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## Henna (*Lawsonia inermis L.*) Cultivation: A Viable Agri-Enterprise in Arid Fringes of Western Rajasthan

Henna,a native of North Africa (Egypt's arid area or perhaps Ethiopia), is an important export oriented dye crop of India. It is grown for its leaves that contain the dye compound lawsone and are widely used as cosmetic dyestuff for coloring hair and body. The oil extracted from flower is the source of "otto of henna" for perfume industry. Henna cultivation occupies about 41,450ha (2010-11) area in Rajasthan and out of this, Pali district alone occupies around 95 percent (39,400 ha) area. Sojat, Marwar Jn. and Raipur tehsils account for around 90 percent henna area of Pali district and produce best quality internationally famous "Sojat brand" of henna.

Fig. Henna field with luxurious vegetative growth

In the hot and arid climate of Western Rajasthan, agriculture production and life support system are constrainted by low and erratic rainfall, high evapo-transpiration and poor soil physical and fertility conditions. Rainfed arable kharif crops like pearl millet, sorghum, sesame, green gram, and clusterbean often ends in failure due to vagaries of monsoon.In such conditions cultivation of henna provides some assured income to the farmers because of its drought hardiness and deep root system. Once established in the field, its plantations are sustainable for 20-25 years under coppice system. It is cultivated by the farmers as ratoon crop under cutting management due to its good regeneration ability in dense plantations mostly as a rainfed crop with no use of fertilizer/ FYM and low level of management etc. Henna, being a perennial shrub, holds a good promise if planted as short rotation forestry plantation and will not only maintain continuous soil cover through foliage/ residue but also help in building a cleaner environment in arid fringes. Henna based agroforestry system could be a good drought proofing strategy that may help farmers to buffer the effect of climate change

### Soil and climatic requirements

Henna can be grown on wide variety of soil and climatic conditions. However, deep, fine sandy or [illegible] for henna cultivation.The plant thrives well under arid to tropical and warm temperate climatic conditions. It needs moderate rainfall of around 400 mm and temperature of about 30-40°C during active growth period during rainy season, and hot, dry and open weather for good harvest of quality leaves. It is also cultivated on slightly saline soil which is common in the region. Climate seems to play a dominant role in the production of quality leaf crop. The distribution of rainfall is important since the crop requires intervening dry sunny periods along with cool nights for proper ripening and expression of high dye content of leaves. Rains at harvesting (Sept-Oct) stage or just after harvest spoils the produce and lower the market value.

## Nursery practices

Henna can be propagated by cuttings as well as by seedlings. However, seedlings are preferred for field planting due to their higher survival rate and economy. Bold uniform seeds are soaked in water for 8 to 10 days, with frequent changing of water or dipped in irrigation channel to break hard seed coat to increase germination. Seeds soaked in 3.0% salt solution for 24 hours results in 60-70 per cent germination. Levelled nursery beds are applied with10 t FYM + 30 kg N + 40 kg P $ha^{-1}$ for optimum sapling growth during nursery stage. Sowing is done during first fortnight of March, when temperatures are optimal for germination (25-30°C). About 6-8 kg seed is needed to raise seedlings for transplanting one hectare.Pre-soaked seeds mixed with fine sand are spread uniformly in beds of around 20 $m^2$ size and irrigated gently. Initially for 30-40 days, beds are irrigated regularly on alternate days in the evening or during night; thereafter irrigation interval is increased to twice a week or depending on weather. To protect sensitive sapling from hot dry winds and sun scorching nursery site with windbreaks and partial shade is ideal.

## Transplantation

Transplantation is carried out during rainy season in the month of July-August. Pre-summer deep ploughing with disc/mould board plough followed by cross cultivation using tine cultivator/ disc harrowing during initial rains gives good field conditions for transplantation and survival of henna saplings. Before transplanting, one final ploughing opening furrows at 30/ 45 cm with tine cultivator or with country plough is considered desirable. After good rains uprooted nursery saplings are cut back to leave about 10cm of both main stem and tap root, and the root portion is drenched with anti-termite pesticide. Thereafter, the saplings are transplanted in furrows at a row spacing of 30 cm and plant to plant spacing of 30cm in peg holes as traditional practice. Proper sapling placement and soil packing followed by rains after transplantation ensures Research Institute showed that planting at 45 cm x 30 cm spacing gave highest dry leaf yield followed by 60 cm x 30 cm spacing at Pali. These spacing are also suitable for mechanical inter-cultural/weeding operations.

## Nutrition

Application of farmyard manure at 5 t $ha^{-1}$ has proved beneficial in terms of seedling establishment and dry leaf yield and quality. It should be mixed well in soil during field preparation before transplanting. Henna crop give response to applied nutrients and therefore, for optimum production it is essential to add fertilizers to the crop. After the establishment of crop in the field, nitrogen can be applied every year at 80 kg per hectare in two equal splits, once after 20 days of growth and then second split a month later. Phosphorus at 40 kg per hectare should be applied and mix in the soil entirely at a time in the crop root zone with first split of N application. Henna crop also shows response to the application of secondary nutrient and micronutrients.

Table: Effect of nutrient management and row spacing on dry leaf yield of henna

| Treatments | Dry leaf yield (kg $ha^{-1}$) | | | |
|---|---|---|---|---|
| | 2003 | 2004 | 2005 | Pooled |
| *Organic manure* | | | | |
| No FYM | 970 | 848 | 1340 | 1053 |
| FYM 5t $ha^{-1}$ | 1099 | 947 | 1466 | 1170 |
| CD (*p=0.05*) | 84 | 71 | 114 | 61 |
| *Fertility levels* | | | | |
| $N_0P_0$ | 983 | 838 | 1243 | 1022 |
| $N_{40}P_{20}$ | 1010 | 851 | 1424 | 1095 |
| $N_{80}P_{40}$ | 1109 | 1003 | 1542 | 1218 |
| CD (*p=0.05*) | 102 | 87 | 140 | 74 |
| *Row spacing* | | | | |
| 30 cm | 985 | 865 | 1326 | 1059 |
| 45 cm | 1085 | 967 | 1443 | 1165 |
| 60 cm | 1033 | 860 | 1441 | 1111 |
| CD (*p=0.05*) | NS | 87 | NS | 74 |

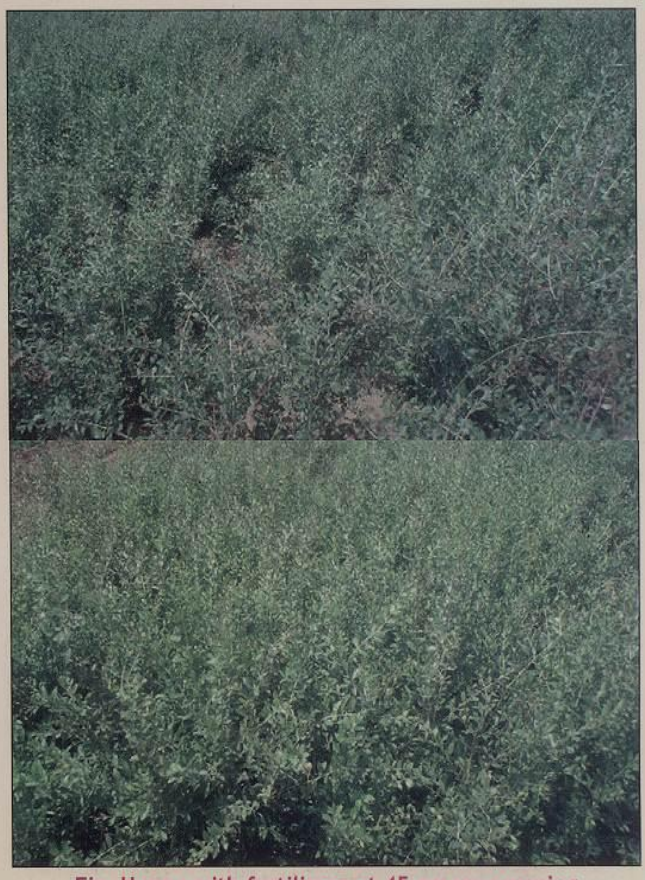

Fig. Henna with fertilizers at 45 cm row spacing

## Interculture

Weed competition causes considerable yield losses to the crop and usually manual hoeing cum weeding or mechanical intercultural operation through tractor is practiced. Mechanical operations are avoided in the new plantation to prevent injury to the fresh transplants. At least one hoeing-cum-weeding is required after a month of transplantation or growth in ratoon crop. Interculture in the ratoon crop, however, is possible employing bullock or tractor drawn implements, if rows are spaced at 45 or 60 cm respectively. Pre emergence application of Atrazine at 1.0 kg a.i. per ha will control most of the broad leaf weeds and annual grasses.

Fig. Interculture with tractor at 60cm row spacing

## In-situ water harvesting

Henna cultivated as rainfed crop and hence, timely soil moisture conservation practices play an important role to enhance the productivity. Soil moisture storage in the crop root zone either by mechanical/ manual intercultural operation also controls weeds, acts as soil mulch, which increases moisture availability period during drought spells.Water harvesting within row, paired row or triplet row pairs not only conserve moisture but also minimize the infestation of weed

Fig. Inter paired row water harvesting (IPRWH)

Recent studies conducted at CAZRI Pali (Jadan) revealed that 30 cm wide and 15 cm deep furrows opened at 60 cm distance for planting henna seedlings helped in rainwater conservation and better establishment. In subsequent years the space between two rows can be used to conserve rainwater and controlling weeds by opening deep furrows. The effect of technique was quite visibleespecially during low rainfall years.

## Intercropping options

To compliment the low productivity of henna during the initial years of establishment leguminous intercrops like green gram and clusterbean resulted in better economic returns. Planting arrangements like henna alley or strip cropping can be adopted according to available intercultural implements and needs of the farmers. Legume crops are more preferred because of their nitrogen fixing ability. In the 1.2 m row spacing of henna plantation one or two rows of green gram or clusterbean could be taken. Henna strip cropped (2.4 m) with another strip (2.4 m) of green gram or clusterbean is better option. In both strips the spacing of the rows should be 60 cm. This type of plantation allows weed control by mechanical means.


Fig. Intercropping with moong bean

Dense plantation increases competition for plant nutrients, light and aeration. During erratic and low rainfall years these limiting natural resources causes leaf shedding in henna, amounts to 10-15 % losses. Sometimes farmers are forced to harvest immature leaves, which cause deterioration of henna quality owing to improper curing of leaves having high moisture content.Dense plantation also promotes insect-pest due to good shade of foliage during good rainfall years and also causes difficulty in hoeing, weeding and intercultural operation. As a result leaves turn brownish and fetch fewer prices in the market. In

contrast, wide row spacing combined with inter-row water harvesting helped in better retention of green leaves until harvest. Also application of balance nutrition in the form of FYM or inorganic fertilizers helped in better leaf production.

## Crop protection

Termite is the major pest of henna in the field. It is controlled by soil application of Chlorpyriphos (10 %) or Furadon 10G at 25kg $ha^{-1}$ during field preparation and by dusting of standing crop with Chlorpyriphos or Furadon. Under prolonged moist and cloudy conditions there may be high incidence of semi-loopers that can be controlled by foliar spray of Quinalphos 30 EC at 1.25 litre $ha^{-1}$.

## Harvesting and yield

Henna takes about three years for establishment and economic sustainable production in the field conditions. Economic leaf production starts from the third year onwards which continues for the next 15-20 years. The first harvest is taken at about 100-110 days in the main growing season. Leafy branches are cut 8-10 cm above the ground using sharp heavy sickle, and wearing protective glove made of soft leather to protect from thorns and spines. The crop is harvested when the leaves are fully mature and yet retain their green colour. This stage is indicated by the onset of ripening of the capsules as well as by the leaves on the main stems that begin to turn yellow and fall. The harvested branches are fully dried in the open preferably in shade and then beaten on the ground to collect the leaves. Dried leaves are finally stored in gunny bags in a dry place for marketing. The average productivity is 1.0 t dry leaves $ha^{-1}$ and during good rainfall season and better management practices it could reach to up to 2.0-2.5 t $ha^{-1}$.

## Economics

Henna cultivation has been found an economically viable agri-enterprise in the region. It involves an establishment cost of about Rs. 31,000 per hectare and recurring expenditure or maintenance cost of 15,000-17,000 per year and gives an average gross return of Rs. 25,000 and net return of around Rs. 8,000-10,000 per hectare per annum with B:C of around 1.2. However, the returns varied as price fluctuations of henna dry leaf are governed by market forces and production of henna leaf in particular year is also affected by rainfall.

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## WEBSITE

Website of ENVIS Centre on Desertification has been changed from *www.cazri.res.in* to *www.cazrienvis.nic.in*

## FORTHCOMING CONFERENCES AND EVENTS

9th European Conference on Precision Agriculture (ECPA) from 7 to 11 July 2013, Lleida, at Catalonia, Spain. Contact: http:// www.ecpa2013.udl.cat/first_call. html

International Conference on Remote Sensing Environment and Transportation Engineering from 26 to [illegible] http://www.rsete2013.org/

8th International Symposium on Digital Earth 2013 from 26 to 29 Aug. 2013, at Sarawak, Malaysia. Contact: http://isde2013.utm.my/

IAG International Conference on Geomorphology from 27 to 31 Aug. 2013, at Paris, France. Contact: http://www.geomorphology-iag-paris2013.com/

EnviroInfo 2013 from 2 to 4 Sept. 2013, at Hamburg. Contact: http://www.enviroinfo2013.org/

7th International Conference of the Urban Soils Working Group, SUITMA from 16 to 23 Sept. 2013, at Torun, Poland. Contact: http://www.suitma7.umk.pl/

11th International Conference of the East and Southeast Asia Federation of Soil Science Societies from 21 to 24 Oct. 2013, at Bogor -West Java, Indonesia. Contact: http://www.esafs11ina.org/

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