

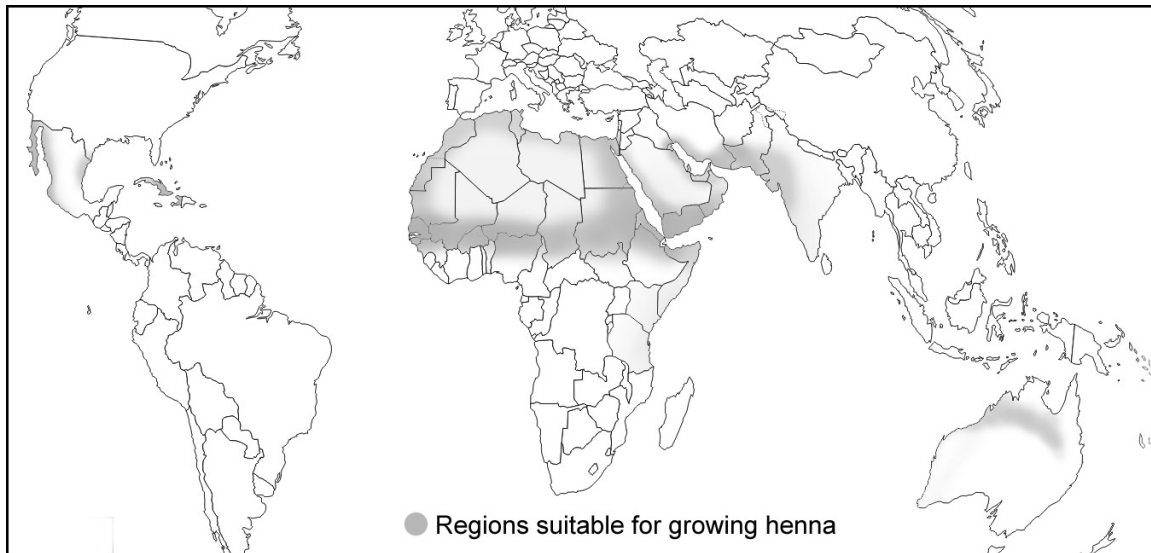
**Address the Epidemic of Para-Phenylenediamine Sensitization and
Aid Marginal Farmers in a Changing Climate**

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Catherine Cartwright-Jones PhD

There is a global epidemic of sensitization to para-phenylenediamine.¹ The popularity of using black hair dye to create ‘black henna’ temporary tattoos for vacation souvenirs for westerners as well as for weddings and other Muslim and Hindu social occasions has exposed millions of people to highly sensitizing doses of PPD. The most commonly used materials for ‘black henna’ tattoos are 15% to 40% PPD black hair dye powders² as well as chunks of 90%+ pure industrial PPD.³ The ornate ‘black henna’ patterns cover large skin surface areas and the ‘black henna’ paste is left in place for half an hour or more introducing a very high dose of PPD to the body. Any person who has had one of these ‘black henna’ temporary tattoos has a high risk of sensitization to PPD and oxidative hair dye.⁴ Substitution of PPD for safe traditional henna began in east Africa in the 1970’s as home hair dye kits were marketed in the region by Bigen and Peacock, and became fashionable in the Kingdom of Saudi Arabia, Pakistan, and India by the early 1980’s.⁵

Women used black oxidative chemical hair dye powders instead of henna because they quickly made black stains on skin, and the finely powdered dye could be manipulated into more complex patterns than roughly sifted local henna. These applications of PPD to skin are done on brides for their weddings and to the guests as well. Many are sensitized by the first time their skin is painted with PPD; if they are not sensitized in the first application, subsequent celebrations with ‘black henna’ for Eids, Karva Chauth and Diwali. Five or fewer applications of 10% PPD in a patch test will sensitize 100% of subjects,⁶ and ‘black henna contains 15% to 60% PPD. Some are unaware PPD sensitization will affect their health in the future; others regard the blisters that arise after application to be of little concern, because they feel it is more beautiful on darker skin and more convenient than traditional henna. As these women mature, they may decide to dye their hair with oxidative hair dye. If so, the sensitization reaction can be severe; anaphylaxis may be fatal.⁷ Forty women have died in recent years in Libya from PPD sensitization,⁸ and lawmakers have called for the outlawing of oxidative hair dye. There has been a similar call in Egypt and the UK.⁹ Khartoum¹⁰ and Karachi¹¹ average hundreds of

admissions to the main hospital per year from PPD sensitization. Sensitized people can safely, immediately transition to pure henna, cassia, and indigo from oxidative hair dye, but they cannot be transitioned to *compound henna or adulterated henna* without risking a destructive chemical reaction between the metallic salts and the activators.

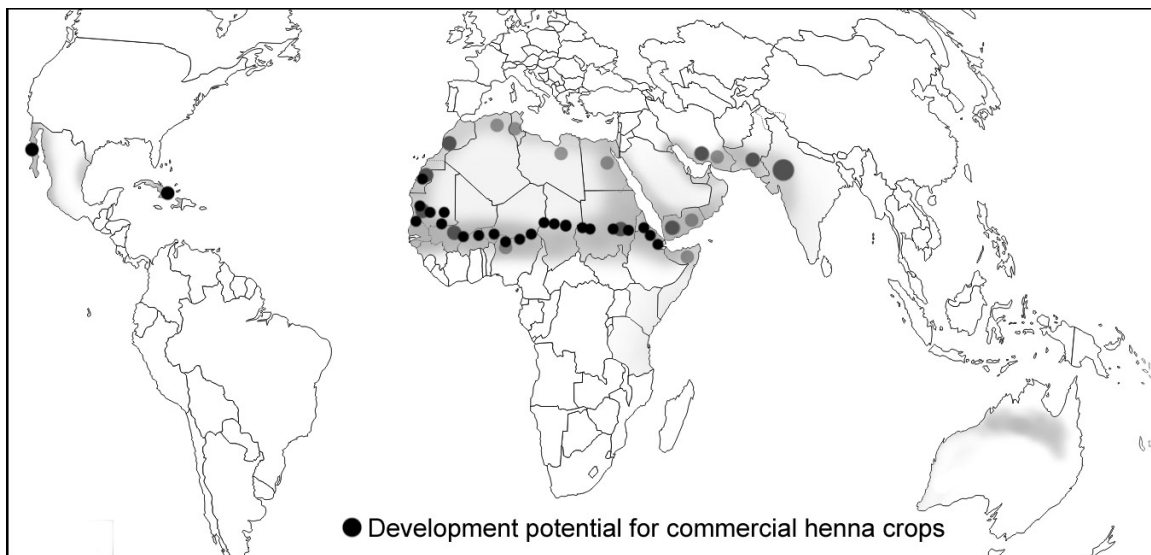


Growing zone for henna

Pure henna, cassia and indigo, in differing proportions and techniques, can produce the complete range of permanent hair dyes from blond through red, brunette, and black. These methods were used across Arabia, the Middle East, the Levant, South Asia and Africa for centuries, but are now regarded as ‘old fashioned’. The notions that henna is inferior, that it destroys hair, is filthy and can only make hair orange is going to require persistent marketing and education. Improvement in the quality of product is crucial to gaining market acceptance and saving lives. Henna must be reframed as a safe, versatile, beautiful, and healthy approach to hair care. Salons and customers must be helped to adjust to and embrace the experience of a slow, nuanced art of women’s self-care. It is entirely feasible to scale up production of henna and improve quality over the next 15 years to meet the demand of the epidemic of PPD sensitization.

Improving and increasing the present supply of henna, indigo and cassia to meet rising demand

The present leader in the production of henna is in Rajasthan, India. The government of India provides substantial support for the henna industry, partly to prevent the expansion of the eastern Thar Desert boundary into Punjabi farmland.¹² This support has made the Punjab the world's dominant henna producer. Henna production and exporting increased from 4,500 tons to 7600 tons per year during the period 1988-93 to 24,000 tons in 2004;¹³ demand for Rajasthan henna production and export is strong and has a steady growth rate of 9% per year. About half of this crop is exported to the USA and Europe. In 2006, 54,750 metric tons of henna leaves were registered through Krishi Upaj Mandi, the government board of agricultural produce, in Sojat city.¹⁴ Scaling up production requires time to plant and grow small trees, but with foresight, it is possible. Scaling up indigo and cassia production is more straightforward, these are tropical annual and perennial plants.



Areas of commercial henna production, 2009

Henna, cassia, and indigo milling and sifting must be improved to 150 micron particle size to be acceptable to western consumers accustomed to easy-to-apply, easy-to-rinse hair dye; there must be no sand or plant debris in the leaf powder. Henna presently in the marketplace is coarsely sifted; twigs and scraps often cling to hair through several washings. The dye content of henna decreases quickly when packaged in thin, single wall cellophane envelopes. Double wall

packaging is necessary for the powders to retain quality over several years. Indigo must be kept from moisture and freezing, or the dye will be spoiled. Henna must be kept under 32C to maintain dye quality. Vacuum packed henna, though it might seem to be an attractive way to preserve quality, adheres to itself and becomes barely breakable even with a hammer.¹⁵

The Central Arid Zone Research Institute in Jodhpur has done work on plant breeding, soils, and pests, enabling more reliable crops of higher quality. Improved milling and an improved supply chain has made Rajasthani henna cost more than henna from other countries.¹⁶ The supply is reliable and quality predictable, but the lawsone content varies from year to year. Based on my own lab testing and 25 years of experience, the highest lawsone content crops from Rajasthan occur during El Nino events when the plants are stressed by extreme heat and late onset of the monsoon. Lower lawsone contents in Rajasthani henna correlate with La Nina events. To obtain consistent lawsone content for marketing and formulation, more than one source will have to be developed to compensate for variation in crop quality. Other countries produce henna, but no other government has allocated resources to henna to the extent as has India.

On the western side of the Thar Desert, henna from Pakistan can be high quality and the milling is usually excellent. LUKE II examinations of henna show Pakistani henna to be grown adjacent to other crops unlike Sojat henna where the main henna district is monocropped. I have found pesticide blow-over from both tomato and cotton crops; the amounts are negligible, but measurable. LUKE II tests of henna from the Sojat crops often reveal low levels of synthetic pyrethrin pesticide residue, probably from treating the castor semi-looper caterpillar (*Achoea janata*) which occasionally invades the monocrop¹⁷ and occasional detectable DDT residue, probably drifted from mosquito treatments of nearby habitation.

According to the independent certified laboratory tests¹⁸ and my personal experience with henna over the last twenty-five years, Yemen produces some of the highest dye content and cleanest henna; I have never found pesticide residue in the LUKE II tests in the henna from Yemen. The milling from some producers is very fine though others have rough milling and sifting. At present the infrastructure in the country has been broken by civil war and suppliers are presently unable to export to the USA. Henna is grown and milled from Iran but trade and

banking restrictions have prevented direct importing into the USA for several years. Morocco has a reputation of perfectly sifted henna, but domestic production has fallen lower than domestic consumption levels; Morocco presently imports henna from India, cultivating more profitable crops and seasonal farm labor migrates to Europe. In Mauritania, henna is grown as a domestic and export product. The samples of Mauritania henna I have tested are coarsely sifted, but are otherwise good henna. The Nigerian henna samples that I have tested contain sand. Sudan produces excellent henna, with high dye content and a more brownish tone than Iranian henna, but more coarsely sifted than is acceptable. All of the countries in the Sahel could be excellent henna producers, but the infrastructure necessary to raise henna production consistent with western market standard is not yet in place.



Expanding commercial henna production in the Sahel

The most promising area for expansion and improvement of henna production is the southern boundary of the Sahel. Rajasthan's success with henna to secure farmland and soil at the eastern edge of the Thar Desert can be repeated in the 'Green Wall' project, the international project to 'green' the southern border of the Sahel, to reverse the Sahara's southward progression and to stabilize farming communities across the area. Henna is indigenous to the region, the small tree with its deep, gnarling, and spreading root base can stay in the ground and for up to fifty years. Henna is often planted as a 'living fence to keep livestock out of vegetable gardens. In addition, henna tolerates soil that has become salinized from irrigation and climate warming. Henna thrives in fine, sandy, well-drained soil; hot, dry, sunny weather conditions promote higher lawsone content in leaves. It is mainly cultivated as a rain fed crop in the semi-arid areas with average annual rainfall of 250 - 450 mm.



Tenacious henna root growth pattern

Leaf harvesting from the henna trees is most productive during the first three decades, but henna plants that are not economically productive, even stumps, tenaciously hold soil in place acting as a living wall against desert encroachment and improving the land. Henna may be intercropped with legumes, further improving the soil.¹⁹ Henna leaves are harvested from the trees once or twice a year, and are a cash crop when all other crops fail from extreme weather events. No mechanical planting, harvesting, or any other fossil fuel-consuming equipment is necessary for tending henna; a hoe, pruning knife and gloves are all that is necessary for crop maintenance and harvest. The cultural association of henna with women may be advantageous; in Sahelian regions where populations have suffered genocidal conflict, women now dominate farming and entrepreneurial activity. As the market demand increases for henna bred and milled to quality standards, farmers will find they can more easily stay on their land and provide for their families, stabilizing populations and governments.

Merging henna, indigo, and cassia into the modern hair dye industry

The users of home hair dye kits are the most vulnerable consumer group; purchasers may be unaware that they are sensitized to oxidative hair dye, and the delayed hypersensitivity reaction to PPD may invalidate patch tests. Education of clients about the benefits of henna and ease of use is paramount; henna is easily applied at home. If the safety, health, and naturalness of henna are marketed strongly, if educating clients about henna is made a priority, sensitized customers' reluctance to change may be overcome. There is no reason for a salon to not use henna on individual clients or for a salon to become 'henna only' to serve many sensitized clients by stylists who have become sensitized. Para-phenylenediamine sensitization is no less an epidemic than HIV is an epidemic, and has many parallels. Recognition of the scope of the problem has been slow. A long latency period has exacerbated both, but the health effects are real, quantifiable, and inevitable in both. With HIV, there was great cultural resistance to acknowledging the epidemic, and great resistance to making the changes to mitigate the risk, such as committing to safe sex. There is considerable resistance to henna in the cosmetology industry because of misinformation and inferior products. These problems can be corrected with education and improved product, and lives saved.

If, in the fifteen years between now and the estimated crest of sensitized population goes gray, henna, indigo, and cassia are improved through rigorous testing, breeding, and infrastructure improvement programs, client base loss can be avoided and product lines can be developed which will benefit not only the industry, but help stabilize farming in marginal regions and counteract desertification through climate change. If the global henna supply must be increased to meet rising demand, alternate growing areas and improved plant breeding should be developed as quickly as possible.

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