt.	70 b	163 b	light brown	1.69 c
3/96	Israel-Yair	66 ab	146 a	dark grown	1.45 e
20/96	Israel-Yair	66 ab	145 a	dark brown	1.72 c
21/96	Israel-Yair	62 a	145 a	dark brown	1.48 e
22/96	Israel-Yair	60 a	145 a	dark brown	1.88 a

* Nos. are averages of four replications.
** Different letters indicate significant differences for each parameter separately at $P < 0.05$ (Duncan's Multiple Range Test).

weight varied from 1.3 to 1.9g/1000 seeds, with no clear correlation with their origin.

Table 3 shows data regarding oil content and the fatty acid composition in seed oils of ten *Eruca sativa* lines: Oil content varies from 24.5 to 29.2%. The three top lines are European introductions. There is a genetic difference in oil content of seeds but this trait could be improved by selection and breeding.

Eruca sativa, as a member of the Brassicaceae, contains erucic acid (C22:1), a fatty acid unique to seed oils. The erucic acid content in the oil varies between 33% (in native Israeli lines) and 47% (in the introduced line from Germany) (Table 3). Lines with high erucic acid contents have lower level of linoleic acid (C18:2) and linolenic acid (C18:3) contents. These fluctuations are indications of biodiversity present in the species related to the the geographic origin of the collected accessions.

Table 4 represents the ratio of mono-unsaturated fatty acids (oleic, C18:1; eicosenoic C20:1 and erucic, C22:1) to polyunsaturated fatty acids (linoleic, C18:2; and linolenic, C18:3). It is interesting to note that the four Israeli accessions, collected by Yair (Mediterranean region) are very uniform in their fatty acid profiles (lines 3/96, 20/96, 21/96, 22/96). The European introduction are different from those, but are also uniform among themselves. The two native lines collected from the Jordan Valley are closer to the European group than to the other Israeli

TABLE 3. FATTY ACID COMPOSITION IN SEED OILS OF *ERUCA SATIVA* LINES (INTRODUCTIONS AND NATIVE FLORA)

Line no.	Origin	Oil content %	Fatty acid (% of total) Palmitic C 16:0	Stearic C 18:0	Oleic C 18:1	Linoleic C 18:2	Linolenic C 18:3	Eicosenoic C 20:1	Erucic C 22:1
1/96	Germany	29.1 a	*5.1 a**	1.3 b	15.1 a	8.3 b	14.7 b	7.4 b	44.7 a
2/96	Italy	28.7 a	4.9 a	1.4 b	16.7 a	10.3 b	14.6 b	7.3 b	42.8 a
6/96	Italy	27.8 ab	4.8 a	1.6 b	15.2 a	9.4 b	15.2 b	7.6 b	43.3 a
16/95	Italy	28.8 a	4.8 a	1.4 b	15.9 a	9.5 b	15.1 b	7.6 b	43.3 a
14/96	Israel-Matt.	27.8 ab	4.7 a	1.4 b	17.8 a	9.4 b	14.9 b	7.5 b	42.4 a
18/96	Israel-Matt.	27.8 ab	5.2 a	1.4 b	16.9 a	9.6 b	14.9 b	7.4 b	41.7 a
3/96	Israel-Yair	24.8 c	4.1 b	1.5 b	9.9 b	14.1 a	19.7 a	9.8 a	37.0 b
20/96	Israel-Yair	26.2 b	4.0 b	1.9 a	11.4 b	14.0 a	18.8 a	9.4 a	36.3 b
21/96	Israel-Yair	25.6 bc	4.2 b	1.8 a	11.5 b	14.8 a	19.2 a	9.6 a	35.2 b
22/96	Israel-Yair	25.5 bc	4.0 b	1.9 a	12.6 b	15.3 a	18.9 a	9.4 a	33.4 b

* Numbers are averages of four replications.
** Different letters indicate significant differences for each parameter separately at $P < 0.05$ (Duncan's Multiple Range Test).

TABLE 4. RATIO OF MONOUNSATURATED/POLYUNSATURATED FATTY ACID IN *ERUCA SATIVA* LINES.

Line no.	Origin	Fatty acid (% of total) C 18:1 + C 20:1 + C 22:1	Fatty acid (% of total) C 18:2 + C 18:3
1/96	Germany	67.2	23.0
2/96	Italy	66.8	24.9
6/96	Italy	66.1	24.6
16/95	Italy	66.8	24.6
14/96	Israel-Matt.	67.7	24.3
18/96	Israel-Matt.	66.0	24.5
3/96	Israel-Yair	56.7	33.8
20/96	Israel-Yair	57.1	32.8
21/96	Israel-Yair	56.3	34.0
22/96	Israel-Yair	55.4	34.2

lines. There is a reciprocal correlation between the levels of monosaturated and polyunsaturated fatty acids in the seed oils. In a study by our group involving the analysis of the diversity of native *Sinapis alba* accessions, a genetic variability among eight accessions collected from two geographical locations was demonstrated by RAPD (Random Amplified Polymorphic DNA) markers. (Granot et al. 1996). A genetic distance between accessions from the two locations was found. In addition, RAPD analysis revealed a genetic link between *Sinapis alba* genotypes and their erucic acid content. These results emphasis the importance of preserving and documenting the natural biodiversity in the species *Eruca sativa.*

LITERATURE CITED

Akeroyd, J. R. 1995. Eruca. Page 161 *in* J. Cullen, J. C. M. Alexander, A. Brady, C. D. Brickell, P. S. Green, V. H. Heywood, P. M. Jörgensen, S. L. Jury, S. G. Knees, A. C. Leslie, V. A. Matthews, N. K. R. Robson, S. M. Walters, D. O. Wijnands, and P. F. Yeo, eds. The European Garden Flora. Vol. IV. Cambridge Univ. Press, Cambridge.

al-'Asali, K. J. 1983. Wathaik Makdisiyyah tarikhyya, I/2, Jordan Academy Pub., Aman.

Dawud B., Umar al-Antaki, 1935. Tadkhirai Uli al-Albab, Cairo (no publisher is indicated)

Clement-Mullet, J. J., ed. 1865. Le livre de l'agriculture d'Ibn al-Awwam. II. Paris (no publisher is indicated).

Elber, Y., Z. Yaniv, D., Schafferman, E. Ben-Moshe and M. Zur. 1989. List of wild crucifer seed collection. The Israel gene bank for agricultural crops. (internal publication), Bet Dagan, Israel.

Fahd, T. ed. 1995. L'Agriculture Nabateenne of Ibn Wahsiyya, II. Institute Francais de Damas Pub. Damascus. pp. 779–780

Feliks, Y. 1976. Plant World of the Bible, Bar-Ilan University Press, Ramat-Gan. pp. 190–191

Granot, D., E. Shabelsky, D. Schafferman and Z. Yaniv. 1996. Analysis of genetic variability between populations of *Sinapis alba* and the effect of cultivation on the variability. Acta Horticulturae 407:67–74.

Gunther, R. T. 1968. The Greek herbal of Dioscorides—de materia medica. II/170, Hafner Publishing Co., New York.

Harkavy, A. 1887. Teshuvot ha-geonim, Tzvi Hirch Tskavsky Pub., Berlin.

Ibn al-Baytar.1875. Kitab al-Jami'li-mufradat al-adwiya wal-aghdiya, I. Bulaq Pub., Cairo.

Jones, W. H. S., trans. 1887. Historia naturalis of Pliny. XX. The Loeb Classical Library Pub., London-Cambridge.

Kühn, C. G. 1826. Claudii Galeni opera omnia, XII. Leipzig.

Löw, I. 1924. Die Flora der Juden, I, Vienna-Leipzig.

Meyerhof, M., ed. 1940. Un Glossaire de Matiere Medicale Compose par Maimonide,MIE Pub., Cairo. 74:40

Meyerhof, M. and Sobhy, G. P. 1937. The abridged version of "The Book of simple drugs" of Ahmad Ibn Muhammad al-Ghafiqi by Gregorius Abul-Farag (Barhebraeus), No. 202 pp. 409–411, al-Ettemad Printing Press, Cairo.

Plitmann, U., C. Heyn, A. Danin and A. Shmida. 1983. Pictorial flora of Israel. Massada Publishers, Israel.

al-Qazwine. 1981. Agaeib al-Mkhlukat, Beit-Hamizrah Haravi. Pub. Beirut.

Thackeray, H. J., trans. 1961. Jewish Antiquities of Josephus. III. The Loeb Classical Library, London. 7:174

Toledano, B. 1961. "al-Mursid al-Kafi" of Tanhum Hayrushalmi, Tel-Aviv.

Tutin, T. G. 1964. Eruca. Page 340 *in* T. G. Tutin, V. H. Heywood, N. A. Burges, D. H. Valentine, S. M.

Walters, and D. A. Webb, eds., Flora Europaea. Vol. I. Cambridge Univ. Press, Cambridge.

Yaniv, Z., Y. Elber, M. Zur and D. Schafferman. 1991. Differences in fatty acid composition of oils of wild Cruciferae seed. Phytochemistry 30:841–843.

Yaniv, Z., D. Schafferman, Y. Elber, E. Ben-Moshe and M. Zur. 1993. Evaluation of *Sinapis alba*, native to Israel, as a rich source of erucic acid in seed oil. Journal of Industrial Crops 2:137–142.

Zohary, M. 1966. Flora Palaestina. Part 1, Israel Academy of Sciences and Humanities, Jerusalem. pp. 246–329.

Zohary, M. 1982. Plants of the Bible. Cambridge University Press, London.

Book Review

Essential Oil Crops. E. A. Weiss. 1997. CAB International, 198 Madison Avenue, New York, NY 10016-4341. xii + 600 pp. (hardcover). U.S. $135.00. ISBN 0-85199-137-8.

The book is divided into 15 chapters. Chapter one is devoted to "World Trade in Essential Oils." This discussion provides information on the major producers (Asian Countries, Brazil, China, Egypt, India, Indonesia, USA), and major importers (European Union Members, Japan, Switzerland, USA) of aromatic materials. Also given are data on the volume of trade per product. Chapter 15, "Distilling and Extracting Essential Oils," discusses and diagrams the various methods of obtaining essential oils.

Chapters 2 through 14 provide full information (history, botany, ecology, soil and fertilizers, cultivation, harvesting, distillation, pests and diseases, products and specifications) on many plant species. The text also provides partial information on other species, e.g., *Cananga* (Annonaceae), *Geranium* and *Pelargonium* (Geraniaceae), *Cymbopogon* and *Vetiveria* (Gramineae), *Pogostemon* (Lamiaceae), *Cinnamomum, Ocotea, Laurus, Litsea* and *Sassafras* (Lauraceae), *Myristica* (Myristicaceae), *Eucalyptus, Melaleuca, Leptospermum, Pimenta* and *Syzygium* (Myrtaceae), *Jasminum* and *Osmanthus* (Oleaceae), *Piper* (Piperaceae), *Rosa* (Rosaceae), *Amyris, Boronia* and *Citrus* (Rutaceae), *Osyris* and *Santalum* (Santalaceae), and *Zingiber* (Zingiberaceae). Common names are also provided.

For unexplained reasons, the author included cloves in the genus *Syzygium*. Past and recent treatments of the Myrtaceae include cloves in *Eugenia*.

In his introductory chapter, Weiss indicated that "the crops selected are those that the author believes should be encouraged in countries where cash crops are limited, or outside inputs to raise rural incomes difficult to obtain. For this reason, the important pine oils have not been included since these are produced in more developed countries."

In our opinion, if the author wanted to help developing countries, he should have provided available information regardless of where the compounds are produced. We say this because the bulk of production of essential oil is in developing countries. His statement also gives an impression that, if oils are produced in developed countries, developing countries should not become involved. This idea could be challenged. Moreover, if the author wanted to promote the production of aromatic plants from the third world, he should have included several commonly grown aromatic plants from those regions. A few examples are *Carum, Coriandrum* (Apiaceae), *Artemisia* (Asteraceae), *Ocimum, Mentha, Satureja* (Lamiaceae), *Aframomum, Cardamomum* and *Cucurma* (Zingiberaceae).

Furthermore, because world consumption of flavors and fragrances is to exceed U.S. $8 billion by the year 2000, Weiss suggests that developed countries should deliberately support essential oil production in less developed countries. Such support, he claims, will reduce demand or aid and limit north-south confrontation. That idea would have been more informative if data were provided showing where the money goes. How much of the money from aromatic plants, for example, would go to the primary producers (the third world countries), and how much of it to those companies who are reprocessing (developed countries). We also believe that the north-south confrontation on trade will be minimized when companies from the third world are properly compensated for their produce.

Although several of the ideas in this book are debatable, the data on plants and their oils is valuable and well documented. We recommend the book for professionals and amateurs interested in *Essential Oil Crops*.

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