CLEOME VISCOSA, CAPPARIDACEAE: A WEED OR A CASH CROP?[1]

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Maikhuri, R. K., R. L. Semwal *(G. B. Pant Institute of Himalayan Environment and Development P. Box No. 92, Srinagar—Garhwal, U.P., India),* **K. S. Rao** *(G.B. Pant Institute of Himalayan Environment and Development, Kosi-Katarmal, Almora- 263643, India),* **S. Nautiyal** *(G.B. Pant Institute of Himalayan Environment and Development, Srinagar—Garhwal, U.P., India), and* **K. G. Saxena** *(School of Environmental Sciences, Jawaharlal Nehru University, New Delhi- 110067, India).* *CLEOME VISCOSA*, CAPPARIDACEAE: A WEED OR A CASH CROP? *Economic Botany 54(2):150–154, 2000.* Cleome viscosa, *an annual herb locally known as Jakhiya, grows naturally from seed in rainfed agricultural land and abandoned crop fields at altitudes ranging from 500 to 1500 m in scattered pockets of the Garhwal Himalaya. The seeds are mostly used as condiment. This species is a good substitute of cumin (*Cuminum cyminum*). Traditionally it is also used to cure a variety of diseases. It provides, three times higher yield when maintained by the farmers as a pure crop compared to yield obtained in mixed cropping conditions. With other food commodities, it is exchanged by the traditional farmers of Garhwal with the people of the areas where it does not grow. Because of its increasing demand, it is being sold in the market and is gaining more and more popularity. Until now no systematic attempt has been made to study the ecological significance and economic potential of* Cleome viscosa. *This paper describes the agronomy, yield, cost-benefit analysis, uses, and ethnobotany of Cleome viscosa. Systematic efforts are needed to promote its cultivation on a larger scale in village community degraded land and in marginal agricultural land where traditional crops grow with difficulty.*

Key Words: Garhwal Himalaya; *Cleome viscosa*; weed; cash crop.

The Garhwal Himalaya is situated between 29° 31′ 9″ and 31° 26′ 5″ N latitude and from 77° 35′ 5″ to 80°6′ longitude, an area of about 30 000 square kilometer. About 80% of people of the region practice subsistence agriculture. Land holdings are small and fragmented and the extent of arable land is only 0.2 ha per capita. Terraced slopes, covering 85% of total agricultural land, are largely under rainfed agriculture, while the valleys covering about 15% of area are under irrigated cropping. Mixed cropping is common in rainfed agricultural systems. The cropping patterns are built around two major cropping seasons viz., kharif (*Eleusine coracana*) (April–October) and rabi (*Brassica* sp.) (October–April) generally up to 1800 m and sometimes up to 2000 m. At higher altitudes (>2000 m), crops are usually grown only during summer season (April–October). Over 40 different traditional crops including cereals, pseudocereals, millets, pulses, oil seeds, tubers, bulbs, spices and condiments, and their numerous farmer selected cultivars are cultivated on a subsistence basis. Many of these crops are little-known or under-exploited not because they are inferior crops, but because they are unfamiliar to the mainstream society (Maikhuri, Nautiyal and Khali 1991; Maikhuri, Rao and Saxena 1996; Maikhuri et al. 1998; Rao and Saxena 1996; Singh, Rao and Saxena 1997).

Cleome viscosa L., Capparidaceae, an annual herb locally known as Jakhiya, grows naturally from seed with cultivated crops such as *Oryza sativa* and *Eleusine coracana* in the rainfed agriculture and abandoned land between 500 and 1500 m. It has long been valued for its seeds which are used as a condiment. However, due to its limited and localized use, until mid 1980s it was generally considered to be a weed and therefore farmers maintained only a few individ-

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uals of this species for their own consumption along with other cultivated food crops. Because of its unique taste and flavor, demand for *C. viscosa* has increased several fold in the region during the recent past and now farmers have started paying more attention to this species. A tendency toward maintaining a higher density of *Cleome viscosa* in agricultural fields in order to obtain a higher yield is fast emerging. Regardless of its promising potential, it is still regarded as a weed by the traditional mountain farmers of Garhwal because it is never sown. Ecological and economic information on this species is lacking and its ethnobotany is discussed only briefly in the literature (Bedi 1978; Bodner and Gereau 1988; Dentan 1971; Jain and Tarafder 1970; Neogi, Prasad and Rao 1989; The Wealth of India 1976: 231).

Our paper discusses the potential of *C. viscosa*, growing naturally but also as a promising crop in some localities in the lower and middle altitude agroclimatic zones (500–1500 m) of Garhwal. We discuss its agronomy, its uses and medicinal properties and we present a cost-benefit analysis for its production. In order to strengthen the agrarian economy of rural mountain societies, we emphasize the need for its large scale cultivation on the lands which now are unproductive.

MATERIALS AND METHODS

The study area comprising five villages, Bughani, Devalgarh, Khola, Sumari and Sweeth, is located at 800–1500 m a.s.l.. near Srinagar township in Garhwal Himalaya. The climate is submontane with an annual rainfall averaging about 1460 mm of which more than 70% occurs in the July–September monsoon season. Mean monthly temperatures range from 12°C in January to 26°C in June.

Cleome viscosa is distributed in warm valleys of Garhwal Himalaya between 500 and 1500 m a.s.l. where it grows abundantly and regenerates naturally year after year in the traditional rainfed agriculture. It is also found as an infrequent species in degraded broad-leaf forests dominated by *Quercus leucotrichophora* and coniferous forests dominated by *Pinus roxburghii* on village fringes. It grows well in gravely and dry soils and its seeds germinate readily. The plant is an erect sticky herb with compound leaves, it is viscidly pubescent, has a strong penetrating odor, yellow flowers, and linear, glandular capsules. The seeds are small, dark brown or black and granular, and resemble mustard seeds. The characteristics of *C. viscosa* are described in Table 1.

TABLE 1. TRAITS OF *CLEOME VISCOSA*.

Character	Distinguishing feature
Elevation	500–1500 m a.s.l.
Days to 50% flowering	35–40
Days to maturity	70–90
Growth habit	Erect
Maximum plant height	100–180 cm
Number of primary branches	1–5
Number of side branches	25-40
Stem color	Green
Flower color	Yellow
Number of pods/plant	100–160
Number of seeds/pod	97–239
Average pod circumference	1.0–1.5 cm
Color of seeds	Dark brown or black
Weight of 1000 seeds	0.5–0.8 gm
Grain yield/plant	20–45 gm
Density/m^2	2–5
Average pod length	5–9 cm
Biomass (by-product) yield/plant	200–300 gm

We selected three replicate plots of four types of agroecosystems: 1. pure stands of *Cleome viscosa*; 2. *C. viscosa* growing as a weed in *Oryza sativa* fields; 3. *C. viscosa* growing as a weed in *Eleusine coracana* (finger millet) fields; and, 4. fallow or abandoned land where *C. viscosa* grows along with other herbaceous weeds. Care was taken to ensure similar aspect and topographic conditions. To determine crop density, twenty quadrats (1m × 1m) were randomly laid in each agroecosystem type when the crop and *C. viscosa* plants had attained maximum vegetative growth (Kershaw 1973; Misra 1968). The economic yield per plant was obtained by harvesting 15 individuals from a given agroecosystem type. The economic yield per hectare in all cases was calculated on the basis of yield from the entire plot. Inputs (human labor, draught power, and organic manure) and outputs (edible and non-edible above ground parts) were monitored for cost-benefit analysis. Male and female labor and draught power were calculated on the basis of prevailing costs. The monetary value of crops, feed and organic manure were calculated on the market price of 1997.

TABLE 2. PLANT DENSITY AND GRAIN AND BY-PRODUCT YIELD OF *CLEOME VISCOSA* IN DIFFERENT AGROECOSYSTEMS OF GARHWAL HIMALAYA.

Agroecosystem type	Density (plant/ha)	Grain yield (Kg/ha)	By-product yield (Kg/ha)
Cleome viscosa (pure stand)	35 000	600	950
Cleome viscosa +	15 000	250	460
Oryza sativa (mixed stand)	250 000	1460	1660
Eleusine coracana +	220 000	980	2180
Cleome viscosa	12 000	210	420
Cleome viscosa (fallow land)	30 000	90	190

RESULTS AND DISCUSSION

AGRONOMIC PRACTICES

Cleome vicosa grows as a weed during Kharif season under rainfed conditions along with a variety of traditional crops. Thinning of this species is done to a large extent in the cropped fields to optimize the crop yield but not in abandoned/fallow fields where it grows in almost pure stands. However, few farmers who could manage extra labor practice casual thinning as a management tool to maximise its production for higher economic gain on abandoned/fallow land.

Farmers pay little attention to agronomic management of *C. viscosa.* Unlike cultivated crops it is not attacked at all by any insect pests nor damaged by wildlife because of its sticky nature and strong pungent odor. A heavy rain at the time of flowering and seed setting is the major threat to a successful *Cleome* harvest.

The harvesting period for *C. viscosa* begins normally in the end of August and extends up to October. Not all plants in a field mature simultaneously. Pods are harvested before they are fully matured because when mature they dehisce readily and scatter their seed. Harvest is commonly carried out by pulling the entire plant which at this time has a shallow root system in a moist and friable soil. If the soil is compact and dry, the plant may be cut with the help of small sickle and piled into sheaves to a height of 4–5 feet. Immediately after the harvest, the plants are threshed by beating the plants gently with wooden sticks after spreading them out on a tarpaulin sheet or on the clean ground. After threshing and a first winnowing, *C. viscosa* is often winnowed a second time with the help of a crude sieve. The sun dried seeds are stored in traditional utensils made of locally available bamboo (*Thamnocalamus spathiflorus*).

YIELD AND COST-BENEFIT ANALYSIS

Plant density, and yield of grain and by-product of *C. viscosa* in pure and mixed stands are presented in Table 2. Density was significantly higher in pure stands (35 000 plants per ha) than in the mixed *C. viscosa*-crop stands (1200–15 000 plants per ha) or fallow land (30 000 plant per ha). Where it was maintained in pure stands as a cash crop, grain yield of *C. viscosa* was higher in than in mixed crops. The lowest yields were obtained from fallow land. In mixed crops the total grain yield was higher in *Cleome* + *Oryza* than in the *Cleome* + *Eleusine* combination. The cost-benefit analyses worked out for *Cleome* in different agroecosystem types showed that the net return was higher from the pure crop whereas the monetary efficiency was higher in the fallow land where labor involved in harvesting was the sole input (Table 3).

USE OF SEEDS AS A CONDIMENT

The leaves of *Cleome viscosa* are used as a green vegetable. Seeds have a pleasant flavor and are used as a condiment by the people of the Garhwal. Poor people who cannot afford cumin (*Cuminum cyminum*) mostly use *Cleome.* Because of its piquant flavor, it along with other spices, is now used extensively as a condiment in the preparation of pickling spices, sausages, green and other vegetables, curries, and pulses. Though its cultivation is confined to a few pockets of the Garhwal region, farmers barter and exchange it with people of the other areas. A kilogram of *Cleome* seed is exchanged for 7 kg of unhusked rice or 4 kg of wheat. For purposes of exchange by volume seed is measured in a small basket, or Pathi, the traditional measuring device which accommodates about 2 kg of grains. Exchange is not merely for economic

TABLE 3. MONETARY INPUTS AND OUTPUTS FOR *CLEOME VISCOSA* IN GARHWAL, HIMALAYA.

Crop	Input[1]		Organic manure	Seed	Total input[1]	Total output[1]	Net return[1]	Monetary output/ input ratio
	Human	Animal						
Pure stand								
Cleome viscosa	2502	1618	1435	65	5620	16 140	10 520	2.9
Mixed stand								
Cleome viscosa + *Oryza sativa*	3417	2370	2110	468	8365	15 840	7475	1.9
Cleome viscosa + *Eleusine coracana*	3196	2030	1730	255	7211	11 674	4463	1.6
Fallow land								
Cleome viscosa	700	0	0	0	700	2240	1540	3.2

[1] Rupees/ha/yr.
38 Rs = 1 $US

gain but involves reciprocity relationships among families. Seed is given by the growers to their kin living in areas where *C. viscosa* does not grow. Because of increased demand within as well as outside Garhwal, a cash market is fast emerging. Middlemen traders purchase 1 kg of *Cleome* from the farmers at the rate of Rs 10/kg sell it in the nearby semi-urban and urban centers at Rs 40 to 70/kg and realize a 70–80% gain. However *C. viscosa* is not yet a significant commercial crop. Most of the product is still consumed by the farmers who grow it.

MEDICINAL PROPERTIES

The leaves are rubefacient and vesicant (The Wealth of India 1976: 231). The juice of the leaves mixed with ghee (clarified butter) is used in the treatment of inflammations of the middle ear. The leaves are also used in external applications for wounds and ulcers. Seeds too are reported to have rubefacient, vesicant and anthelmintic properties. Poultices made from seeds are said to be counter irritants in chronically painful joints. Seeds are used to treat round worm infections. The decoction of roots is administered as a febrifuge (The Wealth of India 1976: 231). The edible portion (discarding the flowers and pods) contains: moisture 80.41%; protein 5.64%; ether extractives 1.85%; ash 3.75%; Ca 0.881%; P 0.073%; Fe 2445 mg/100 g; ascorbic acid 203.6 mg/100 g. From the benzene extract of the dried seeds, a fixed oil (yield, 36.6%) has been obtained which, on standing, deposits palmitic and myrestic acids, and called viscosic acid (m.p. 97°C) (The Wealth of India 1976: 231).

CONCLUSION

Though *Cleome viscosa* has long been used as a condiment in Garhwal, its popularity among the people living outside of Garhwal is a recent phenomenon. Its piquance has increased its market value and demand. Despite having tremendous potential, it is still not cultivated as a commercial cash crop. Since it does not require any major inputs for cultivation, it can be easily cultivated on a larger scale in areas unsuitable for traditional crops. It can be cultivated in abandoned and unproductive lands near villages. Its cultivation can be promoted in other areas of Garhwal having similar agro-climatic conditions by making farmers aware of the growing economic potential of this species. Although a partial chemical analysis of the edible portion (except flowers and pods) of this plant is known (The Wealth of India 1976: 231), little information is available on its nutritional and medicinal value. Small farmers' marketing co-operatives might be established so that farmers can realize a greater share of the profits from *C. viscosa* commerce. Appropriate economic benefits may promote farmers' interest in the cultivation and maintenance of this locally important economic species.

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LITERATURE CITED

Bedi, S. J. 1978. Ethnobotany of Ratan Mahal Hills, Gujrat, India. Economic Botany 32:278–284.

Bodner, C. C., and R. E. Gereau. 1988. A contribution to Bontoc ethnobotany. Economic Botany 42:307–369.

Dentan, R. K. 1971. Some Senoi Semai planting techniques. Economic Botany 25:136–159.

Jain, S. K., and C. R. Tarafder. 1970. Medicinal plant-lore of the santals. Economic Botany 24:241–278.

Kershaw, K. A. 1973. Quantitative and dynamic plant ecology. Edward Arnold, London.

Maikhuri, R. K., M. C. Nautiyal, and M. P. Khali. 1991. Lesser-known crops of food value in Garhwal Himalaya and a strategy to conserve them. FAO/IBPGR Plant Genetic Resources Newsletter 86:33–66.

———, K. S. Rao, and K. G. Saxena. 1996. Traditional crop diversity for sustainable development of Central Himalayan agroecosystems. International Journal of Sustainable Development and World Ecology 3:8–31.

———, S. Nautiyal, K. S. Rao, and K. G. Saxena. 1998. Medicinal plant cultivation and biosphere reserve management: a case study from the Nanda Devi Biosphere, Reserve, Himalaya. Current Science 74:157–163.

Misra, R. 1968. Ecology workbook, 224 pp. Oxford and IBH Publishing Co., New Delhi.

Neogi, B., M. N. V. Prasad, and R. R. Rao. 1989. Ethnobotany of some weeds of Khasi and Garo hills, Mehalaya, Northeastern India. Economic Botany 43:471–479.

The Wealth of India. 1976. A dictionary of Indian raw materials and industrial products. Raw material, Vol. VII C, Council of Scientific and Industrial Research (CSIR) Publ.

Rao, K. S., and K. G. Saxena. 1996. Minor forest products' management: problems and prospects in remote high altitude villages of Central Himalaya. International Journal of Sustainable Development and World Ecology 3:60–70.

Singh, G. S., K. S. Rao, and K. G. Saxena. 1997. Energy and economic efficiency of mountain farming system: a case study of north-western Himalaya. Journal of Sustainable Agriculture 9:25–49.