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Perilla frutescens: Interesting New Medicinal and Melliferous Plant in Italy

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The goal of this study is to inform those potentially interested (researchers, farmers, industry and public bodies) in the medicinal and aromatic properties, and profitability of *Perilla frutescens* (L.) Britton (Lamiaceae). Perilla, a medicinal and edible plant of Asian origin, was recently introduced to the Piedmont Region in the north-west of Italy. *P. frutescens* is commonly known for its anti-allergic, anti-tumor, and anti-oxidant properties. It is also widely used as human food. We collected a variety of data on Perilla crops in the Piedmont Region, including: agricultural practices, crop profitability, and its value as a bee plant. Our results suggest that ease of cultivation, approximate break-even economics, medicinal claims, and value for bees all contribute to make Perilla of economic interest in Italy.

Keywords: *Perilla frutescens*, medicinal plant, herb, profitability, production cost, pollinator, beekeeping, Piedmont.

Currently, increased attention is being given to medicinal and aromatic plants (MAPs) that can serve as sources for the agricultural and industrial sectors [1-3]. Italy is among the largest markets for MAPs, ranking eighth after China, France, Germany, Japan, Spain, the UK, and the USA [4]. In addition, about 70% of the national MAPs market depends on imported herbs and/or their derivatives [1-3]. The cultivated area for Italian MAPs is both large and diverse; it covers more than 4,500 hectares and approximately 100 species are represented. The principal crops are mint, chamomile, sage, Florentine iris, and hypericum [3], most of which are typical and of very high quality [1-3].

One-third of the area under MAPs cultivation (approximately 700 hectares when bergamot and manna ash trees are excluded) is located in the Piedmont Region (52%), followed by Tuscany (15%), Calabria (12%), and other regions (31%) [3]. Across Italy, there are more than 4,000 farms with MAPs of relatively small size (0.55 hectares) situated in hilly and mountainous areas [3-5]. Generally, farmers have poorly organized business activities [1-2].

Perilla frutescens (L.) Britton, family Lamiaceae, is an annual, herbaceous species with toothed leaves and small white flowers. It is widely grown in China, Japan, and Korea, where it is known as either Shiso or Egoma. There are two cultivars of *P. frutescens*, red (*P. frutescens* cv. *acuta* Kudo) and green (*P. frutescens* cv. *acuta* forma *viridis*) [6]. Perilla has been used for hundreds of years in the Orient for its multiple medicinal properties [7]. While it is primarily valued for its high anti-oxidant [9] and anti-allergic qualities [6], several of its parts can be used for human food, as well as in industry and folk medicine (leaves, seeds and oil) [8]. Many compounds isolated from Perilla have been associated with medicinal qualities: Luteolin [10] has been reported as anti-inflammatory and anti-allergic; luteolin [11] and triterpene acids [12] have been deemed to have anti-tumor qualities; rosmarinic acid [13] is considered to be a superoxide scavenger; and apigenin and 2,4,5-trimethoxycinnamic acid have been reported to be antidepressants [14].

Since Perilla is a relatively new species to Italy, this study aims to inform researchers, farmers, beekeepers, industry, and public bodies interested in medicinal and aromatic plants of its agricultural practices, profitability, and insect significance. Strangely, despite its distribution and wide use, no pollinator data exist for Perilla, nor has its potential forage by *Apis mellifera* (L.) been studied.

Investigations of the insects visiting Perilla were conducted in three different crops in the Province of Turin during September-October 2010. Area farmers, including two beekeepers, provided crop management information. Perilla is sown in seedbeds during late winter, then transplanted to the field in rows. Required agronomic

practices include plowing, manuring, ridging, and manual weeding. Perilla reaches a height of 60-100 cm and flowers between September and October. Irrigation is not strictly required. The seeds are collected in November and the leaves are harvested in the summer.

Table 1 shows the economic results of the examined crop:
i) direct cost, and indirect plus implicit costs were 39.6%, and 60.4%, respectively, of the total production cost;
ii) total production cost was mainly affected by indirect plus implicit costs, especially by the high cost of family labor (31.3%) and by the agricultural practice costs (39.6%) (Table 1);
iii) the difference between total output and total direct cost is highly positive (Table 1), while the economic profit is slightly negative. We can consider these economic results to be representative of the management performance of many small family farms with MAPs in Italy.

During flowering, the frequency of pollinators foraging on Perilla was high. Honeybees comprised 93% of all insect visitors to this crop, with an average number of 14 individuals per square meter. The nectar was the only harvested product. In addition to the honey bee, *Bombus pascuorum* (Scopoli) was the main pollinator. Similar results were obtained from observations made by farmers in the two other areas studied in Turin Province.

The utility of this plant to honey bees is in the late period of flowering given the scarcity of other blossoming plants. Beekeepers are very interested in new species, which can be alternative resources during periods of wild flower scarcity or to achieve higher honey production yields.

In fact, Perilla might be a resource that could provide an autumn harvest, indirectly extend the queen bee egg-laying period, and, thereby, mitigate losses from the parasite *Varroa destructor* (Anderson & Trueman). Another advantage for beekeepers is the Perilla reseeding. It provides a new bloom for the following year without additional farmwork. Perilla seems to be an interesting plant for bees, a value which must be added to its acclaimed medicinal properties. Its ease of cultivation, positive economics, important medicinal properties, and value as a bee plant, conspire to make Perilla a medicinal plant of great interest in Italy.

Experimental

Farm business analysis*:* We collected the economic data from a small family farm. The total utilized agricultural area (UAA) of the farm was 1.5 hectares, of which 0.5 was assigned to Perilla. There was a single labor unit. At the beginning of 2011, economic data were collected through two personal interviews and an *ad hoc* questionnaire [15-19]. Total output, costs, and economic profit of Perilla were calculated assuming 1,000 sq m during 2010. The hourly wage used to estimate the cost of the family labor was the only data referenced to 2011.

The value of the total output provided by the Perilla farmer used in our case study included all cash revenues

Table 1: Total output, production cost and economic profit of *Perilla frutescens* (open field, 2010).

Total Output/Costs	€/1,000 sq. m* (a)	% (b)
Total Output	**1,305**	
Direct Costs		
Sowing	85	*6.4*
Plowing, and Manuring	170	*12.9*
Transplanting, Ridging, and Manual Weeding	85	*6.4*
Harvesting, and Post-Harvesting	182	*13.9*
Total Direct Costs	**522**	***39.6***
Indirect and Implicit Costs		
Depreciation, Insurance, and Repairs**	27	*2.0*
Taxes	33	*2.5*
Overheads	91	*6.9*
Family Labor	413	*31.3*
Operating Costs, and Machinery (Interest)	95	*7.2*
Land Capital Cost	139	*10.5*
Total Indirect, and Implicit Costs	**798**	***60.4***
Total Costs	**1,320**	***100.0***
Total Output - Total Direct Costs	**782**	
Economic Profit (Total Output - Total Costs)	**-15**	

*1€=1.3245 US$. Yearly average currency rate, 2010 (www.irs.gov.)
** Machinery. Source: Our calculation.

from the crop, be it dried leaves or seed. In this work, the total production cost was divided into three categories: direct costs, indirect costs, and implicit costs [15-17]. The farmer provided the direct cost information, which included the real costs of Perilla production according to the agricultural practices.

Indirect costs, which are those associated with the entire farm, include both cash- and non-cash costs, such as overheads, taxes, depreciation, insurance, and machine repairs. These are shared costs and difficult to assign to a specific product. In this case study, we allocated the cash shard costs using a method in which the shared costs of the farm were divided by 15,000 sq m (total UAA), and the calculated value was apportioned assuming 1,000 sq m of Perilla. Depreciation, a non-cash expense, was calculated by the straight-line method [15-17], and referenced to 1,000 sq m.

Farmer-owned inputs (e.g. family labor), implicit costs, are not real costs, so they were calculated according to the principle of opportunity cost or "the income that would have been received if the input had been used in its most profitable alternative use" [17]. We determined the labor cost by multiplying the total hours of work needed to produce 1,000 sq m of Perilla by 7.20 euros per hectare, which is the basic hourly wage of a 'qualified horticultural worker' referenced to the year 2011 [15,17,20]. The capital cost of the land was calculated assuming a value of 69,452 euros per hectare [21] and an annual interest rate of

2%. The implicit cost of operating capital is the annual interest on the total operating expenses of the Perilla crop, and was calculated using a 6% annual borrowed capital cost. Machine interest cost was calculated by multiplying the acquisition cost of the machinery by the rate of the capital borrowed to purchase it, or 4% annually [15-17].

The difference between the value of total output and total costs, including opportunity costs, is the (estimated) economic profit [15-17]**.**

Flower visitation analysis: An apiary of 10 hives was located near a plot of 1,200 sq m planted with Perilla. It was situated in a hilly area of Piedmont, near Turin, 350 m above sea level.

During the flowering period, investigations were carried out every 3 days on the insects visiting the crop. The investigations, based on methods developed by several researchers [22-23], were conducted from 8 am to 6 pm, counting the number of individuals of different species that frequented the flowers of Perilla for 5 minutes in 1 sq m, in different parts of the plot. The nectar and/or pollen products collected from Perilla by the honey bees were assessed.

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References

[1] Barbieri C. (**2001**) Indagine conoscitiva sul mercato delle piante officinali e dei loro derivati, con particolare riferimento alle problematiche delle specie coltivate in Valle Cannobina. Regione Piemonte, Università degli Studi di Torino, Dipartimento di Economia e Ingegneria Agraria, Forestale e Ambientale, Università di Torino, EU INTERREG II, Programma Operativo Plurifondo concernente la frontiera esterna ITALIA – SVIZZERA – II Fase di Programmazione, MISURA 2.1, AZIONE a), Torino, 1-140 .

[2] Crescimanno M. (a cura di) (**2006**) *Le piante officinali in Sicilia*. Università degli Studi di Palermo, Dipartimento di Economia dei Sistemi Agro Forestali, Consorzio di Ricerca Bio Evoluzione Sicilia (BES). Palermo, 1-237.

[3] Marzi V, De Mastro G. (**2008**) *Piante officinali.* Mario Adda Editore, Bari, 143-153.

[4] Mills S, Lee J, Banerji G, Pillai S. (**2008**) International market prospects for sustainably sourced medicinal and aromatic plants from India, prepared for the Whitley Fund for Nature, on-line version, April 2011, 1-65.

[5] Istituto Nazionale di Statistica (ISTAT). (**2000**) *V Censimento Generale dell'Agricoltura*. Roma.

[6] Makino T, Furuta Y, Wakushima H. (**2003**) Anti-allergic effect of *Perilla frutescens* and its active constituents. *Phytotherapy Research*, ***17***, 240-243.

[7] Duke JA. (**1985**) *CRC Handbook of medicinal herbs*. CRC Press, Inc., Boca Raton, FL, USA.

[8] Longvah T, Deosthale YG. (**1991**) Chemical and nutritional studies on Hanshi **(***Perilla frutescens*), a traditional oilseed from northeast India. *Journal of the American Oil Chemists' Society*, ***68***, 781-784.

[9] Raudonis R, Bumblauskiene L, Jakstas V, Pukalskas A, Janulis V. (**2010**) Optimization and validation of post-column assay for screening of radical scavengers in herbal raw materials and herbal preparations. *Journal of Chromatography*, ***1217***, 7690-7698.

[10] Ueda H, Yamazaki C, Yamazaki M. (**2002**) Luteolin as an anti-inflammatory and anti-allergic constituent of *Perilla frutescens*. *Biological & Pharmaceutical Bulletin*, ***25***, 1197-1202.

[11] Ueda H, Yamazaki C, Yamazaki M. (**2003**) Inhibitory effect of *Perilla* leaf extract and luteolin on mouse skin tumour production. *Biological & Pharmaceutical Bulletin*, ***26***, 560-563.

[12] Banno N, Akihisa T, Tokuda H, Yasukawa K, Higashihara H, Ukiya M, Watanabe K, Kimura Y, Hasegawa JI, Nishino H. (**2004**) Triterpene acids from the leaves of *Perilla frutescens* and their anti-inflammatory and antitumor-promoting effects**.** *Bioscience, Biotechnology, and Biochemistry*, ***68***, 85-90.

[13] Nakamura Y, Ohto Y, Murakami A, Ohigashi H. (**1998**) Superoxide scavenging activity of rosmarinic acid from *Perilla frutescens* Britton var. *acuta* f. *viridis*. *Journal of Agricultural Food and Chemistry*, ***46***, 4545–4550.

[14] Nakazawa T, Yasuda T, Ueda J, Ohsawa K. (**2003**) Antidepressant-like effects of apigenin and 2,4,5-trimethoxycinnamic acid from *Perilla frutescens* in the forced swimming test. *Biological & Pharmaceutical Bullettin*, ***26***, 474-48.

[15] Barbieri C, Trione S. (**1995**) I costi di lavorazione di alcuni prodotti frutticoli in differenti tipi di impresa. CNR-P. F. RAISA, Sottoprogetto 1, Pubblicazione N. 2030. Quaderni del Dipartimento di Economia Agraria, Università degli Studi di Torino, Torino, 23-26.

[16] Ghelfi R. (**2000**) Evoluzione delle metodologie di analisi dei costi aziendali in relazione alle innovazioni tecniche ed organizzative. Atti XXXVII Convegno SIDEA (Società Italiana di Economia Agraria), *Innovazione e Ricerca nell'Agricoltura Italiana*. Bologna, 14-16 September 2000, 407-420.

[17] Kay RD, Edwards WM, Duffy PA. (**2004**) *Farm Management*. Mc Graw Hill, New York, 1-445.

[18] Mittal R, Singh SP. (**2007**) Shifting from agriculture to agribusiness: the case of aromatic plants. *Agricultural Economics Research Review*, ***20*** (Conference Issue), 541-550.

[19] Shabbara HM, Taha AE. (**2007**) An economical study of the most important Egyptian aromatic plants. *Journal of Applied Sciences Research*, ***3***, 747-756.

[20] Consiglio Nazionale dell'Economia e del Lavoro (CNEL). (**2010**) Contratto Collettivo Nazionale di Lavoro Roma, 25 Maggio 2010. Roma, 1-44.

[21] Agenzia del Territorio. (**2010**) Ufficio del Territorio di Torino - Valori Agricoli Medi della Provincia. Annualità 2010. Torino, 1-21.

[22] Ferrazzi P, Priore R. (**1987**) Contributo alla conoscenza dell'attività bottinatrice di *Apis mellifera* L. sulla flora della Campania. I. Salicaceae-Rosaceae. *Annali della Facoltà di Scienze Agrarie dell'Università degli Studi di Torino*, ***14***, 213-235.

[23] Piana ML, Persano Oddo L. (**2001**) Applicazione al miele del regolamento comunitario 2081/92. In *Miele e territorio. Guida alla valorizzazione del miele attraverso le denominazioni di origine*. Persano Oddo L, Piana ML (Eds), Ministero delle Politiche Agricole e Forestali, Istituto Sperimentale per la Zoologia agraria, 29-31.