

## Short Communication:

# Dye-yielding plant resources of Maharashtra, India: A checklist

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**Abstract.** Patil SH, Kurlapkar DD, Gaikwad DK. 2019. Dye-yielding plant resources of Maharashtra, India: A checklist. *Biodiversitas* 20: 250-266. Natural dyes have rich variation in sources of dyestuff and possess superior aesthetic quality, which is more pleasing to the eye due to unique natural color. Because of their nontoxic effect, they are used for coloring textile, cosmetics, drugs, and various food products. Although indigenous knowledge system has been practiced over the years in the past, the use of natural dyes has diminished over generations due to lack of documentation. Also, there is not much information available on databases of either dye-yielding plants or their products. Therefore, the purpose of the present study was to document the dye yielding plant species and associated knowledge from the study area. Present study provides the first comprehensive checklist of dye yielding Angiosperms of Maharashtra and their resulting color, pigment, and distribution have also been reported. A checklist consists of 195 species distributed among 153 genera and 58 families are presented based on published literature on dye plants, various state and regional floras.

**Keywords:** Dye yielding plants, Maharashtra, natural dyes

## INTRODUCTION

In ancient times color was considered spiritual necessity of equal importance to the physical need of food. Since the very dawn of civilization, mankind has shown his liking and attraction of colors. Even in prehistoric days when man lived in caves, they used available natural dyestuff and pigment for coloring animal skin and their own skin during festivals as well as during wars (Rani et al. 2002). Because they believed that the color would give them magical powers, protect them from evil spirits and help them to achieve victory in war (Siva 2003). According to Dogan et al. 2003, from the beginning of 13th-century use of natural dyestuff by Phoenicians, Hebrews and Venetians were also started. According to Pal (2017) the description of natural dyes presents in Atharva Veda, Bhṛigu Samhita was written using natural dyes, the frescos of Ajanta dating as far back as 1st century A.D. were painted with natural dyes while in epics like Ramayana and Mahabharata, Pitamber a yellow garment used for decorating idols of deity is evident. Before 2500 B.C., Henna was used as dye while in Bible a reference of Saffron as dye also mentioned. In China first report of natural dye extraction from plant sources dates back to around 2600 B.C. During the Indus valley civilization at Mohenjo-Daro and Harappa (3500 B.C.), it was found that color on clothing has been practiced (Siva 2007). In Egypt, it was also reported that peoples were used colored cloths for wrapping mummies. Chemical tests of red fabrics found in the tomb of King Tutankhamen in Egypt show the presence of alizarin, a pigment extracted from madder (Dangwal and Sharma 2011). It was also known that peoples of Aztec and Maya culture used dye obtained from insect such as Cochineal dye (Visalakshi and

Jawaharlal 2013).

Till the 19<sup>th</sup> century, natural dyes were used to dye textile, leather, furs, hairs, feathers, matting, basketry, bone, and ivory. In 1856, William Henry Perkin (Germany) accidentally discovered Mauveine, a synthetic colorant. With the advent of synthetic dyes competes with natural dyes and almost completely replaced the latter within a century (Maxia et al. 2013). But in the last century use of synthetic dyes were disseminated throughout the world because of low cost, wide range of colors, greater reproducibility, and fastness. In recent years the adverse effects of these artificial colorants are getting highlighted. Productions of synthetic dyes make use of petrochemical source, and some of these dyes contain carcinogenic amines (Haji 2011). Synthetic materials and their products are more complex; it will take a long time for decomposing and return to nature hence causes environmental pollution (Lal et al. 2011). The synthetic dyes or their intermediates like anthraquinone, azo, triarylmethane, etc. are potential carcinogenic or genotoxic compounds (Barański et al. 1992). Research has shown that most of the synthetic dyes cause health-related problems, as it decreases food intake capacity, growth and fertility rate, causes damage to liver, spleen, kidney, and heart; inflicts lesions on skin, eyes, lungs and bones (Sinha et al. 2012). Furthermore, synthetic dyes are failed to qualify environmental standards imposed by countries worldwide, this has led to the increasing demand to the natural colorants in textile industries.

Natural dyes obtained from plants and animals are pigmentary molecules which impart colors to the material. These molecules contain aromatic ring structure coupled with azide chain are usually required for resonance and thus to impart color. There is correlation of chemical

structure with color, chromogen - chromophore with auxochrome. For textile coloration chromophore and auxochrome are considered as most important chemical constituents of dyes (Trotman 1984; Foulds 1995). Natural dyes are eco-friendly, biodegradable and non-allergic as derived from natural resources. Most of the dyes are used known for their medicinal properties among Ayurvedic practitioners. In ancient time, in India different flowers like Seuli (*Nyctanthes arbortristis* L.), Palash (*Butea monosperma* (Lam.) Taub.) etc. used in Holi festivals and in those days this festival was safe because the natural dyes were not harmful to the human body (Das and Mandal 2012). Natural dyes are having anticancerous, anti-inflammatory and antimicrobial properties. Curcumin from *Curcuma longa* L., Lawsone from *Lawsonia inermis* L., Punicalagin from *Punica granatum* L. are known to possess antimicrobial properties and also dyes from *Acacia catechu* (L.f.) Willd., *Quercus infectoria* Oliv., *Rubia cordifolia* L. and *Rumex maritimus* L. exhibited antimicrobial activity against pathogenic bacteria (Singh et al. 2005). These health beneficial features of natural dyes are due to flavonoids, tannins and other secondary metabolites. Natural dyes are also used in food products. One of the examples is lycopene-a red colored carotenoid pigment present in fruits like tomato, watermelon, carrot used as color ingredient in many food products. Due to its possible role in the prevention of chronic diseases such as prostate cancer in recent year it has received considerable attention (Lawrence et al. 2015). Natural dyes are potential and possibly only alternative for more viable and safer dyeing in the textile industry. (Purohit et al. 2007).

Bulk of the natural dyes extracted from plant parts like flower, leaf, bark, fruits, seeds, animal sources, fungi, and lichens. Availability, color yield and reproducibility are the problems with natural dyes (Guljarani 2001). Particularly in India, natural dyes are being demanded not only for textile but also to be employed in food coloring, cosmetics and hair dye (Baliarsingh 2012). Reawakening interest in natural dyes is observed in "Naturally or International Symposium/Workshop on Natural Dyes" collaboratively organized by UNESCO and Crafts Council of India in 2006.

Only 150 coloring agents, out of 2000, produced by plants are exploited for dyeing purpose (Siva 2007). There is an urgent need to explore natural sources of dyes, identify new and rediscover traditional dyeing methods, and find out more precise and specific ways of applying natural dyes to get the required shades of color, and ensure colorfastness and examine the processes that have a potential for making natural dyes more eco-friendly and commercially important again. It is needed that research efforts should be directed towards exploring and bioprospecting of naturally available dye yielding resources. Das and Mondal (2012) attempted a survey of folk use of dye yielding plants and also its medicinal value from lateritic zone of West Bengal. Sutradhar et al. (2015) have documented the dye yielding plants of Tripura. Rashid (2013) accounts 48 plant species belongs to 40 genera and 27 families from Rajouri of Jammu and Kashmir. Lichens are excellent textile dyes; Shulka et al.

(2014) have cataloged 11 species of Himalayan lichen as source of natural dyes. Maharashtra, well known for its richness in biodiversity but very little dye yielding resources are documented. In this backdrop present study aims to generate baseline data on the dye yielding plants of Maharashtra state, India.

## MATERIALS AND METHODS

### Scope and study area

The present checklist includes flowering plants in Maharashtra used as a source of dye. It consists of plant resources that are native to region, also cultivated and introduced species are included. Area wise, Maharashtra is India's third largest state and second most populous state of India. It occupies geographical area of 307,313 km<sup>2</sup>. It is situated in the 15°60' to 20°75' N latitude and 72°61' to 74°40' E longitude and comprises ca.750 km of Western Ghats. The state shares its boundaries with Gujarat to the North-West, Madhya Pradesh to the North, Chhattisgarh to the East and Karnataka and Goa to the South. Maharashtra is divided into 36 districts and six administrative divisions. Biogeographically state has been classified into three provinces viz. The Konkan, Western Ghats or Sahyadri and The Maharashtra Plateau. The 'Konkan' is a narrow strip of coastal land lying between the Arabian Sea and the Western Ghats. The western side of the Konkan region has a coastal length of about 720 km, whereas the width of this region ranges from 30 to 60 km. The area of the Western Ghats of Maharashtra is known as 'Sahyadris', with a total length of 750 km and an average width of 80 km. The western face of the Ghats is cut by deep ravines and canyons. Many of the peaks of the Western Ghats are more than 1400 m in height. The highest peak of Maharashtra is Kalasubai (1646 m) other important peaks are Salher (1567 m), Mahabaleshwar (1438 m), Saptashringi (1416 m) and Trimbekeshwar (1304 m). Tapti, Godavari, Bhima and Krishna are the main rivers of the state. The state has a tropical monsoon climate and it experiences four seasons during a year. The summer season is the March to May followed by rainy season from June to September. The post-monsoon season is the October to November and December to February is the winter. The temperature of the state varies between 10°C in winter and 43°C in the summer and relative humidity varies between 40-85%. The total rainfall in different parts of Maharashtra is not uniform. There is heavy rainfall in the coastal region (about 2000 mm), scanty in the central parts (about 500 mm) and medium in the eastern parts (about 1000 mm). Most of the soils in Maharashtra are formed from the Deccan traps generally from the augite or amygdaloidal basalt. These soils are black, dark brown or reddish in color. There are 16 forest types, which belongs to six forest type groups i.e. Tropical Semi-Evergreen, Tropical Moist Deciduous, Littoral and Swamp, Tropical Dry Deciduous, Tropical thorn, and Subtropical Broad lived Hill forests (Champion and Seth 1968). Since the pioneering phase of plant explorations in India, Maharashtra has attracted many renowned botanists.

### Data retrieval

The present checklist is an outcome of detailed literature consultation pertaining to natural dye resources (Krishnamurthy et al. 2002; Rani et al. 2002; Gokhale et al. 2004; Akimpou et al. 2005; Siva 2007; Kar and Borthakur 2008; Gaur 2008; Prabhu and Bhute 2012; Antima et al. 2012; Maxia et al. 2013; Sharda and Rastogi 2013; Ozturk et al. 2013; Visalakshi and Jawaharlal 2013; Jarngal and Katoch 2014; Sutradhar et al. 2015; Patil and Shisode 2017; Kumari et al. 2018). The online databases, The Plant list (<http://www.theplantlist.org/>), Tropicos (<http://www.tropicos.org/>) and IPNI (<http://www.ipni.org/>) were accessed for family name, plant names and bibliographical details. The distributional details of plants were obtained through state floras as Flora of Maharashtra by M. R. Almeida (1996) and the Flora of Maharashtra State by Botanical Survey of India (Singh et al. 2001). Almost all the available district and regional floras were also consulted which includes Flora of Osmanabad (Naik 1979), Flora of Nagpur district (Ugemuge 1986), Flora of Akola district (Kamble and Pradhan 1988), The flora of Savantwadi (Almeida 1990), Flora of Nasik district (Lakshminarasimhan and Sharma 1991), Flora of Buldhana district (Diwakar and Sharma 2000), Flora of Mahabaleshwar and adjoining (Deshpande et al. 1993), Flora of Yavatmal district (Karthikeyan and Kumar 1993), Flora of Marathwada (Naik 1998), Flora of Ahmednagar district (Pradhan and Singh 1999), Flora of Kolhapur district (Yadav and Sardesai 2002), Flora of Dhule and Nandurbar district (Patil 2003), Flora of Jalgaon district (Kshirsagar and Patil 2008), Flora of Baramati district (Bhagat et al. 2008), Flora of Solapur district (Gaikwad and Garad 2015).

## RESULTS AND DISCUSSION

The present study is a first attempt to compile a statewide list of dye yielding flowering plant resources. The data compiled as botanical names, family, plant part used, dye color and coloring agents are listed in table 1. A total of 195 dye yielding species belonging to 153 genera and 58 families has been reported in the present work. The listed plant species belong to 52 families of Dicotyledons and 5 families of Monocotyledons. The highest number of dyes yielding species found in family Fabaceae with 44 species followed by Asteraceae, Malvaceae, and Moraceae with 9 species, Rosaceae with 7 species and Zingiberaceae with 6 species. There are 6 families (Amaranthaceae, Anacardiaceae, Apocynaceae, Combretaceae, Meliaceae, Solanaceae, etc.) having 5 species, 3 families (Boraginaceae, Euphorbiaceae, Lythraceae) having 4 species and 7 families (Casuarinaceae, Myrsinaceae, Phyllanthaceae, Rhamnaceae, Rhizophoraceae, Rutaceae, Sapotaceae etc. having 3 species and remaining families are with minimum number of species. (Figure 1). The genera represented by higher number of species were *Acacia* (7 species), *Terminalia* (5 species), *Curcuma*, *Ficus*, *Indigofera* and *Senna* (4 species), *Bauhinia* and *Caesalpinia* (3 species) and rest of genera with minimum number of species.

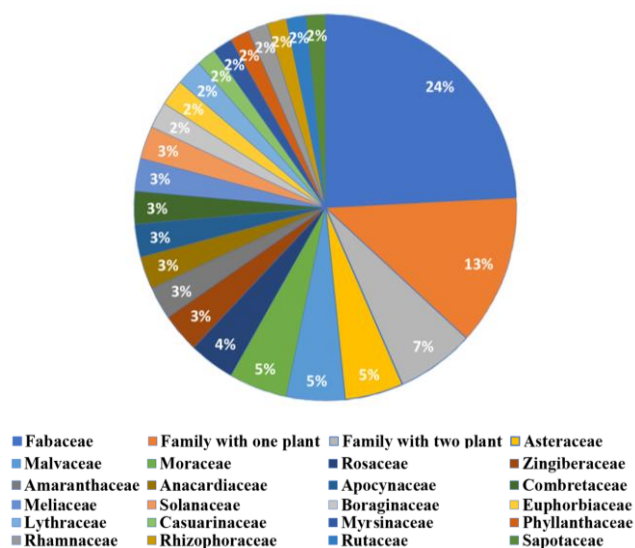


Figure 1. Family wise distribution of dye yielding plants from Maharashtra, India

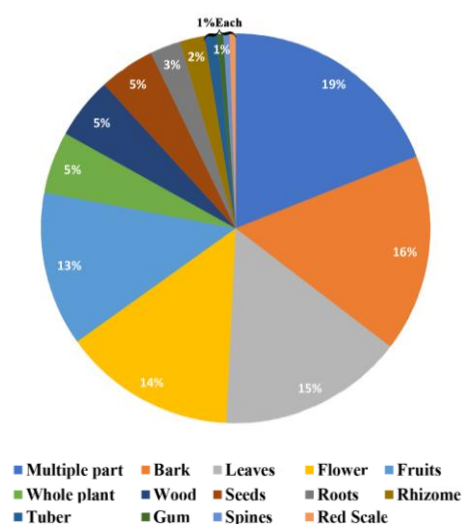


Figure 2. Percentage use of different plant part for use of dye

Dye yielding plant parts percentage found to be, bark (16%), leaves (15%), flower (14%), fruit (13%), wood (5%), seed (5%), roots (3%), rhizome (2%), tuber (1%), gum (1%), spines (1%), and red scales (1%) were found in use as source of coloring material. (Figure 2.) There were 37 species with more than one plant part in use. The important dye extracted from roots or underground plant parts including *Amaranthus spinosus* L., *Ampelocissus latifolia* (Roxb.) Planch., *Beta vulgaris* L., *Curcuma angustifolia* Roxb., *Curcuma aromatica* Salisb., *Curcuma longa* L., *Curcuma zedoria* (Christm.) Roscoe., *Toddalia asiatica* (L.) Lam., *Zingiber officinale* Roscoe. etc. Rind of fruits from *Acacia nilotica* (L.) Delile., *Punica granatum* L., *Terminalia arjuna* (Roxb. ex DC.) Wight & Arn., *Terminalia chebula* Retz. are also used for extracting dyes.

Fruit pulp of *Garcinia spicata* Hook. f., *Phyllanthus emblica* L. also made into dyes. Coir from *Cocos nucifera* L., Gum of *Delonix regia* (Bojer ex Hook.) Raf., Spines of *Bombax ceiba* and also wood ash of *Euphorbia tirucalli* L. used for dye extraction. While in species such as *Amaranthus hypochondriacus* L., *Cuscuta reflexa* Roxb., *Eclipta prostrata* (L.) L., *Indigofera tinctoria* L., *Xylaria xylocarpa* Taub. all parts used for dye extraction. Scientifically, the real nature of dye color varies from plant to plant and their parts. Range of colors to be maintained by the potential species is wide. They exhibit colors such as brown, yellow, purple, violet, pink, red, green, blue, orange, grey, etc.

Previous studies, from Maharashtra recorded are either for local regions or for specific taxa. Most of the reports are ambiguous or erroneous. Patil and Shisode (2017) have documented 53 Angiosperm species as natural dye yielding sources in Khandesh region. Gokhale et al. (2004) reported 500 dye types from indigenous species from India. Among other considerable studies Siva (2007) reported 88 dye resources. Among the considerable studies from other states of India include, Tiwari and Bharat (2008) have recorded 33 dye yielding resources from Achanakmar-Amarkantak Biosphere reserve, Chhattisgarh. Kar and Borthakur (2008) have reported 47 dye yielding plants from Assam. Sutradhar et al. (2015) have made an attempt to document dye yielding plant resources from Tripura, which incorporates 39 species distributed under 35 genera and 26 families.

The present findings record Fabaceae as a most dominant natural dye yielding family, which is in congruence with studies by Nidhi and Katoch (2014), Sutradhar et al. (2015) and Singh (2017). Almost all of the plant parts yield dye, although in present report shows that bark, leaves, flowers, and fruits hold greater percentage of dye pigments. The same has been noticed by Nidhi and Katoch (2014) and Singh (2017).

In conclusion as the natural dyes are quite safe and economically viable, it needs to explore the sustainable utilization of these dyes for various practices. To know the real potential and availability of natural dye yielding resources more detailed studies and scientific investigations are necessary. It is revealed from present checklist that there are lots of dye yielding plants still untouched and information on dye pigments is lacking for most of the plants. Since the present checklist reports highest number of potential dyes yielding plant taxa. These dye resources must be utilized sustainably to extract natural dyes. Research efforts directed toward standardizing dye extraction methods, characterization and molecular elucidation of dyeing pigment will uplift the commercial values of natural dyes.

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## REFERENCES

- Akimou G, Rongmei K, Yadav PS. 2005. Traditional dye yielding plants of Manipur, North East India. *Indian J Trad Knowledge* 4: 33-38.
- Almeida MR. 1996. Flora of Maharashtra. St. Xavier's College, Mumbai.
- Almeida SM. 1990. Vol. I and Vol. II The Flora of Savantwadi Maharashtra, India. Scientific Publishers Jodhpur, India.
- Antima S, Dangwal LR, Dangwal M. 2012. Dye Yielding Plants of the Garhwal Himalaya, India: A Case Study. *Intl Res J Biol Sci* 4: 69-72.
- Baliarsingh S, Panda AK, Jena J, Das T, Das NB. 2012. Exploring sustainable technique on natural dye extraction from native plants for textile: Identification of colorants, colorimetric analysis of dyed yarns and their antimicrobial evaluation. *J Clean Prod* 37: 257-264.
- Barański B, Przybojewska B, Spiechowicz E, Wyszynska K, Zimnicki J. 1992. Identification of potential carcinogenic dyes and intermediates on the basis of their genotoxicity. *Medycyna Pracy* 43: 469-77.
- Bhagat RB, Shimpale VB, Deshmukh RB. 2008. Flora of Baramati. Pune.
- Champion HG, Seth SK. 1968. A revised survey of the forest types of India. Manager of Publications, Delhi, India.
- Dangwal LR, Sharma A. 2011. Indigenous traditional knowledge recorded on some medicinal plant in Narendra Nagar (Tehri Garhwal), Uttarakhand. *Indian J Nat Prod Resour* 2: 116-120.
- Das PK, Mondal AK. 2012. Biodiversity and Conservation of Some Dye Yielding Plants for Justification of its Economic status in the Local areas of Lateritic Zone of West Bengal, India. *Adv Biores* 1: 43-53.
- Deshpande S, Sharma BD, Nayar MP. 1993. Flora of Mahabaleshwar and adjoining, Maharashtra. Botanical Survey of India, Calcutta.
- Diwaker PG, Sharma BD. 2000. Flora of Buldhana district, Maharashtra. India. Botanical Survey of India, Calcutta.
- Dogan Y, Başlar S, Mert HH and Ay G. 2003. Plants used as natural dye sources in Turkey. *Econ Bot* 57: 442-453.
- Foulds J. 1995. Dyeing and Printing. A Handbook on Small Scale Textiles. Intermediate Technology Publications, London.
- Gaikwad SP, Garad KU. 2015. Flora of Solapur district. Tatis Enterprises and Publishers, New Delhi.
- Gaur R. 2008. Traditional dye yielding plants of Uttarakhand, India. *Nat Prod Rad* 7: 154-165.
- Gokhale SB, Tatiya AB, Bakliwal SR, Frsule RA. 2004. Natural dye yielding plants in India. *Nat Prod Rad* 3: 228-234.
- Gulrajani ML. 2001. Present status of natural dyes. *Indian J Fibre Text Res.* 26: 191-201.
- Haji A. 2011. Antibacterial dyeing of wool with natural cationic dye using metal mordants. *Mater Sci (Medžiagotyra)* 18: 1392-1320.
- Jarngal N, Katoch KN. 2014. Herbal Dye Yielding Plants of District Kathua, Jammu And Kashmir State, India. *Intl Res J Biol Sci* 3: 73-79.
- Kamble SY, Pradhan SG. 1988. Flora of Akola district. Botanical Survey of India, Calcutta.
- Kar A, Borthakur SK. 2008. Dye yielding plants of Assam for dyeing handloom textile products. *Indian J Tradit Know.* 7: 166-171.
- Karthikeyan S, Kumar A. 1993. Flora of Yavatmal District, Maharashtra, Botanical Survey of India, Calcutta.
- Krishnamurthy KV, Siva R, Kumar TS. 2002. Natural dye-yielding plants of Shervaroy Hills of Eastern Ghats. Proceedings of the National Seminar on Conservation of Eastern Ghats, March 24-26, 1998, Kalavani Port Auditorium, Visakhapatnam, Andhra Pradesh, India.
- Kshirsagar SR, Patil DA. 2008. Flora of Jalgaon district, Maharashtra. Bishen Singh Mahendra Pal Singh Publishers and Distributors, Dehradun, India.
- Kumari P, Seth MK, Gogtia R. 2018. Dye Yielding Woody Plants along the National Highway from Parwanoo to Kaurik in Himachal Pradesh. *Saudi J Life Sci* 3:134-139.
- Lakshminarasimhan P, Sharma BD. 1991. Flora of Nasik District. Botanical Survey of India, Calcutta.

- Lal C, Sharma MC, Shakyawar DB, Raja ASM, Sharma KK, Pareek PK. 2011. Natural dye constituents from rind of *Punica granatum* and its application on Pashmina fabrics. Arch Appl Sci Res 3: 350-357.
- Lawrence B, Mahesh S, Aswathy JM, Murugan G, Murugan K. 2015. Ethnic knowledge of dye yielding plants used by the Kani tribes of Ponnudi hill: A case study. Indo Amer J Pharmaceut Res 5: 2611-2616.
- Maxia A, Meli F, Gaviano C, Picciau R, Martis BD, Kasture S, Kasture V. 2013. Dye plants: Natural resources from traditional botanical knowledge of Sardinia Island, Italy. Indian J Tradit Know 12: 651-656.
- Naik VN. 1979. Flora of Osmanabad. Venus Publishers, Aurangabad, India.
- Naik VN. 1998. The Flora of Marathwada. Amrut Publication, Aurangabad, India.
- Ozturk M, Uysal I, Gucel S, Altundag E, Dogan Y, Baslar S. 2013. Medicinal uses of natural dye-yielding plants in Turkey. Res J Tex Appl 17: 69-80.
- Pal A. 2017. Chemical Investigation on Selected Indigenous Plants for Natural Dyes and Dyeing Characteristics. [Dissertation]. Forest Research Institute (Deemed), University Dehradun, Uttarakhand.
- Patil DA, SB Shisode. 2017. Natural dye: Yielding vegetable sources in Khandesh region (Maharashtra) India. Intl J Adv Res Dev 2: 18-21
- Patil DA. 2003. Flora of Dhule and Nandurbar district, Maharashtra. Bishen Singh Mahendra Pal Singh Publishers and Distributors, Dehradun, India.
- Prabhu KH, Bhute AS. 2012. Plant-based natural dyes and mordants: A Review. J Nat Prod Plant Resour 2: 649-664.
- Pradhan SG, Singh NP. 1999. Flora of Ahmednagar District, Maharashtra. Bishen Singh Mahendra Pal Singh, Dehradun, India.
- Purohit A, Mallick S, Nayak A, Das NB, Nanda B, Sakio S. 2007. Developing Multiple Natural Dyes from Flower Parts of Gulmohur. Curr Sci 92: 168-182.
- Rani SS, Murthy RKS, Pullaiah T. 2002. Dye yielding plants of Andhra Pradesh, India. J Econ Tax Bot 26: 740-749.
- Rashid A. 2013. Dye yielding plant diversity of district Rajouri Jammu and Kashmir state-India. Intl J Pharm Bio Sci 1: 263-266.
- Sharda NL, Rastogi D. 2013. Unexplored treasure of the Garhwal Himalayas: Dye yielding Plants for sustainable dyeing. J Acad Ind Res 2: 155-159.
- Shulka P, Upreti DK, Nayakas S, Tiwari P. 2014. Natural dyes from Himalayan lichens. Indian J Tradit Know 13: 195-201.
- Singh NP, Lakshminarasimhan P, Karthikeyan S and Prasanna PV. 2001. Flora of Maharashtra State. Botanical Survey of India, Calcutta.
- Singh R, Jain A, Panwar S, Gupta D, Khare SK. 2005. Antimicrobial activity of some natural dyes. Dyes Pigm 66: 99-102.
- Sinha K, Saha PD, Datta S. 2012. Extraction of natural dye from petals of Flame of forest (*Butea monosperma*) flower: Process optimization using response surface methodology (RSM). Dyes Pigm 94: 212-216.
- Siva R. 2003. Assessment of genetic variation in some dye-yielding plants using isozyme data. [Dissertation]. Bharathidasan University, Tiruchirapalli, India.
- Siva R. 2007. Status of natural dyes and dye yielding plants in India. Curr Sci 92: 916-925.
- Sutradhar B, Deb D, Majumdar K. 2015. Traditional dye yielding plants of Tripura, Northeast India. Biodiversitas 16: 121-127.
- Tiwari SC, Baharat A. 2008. Natural dye yielding plants and Indigenous knowledge of dye preparation in Achanakmar- Amarkantak Biosphere reserve Central India. Nat Prod Rad 7: 82-87.
- Trotman ER. 1984. Dyeing and Chemical Technology of Textile fibres. 6th ed. Griffin, London.
- Ugemuge NR. 1986. Flora of Nagpur District, Maharashtra, India. Shree Publication, Nagpur.
- Visalakshi M, Jawaharlal M. 2013. Healthy Hues-Status and Implication in Industries-Brief Review. J Agric Allied Sci 2: 42-51.
- Yadav SR, Sardesai MM. 2002. Flora of Kolhapur District. Shivaji University, Kolhapur.

**Table 1.** Dye yielding plants of Maharashtra, India

Botanical Name and Family	Part/s used	Color	Pigment	Reference	Distribution
<b>Acanthaceae</b>					
<i>Barleria prionitis</i> L.	Flowers	Yellow			Along hedges. Common. Ahmednagar, Akola, Aurangabad, Beed, Bombay, Chandrapur, Dhule, Jalna, Jalgaon, Kolhapur, Nagpur, Nanded, Nasik, Osmanabad, Parbhani, Pune, Raigad, Ratnagiri, Satara, Sindhudurg, Thane, Yavatmal.
<i>Justicia adhatoda</i> L.	Leaves	Orange, yellow/green	Adhatodic acid, Carotene, Luteolin, Quercetin.	Sutradhar et al. 2015	Usually found as a hedge plant along roadsides. Ahmednagar, Aurangabad, Beed, Chandrapur, Dhule, Jalgaon, Jalna, Latur, Kolhapur, Nagpur, Nanded, Osmanabad, Parbhani, Pune, Raigad, Ratnagiri, Satara, Sindhudurg, Thane.
<b>Amaranthaceae</b>					
<i>Achyranthes aspera</i> L.	Whole plant	Black/ Brown			Rare in swampy habitat. Chandrapur, Kolhapur, Nanded, Nasik.
<i>Amaranthus hypochondriacus</i> L.	Whole plant	Pink-Purple	Tannin.	Gokhale et al. 2004	Occasional on wastelands and around fields. Aurangabad & Beed.
<i>Amaranthus spinosus</i> L.	Roots	Pink (Auxillary)			Common in open areas and waste places as a weed.
<i>Beta vulgaris</i> L.	Roots	Red			Cultivated in many parts for fleshy roots used in salad, vegetables etc.
<i>Celosia argentea</i> L.	Flowers	Pink, Red	Betalains	Sutradhar et al.2015	The familiar Cocks comb is planted in gardens.
<b>Amarylildaceae</b>					
<i>Allium cepa</i> L.	Red scales	Yellow, Brown, Bright Red	Carotenoid		Widely cultivated. Ahmednagar, Buldhana, Chandrapur, Nagpur, Osmanabad, Pune, Satara, Sindhudurg, Thane.
<b>Anacardiaceae</b>					
<i>Anacardium occidentale</i> L.	Pericarp	Black			Usually planted, occasionally found as an escape in deciduous forests. Ahmednagar, Bombay, Chandrapur, Kolhapur, Nasik, Pune, Raigad, Ratnagiri, Satara, Sindhudurg, Thane.
<i>Lannea coromandelica</i> (Houtt.) Merr.	Bark, Fruits	Yellow, Brown			Common throughout in deciduous forests.
<i>Mangifera indica</i> L.	Bark, Leaves	Black	Mangiferin.	Gokhale et al. 2004	Commonly cultivated, sometimes found wild.
<i>Semecarpus anacardium</i> L.f.	Fruits	Grey, Black	Bhilawanol	Siva, 2007	Common throughout in deciduous forests.
<i>Spondias pinnata</i> (L. f.) Kurz.	Fruits	Black			Occasional in hill forests and around fields. Ahmednagar, Aurangabad, Bombay, Latur, Nagpur, Nasik, Pune, Raigad, Ratnagiri, Thane.

**Annonaceae**

<i>Annona reticulata</i> L.	Dry unripe fruits	Black	Catechin	Gokhale et al. 2004	A native of Tropical America. Usually cultivated but also occurs as an escape.
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**Apocynaceae**

<i>Holarrhena pubescens</i> Wall. ex G. Don	Leaves	Blue			Common throughout the state in dry deciduous and semi-evergreen forests.
<i>Nerium indicum</i> Mill.	Roots, Bark	Black			Grown in gardens for showy Flowers, sometimes found as an escape.
<i>Tabernaemontana divaricata</i> (L.) R.Br. ex Roem. &Schult.	Seeds	Red			Grown in the gardens.
<i>Wrightia arborea</i> (Dennst.) Mabb.	Seeds, Roots	Yellow			Common in moist forests. Akola, Amravati, Chandrapur, Kolhapur, Nanded, Nasik, Pune, Raigad, Ratnagiri, Thane.
<i>Wrightia tinctoria</i> R. Br	Leaves	Blue	Indigo yielding glucoside.	Gokhale et al. 2004	Common throughout the state in dry and moist deciduous forests.

**Aracaceae**

<i>Areca catechu</i> L.	Nuts	Brown			Cultivated. Southern Konkan.
<i>Cocos nucifera</i> L.	Coir	Dark Brown			Kolhapur.

**Asphodelaceae**

<i>Agave americana</i> L.	Leaves	Laxative			Chandur, Ingali, Kodoli, Rui, Wasagade.
<i>Aloe vera</i> (L.) Burm.f.	Whole plant	Red			Scattered in waste places, road sides and along hedges. Ahmednagar, Akola, Buldhana, Nagpur, Nasik, Osmanabad, Pune, Satara, Thane.

**Asteraceae**

<i>Artemisia japonica</i> Thunb.	Bark	Brown			A few along forest edges. Raigad, Pune, Satara.
<i>Caesulia axillaris</i> Roxb.	Whole Plant	Yellow			Kagal, Kolhapur, Shirol.
<i>Carthamus tinctorius</i> L.	Flowers	Yellow, Red	Carthamin, Carthamon.	Gokhale et al. 2004	Safflowers. a native of S.W. Asia is cultivated in the black soil districts of Bombay Presidency, for the use of dyers as well as for oil extracted from Seeds.
<i>Coreopsis tinctoria</i> Nutt.	Flowers	Yellow			A native of N. America, grown in gardens.
<i>Cosmos bipinnatus</i> Cav.	Corolla	Yellow	Apigenin		Native of Mexico, grown in gardens. Marathwada, Nasik.
<i>Eclipta prostrata</i> L.	Whole plant	Black, Red	Phenols, coumarins, flavones	Sutradhar et al. 2015	Common throughout in wet situations
<i>Helianthus annuus</i> L	Flowers	Yellow, Violet			The Common Sunflowers native of Western USA, is cultivated throughout for oil Seeds.
<i>Tagetes erecta</i> L.	Flowers	Yellow	Quercetagenin	Singh and Bharati.2014	The African Marigold, a native of Mexico is grown abundantly in gardens.
<i>Wedelia chinensis</i> (Osbeck) Merr.	Flowers, Roots	Black			Rare. 'Konkan'.

<b>Balsaminaceae</b> <i>Impatiens balsamina</i> L.	Corolla	Orange, Pink, Red, Purple	Monoglycosidic anthocyanin based on pelargonidin.	Gokhale et al. 2004	Common in moist soil on plains and Ghats.
<b>Basellaceae</b> <i>Basella alba</i> L.	Seeds	Purple, Violet, Maroon	Gomphrenin-I	Sutradhar et al. 2015	As an escape throughout the State. Also grown extensively as vegetable and makes a good spinach.
<b>Bignoniaceae</b> <i>Kigelia africana</i> (Lam.) Benth.	Wood, roots	Grayish brown			Commonly planted as avenue trees and also grown in gardens.
<i>Spathodea campanulata</i> P. Beauv.	Leaves	Orange			Commonly planted as avenue tree.
<b>Bixaceae</b> <i>Bixa orellana</i> L.	Seeds	Orange, Red, Pink	Bixin, orellin, beta-carotene	Siva, 2007.	It is a native of Tropical America. Commonly cultivated.
<b>Boraginaceae</b> <i>Cordia domestica</i> Roth. <i>Ehretia laevis</i> Roxb.	Roots, Leaves Inner Bark	Yellow, Red Red			Infrequent in deciduous forest. 'Konkan'. Frequent in deciduous forests. Ahmednagar, Chandrapur, Dhule, Kolhapur, Nagpur, Nasik, Pune, Raigad, Ratnagiri, Sindhudurg.
<i>Heliotropium indicum</i> L.	Leaves	Black			Frequent in open, moist places as weed. Bombay, Dhule, Nagpur, Nasik, Pune, Ratnagiri, Satara, Sindhudurg, Thane.
<i>Heliotropium strigosum</i> Willd.	Leaves	Black			Frequent in open areas and in fallow fields in plains in deciduous forests. Chandrapur, Sindhudurg.
<b>Brassicaceae</b> <i>Brassica oleracea</i> L.	Flowers	Pink			Cultivated in many parts for its Flowers which are used as vegetable.
<b>Burseraceae</b> <i>Garuga pinnata</i> Roxb.	Leaves	Red			In deciduous forests. Common throughout the state.
<b>Casuarinaceae</b> <i>Casuarina equisetifolia</i> L.	Bark	Light Reddish Brown			Widely distributed from south East Asia to Pacific Islands to North and North East Australia. Cultivated widely in tropics, mostly naturalized in India.
<b>Clusiaceae</b> <i>Garcinia spicata</i> Hook. f.	Fruit pulp, Bark	Yellow	Fucugetin	Singh and Bharati.2014	Rare in semi-evergreen forests. Ahmednagar, Ratnagiri, Sindhudurg.
<i>Garcinia xanthochymus</i> Hook. f	Unripe fruits, Bark	Yellow			Occasional near streams in semi-evergreen to wet deciduous forests. Bombay, Kolhapur, Nagpur, Pune, Sindhudurg.



<i>Terminalia alata</i> Roth.	Bark	Red, Brown	Ellagic acid	Singh and Bharati.2014	Frequent in deciduous forests.
<i>Terminalia arjuna</i> (Roxb. ex DC.) Wight & Arn.	Bark, Fruit rind	Sandy, Khaki Red	Arjunic acid	Sutradhar et al. 2015	Common throughout.
<i>Terminalia bellirica</i> (Gaertn.) Roxb.	Fruits	Brown, Black, Blue	Chebulagic acid, gallic acid, ellagic acid	Sutradhar et al. 2015	Common throughout.
<i>Terminalia catappa</i> L.	Leaves	Brown, Black	Ellagic acid	Singh and Bharati.2014	It is a native of Tropical Asia, planted in gardens and along roadsides.
<i>Terminalia chebula</i> Retz.	Fruit rind	Yellow, Black, Brown, Dark blue, Dark grey, Creamy Brown	Chebulinic acid	Sutradhar et al. 2015	Frequent in moist deciduous or dry deciduous forests. Ahmednagar, Chandrapur, Dhule, Kolhapur, Nasik, Pune, Raigad, Ratnagiri, Satara, Sindhudurg, Thane.
<b>Convolvulaceae</b>					
<i>Cuscuta reflexa</i> Roxb.	Whole plant	Yellow	Cuscutin, quercetin, coumarin	Sutradhar et al. 2015	Common parasite on <i>Bauhinia</i> sp., <i>Ficus</i> sp., <i>Ziziphus</i> spp., etc.
<b>Dioscoreaceae</b>					
<i>Dioscorea bulbifera</i> L.	Tuber	Pale color			Common in all districts.
<b>Dipterocarpaceae</b>					
<i>Shorea robusta</i> Gaertn.	Bark	Red, Black			Introduced as an ornamental tree. Amravati.
<b>Ebenaceae</b>					
<i>Diospyros melanoxylon</i> Roxb.	Bark	Black			Common in dry deciduous forests. Ahmednagar, Akola, Bombay, Chandrapur, Jalgaon, Nasik, Pune, Raigad, Satara, Thane, Yavatmal.
<i>Diospyros. peregrina</i> (Gaertn.) Gürke	Fruits	Yellow			Found in moist & semi-evergreen forests. Ahmednagar, Chandrapur, Pune, Ratnagiri.
<b>Euphorbiaceae</b>					
<i>Chrozophora rottleri</i> (Geiseler) A. Juss. ex Spreng.	Fruits	Yellow			Common.
<i>Euphorbia tirucalli</i> L.	Wood ash	Auxillary			Frequent. Ahmednagar, Aurangabad, Mumbai, Buldhana, Pune, Ratnagiri, Thane.
<i>Jatropha curcas</i> L.	Bark, Leaves, Root	Dark blue, Purple, Yellow			Frequent.
<i>Mallotus philippensis</i> (Lam.) Müll. Arg.	Fruits	Red, Orange	Rottlerin, isorottlerin	Sutradhar et al. 2015	Common.
<b>Fabaceae</b>					
<i>Acacia pennata</i> Dalzell & A. Gibson	Bark	Brown, Black			Common.
<i>Acacia caesia</i> (L.)	Bark, leaves, pods	Black			Occasional on hill slopes. Mumbai, Nanded

<i>Acacia catechu</i> (L.F.) Willd.	Heart wood	Brown, Red, Black	Catechin, Catechin red.	Gokhale et al. 2004	Common in deciduous forests.
<i>Acacia chundra</i> (Roxb. ex Rottl.)	Heart wood	Brown			Common throughout in dry deciduous forests.
<i>Acacia farnesiana</i> (L.) Willd.	Bark, Fruits	Yellow			Planted in hedges, also naturalized in some villages. Bombay, Nasik, Pune, Osmanabad, Ratnagiri, Thane, Yavatmal.
<i>Acacia leucophloea</i> Willd.	Leaves, Bark	Red, Yellow			Common throughout in scrub forests.
<i>Acacia nilotica</i> subsp. Indica (Benth.) Brenan.	Bark, Fruit rind	Brown, Black, Yellow	Catechin	Gokhale et al. 2004	Dhule, Jalgaon, Marathwada, Pune, Solapur.
<i>Adenanthera pavonina</i> L.	Wood	Red			Often planted, rarely wild in moist deciduous forests. Bombay, Dhule, Jalgaon, Nagpur, Pune, Raigad.
<i>Aegle marmelos</i> (L.) Corrêa	Bark	Red			Common throughout in dry deciduous forests and also planted.
<i>Albizia procera</i> (Roxb.) Benth.	Bark	Brown			Common. Akola, Chandrapur, Nasik, Pune, Raigad, Yavatmal.
<i>Albizia odoratissima</i> (L.f.) Benth.	Stem, Bark	Brown, Brick red			Common.
<i>Bauhinia purpurea</i> L.	Bark	Violet, Purple, Yellow	Chalcone, butein	Gokhale et al. 2004	Common in deciduous forests, also planted in gardens and along roadsides.
<i>Bauhinia variegata</i> L.	Leaves	Purple	Anthocyanin	Sutradhar et al. 2015	Planted. Chandrapur, Nasik, Osmanabad, Pune, Satara, Thane.
<i>Bauhinia. vahlii</i> Wight & Arn.	Bark	Brown, Black			In moist deciduous forests. Frequent. Amravati, Chandrapur, Nagpur, Pune, Raigad, Yavatmal.
<i>Butea monosperma</i> (Lam.) Taub.	Leaves Flowers	Red, Yellow	Butein, butin, isobutrin, coreopsin, isocoreopsin	Sutradhar et al. 2015	Common throughout in deciduous forests of the state.
<i>Butea superba</i> Roxb.	Bark	Red	Glycosides, Butrin, Butein.		In moist and dry deciduous forests, frequent. Akola, Amravati, Chandrapur, Dhule, Kolhapur, Nagpur, Nanded, Nasik, Pune, Raigad, Thane, Yavatmal.
<i>Caesalpinia coriaria</i> (Jacq.) Willd.	Fruits	Brown, Black	Ellagic acid	Singh and Bharati.2014	Native of S. America
<i>Caesalpinia pulcherrima</i> (L.) Sw.	Flowers	Pale violet			Planted in gardens.
<i>Caesalpinia sappan</i> L.	Bark, Sapwood, Pods.	Red, Black	Brazilin, Sappan red.	Gokhale et al. 2004.	Planted in gardens. Bombay, Kolhapur, Pune.
<i>Cassia fistula</i> L.	Bark, Flowers, Fruit	Brown, Black, Yellow	Leucoanthicynidin.	Gokhale et al. 2004.	Common throughout the state in deciduous forests. Also planted in home gardens
<i>Clitoria ternatea</i> L.	Leaves	Blue	Anthocyanin pigment ternatin	Sutradhar et al. 2015	Along hedges and also cultivated, common throughout the state
<i>Delonix regia</i> (Bojer ex Hook.) Raf.	Gum	Yellow			Planted throughout the state along road-sides and in gardens.
<i>Erythrina suberosa</i> Roxb.	Flowers	Dark brown			In deciduous forests, frequent.
<i>Erythrina variegata</i> L.	Flowers	Red	Anthocyanin and betalains pigment	Sutradhar et al. 2015	In deciduous forests and also planted, common.
<i>Flemingia macrophylla</i> (Willd.) Kuntze ex Merr.	Leaves, Bark	Black			In moist deciduous forests, frequent. Pune, Ratnagiri, Satara, Thane, Yavatmal.
<i>Indigofera cassioides</i> Rottler ex DC.	Leaves	Blue			In hilly forests, Common.
<i>Indigofera cordifolia</i> B. Heyne ex Roth	Flowers	Black			Common throughout in plains in open situations.

<i>Indigofera parviflora</i> F. Heyne ex Hook. & Arn.	Leaves	Yellow				In wastelands and as forest undergrowth, frequent 'Konkan', Osmanabad, Pune.
<i>Indigofera tinctoria</i> L.	Whole plant	Indigo Blue	Indigotin	Sutradhar et al. 2015		Common throughout in plains, in open situations and also cultivated.
<i>Peltophorum pterocarpum</i> (DC.) Backer ex K. Heyne	Wood, Leaves	Brown black				Planted in gardens and along road sides. Ahmednagar, Bhandara, Bombay, Chandrapur, Osmanabad, Pune, Raigad, Sindhudurg, Thane
<i>Pithecollobium dulce</i> Benth	Bark	Black				Common.
<i>Pongamia pinnata</i> (L.) Pierre	Seeds	Brown				Common throughout the state along the river banks, also cultivated.
<i>Prosopis juliflora</i> (Sw.) DC.	Pod Husk	Yellow				Common along banks of rivers and on hill slopes. Akola, Chandrapur, Dhule, Osmanabad.
<i>Pterocarpus marsupium</i> Roxb.	Bark	Red	Epicatechin.			In deciduous forests, common
<i>Pterocarpus santalinus</i> L.f.	Wood	Red	Santalin			In gardens, Thane. Occasionally introduced in gardens.
<i>Senna alata</i> (L.) Roxb.	Seeds	Black	Chrysophanic acid, Emodin	Singh and Bharati 2014		Planted. Pune.
<i>Senna auriculata</i> (L.) Roxb.	Fruits, Seeds and Flowers	Red, Orange, Yellow	Chrysophanic acid, Emodin	Singh and Bharati 2014		Along the drier tracts in open situations
<i>Senna occidentalis</i> (L.) Link	Seeds	Brown	Chrysophanic acid, Emodin	Singh and Bharati 2014		Common, along the waste lands.
<i>Senna tora</i> (L.) Roxb.	Seeds	Yellow	Chrysophanic acid, Emodin	Singh and Bharati 2014		Common throughout the state in waste places.
<i>Tamarindus indica</i> L.	Leaves	Grey, Brown				As an escape in the outskirts of forests and also found planted around villages.
<i>Tephrosia candida</i> DC.	Leaves	Red, light blue				A native of Himalayas, W. Indo-China and Malay Archipelago, occasionally planted in gardens. Pune.
<i>Tephrosia purpurea</i> (L.) Pers	Leaves	Blue				Common throughout the waste places and plains.
<i>Trigonella foenum-graecum</i> L	Leaves	Yellow				Cultivated throughout for its leaves and seeds.
<i>Xylia xylocarpa</i> Taub.	Whole plant	Brown				Chandrapur, Raigad, Ratnagiri, Satara.
<b>Lamiaceae</b>						
<i>Leucas cephalotes</i> (Roth) Spreng.	Seeds	Auxillary				Common throughout the State in the undergrowth and in open situations.
<i>Tectona grandis</i> L.F.	Wood	Deep orange	Tecto Leavesquinone	Sutradhar et al. 2015		Common in deciduous forests.
<b>Lauraceae</b>						
<i>Cassytha filiformis</i> L.	Whole plant	Brown				Frequent in deciduous forests on hosts like Ipomoea spp., Vitex spp., etc. Amravati, Bhandara, Chandrapur, Nagpur, Pune, Ratnagiri, Sindhudurg, Thane, Yavatmal.
<b>Linaceae</b>						
<i>Reinwardtia indica</i> Dumort.	Flowers	Yellow				On hill tops, frequent. Kolhapur, Nasik, Pune, Raigad, Ratnagiri, Satara, Sindhudurg, Thane.

**Loganiaceae**

<i>Strychnos nux vomica</i> L.	Seeds	Brown, Black			Scattered in forests, along roadsides and coasts. Kolhapur, Raigad, Ratnagiri, Sindhudurg.
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**Lythraceae**

<i>Lagerstroemia parviflora</i> Roxb.	Bark	Brown			Frequent in moist open situations, throughout Maharashtra.
<i>Lawsonia inermis</i> L.	Leaves	Red, Bluish black	Lawsone	Sutradhar et al. 2015	Commonly cultivated.
<i>Punica granatum</i> L.	Fruit rind	Brown, Yellow-Red	Flavogallol.	Gokhale et al. 2004	Planted for fruits throughout the state.
<i>Woodfordia fruticosa</i> (L.) Kurz	Flowers	Red orange, Reddish yellow	Lawsone.	Gokhale et al. 2004	Common throughout.

**Magnoliaceae**

<i>Michelia champaca</i> L.	Wood	Yellow			Usually planted as an ornamental tree near temples, rivers and gardens for its Flowers.
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**Malpighiaceae**

<i>Malpighia glabra</i> L.	Flowers	Yellow			It is a Native of Texas. Grown in gardens.
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**Malvaceae**

<i>Abelmoschus esculentus</i> (L.) Moench.	Flowers	Purple		Malvaceae	Cultivated in most districts of the state for its fruits which are used as vegetable. The species Asiatic in origin.
<i>Alcea rosea</i> L.	Flowers	Brown, Red			Cultivated in the Gardens for its showy Flowers. Ahmednagar, Aurangabad, Nagpur, Osmanabad, Pune, Sindhudurg.
<i>Bombax ceiba</i> L.	Spines	Red			Common throughout the State in deciduous forests. Sometimes planted.
<i>Gossypium herbaceum</i> L.	Flowers	Yellow			Cultivated for its floss. Chandrapur.
<i>Hibiscus rosa-sinensis</i> L.	Corolla	Red	Anthocyanidins, isoflavanol, flavone	Sutradhar et al. 2015	A native of Africa. Commonly cultivated in gardens. Bombay, Chandrapur, Nagpur, Osmanabad, Pune, Ratnagiri, Sindhudurg, Thane.
<i>Kydia calycina</i> Roxb.	Bark	Maroon			Common in deciduous forests.
<i>Malva sylvestris</i> L.	Leaves	Green			It is an ornamental usually grown in gardens and also found as an escape. Aurangabad, Bombay, Nagpur.
<i>Thespesia populnea</i> (L.) Sol. ex Corrêa	Fruits	Yellow			Wild along sea-shore and commonly cultivated along road sides.
<i>Urena lobata</i> L.	Wood	Brown			Common in waste places and also along roadside. Amravati, Bhandara, Kolhapur, Nagpur, Pune, Raigad, Ratnagiri, Satara, Sindhudurg, Thane.

**Melastomataceae**

<i>Melastoma malabathricum</i> L.	Leaves	Black purple			Usually found in moist and semi-evergreen to evergreen forests. Chandrapur, Ratnagiri, Satara, Sindhudurg.
<i>Memecylon umbellatum</i> Burm. f.	Leaves	Yellow			Found in moist and semi-evergreen forests. Ahmednagar, Bombay, Chandrapur, Kolhapur, Nasik, Pune, Raigad, Ratnagiri, Satara, Sindhudurg, Thane.

**Meliaceae**

<i>Aphanamixis polystachya</i> (Wall.) R. Parker	Bark	Dark green			In evergreen forests. Bombay, Pune, Sindhudurg.
<i>Azadirachta indica</i> A.Juss.	Bark	Brown			Planted. Common throughout the state along the roadsides and in gardens. Sometimes naturalized through self-propagation
<i>Chukrasia tabularis</i> A. Juss.	Leaves, Bark	Red, Brown			In evergreen forests. Sometimes found planted also. 'Konkan', Pune, Raigad, Sindhudurg.
<i>Soymida febrifuga</i> (Roxb.) A. Juss	Bark	Brown, Red			Common. In deciduous forests.
<i>Toona hexandra</i> M. Roem.	Flower, Seeds	Yellow			In moist deciduous forests. Dhule, Nanded, Pune, Raigad, Ratnagiri, Satara, Sindhudurg.

**Moraceae**

<i>Artocarpus heterophyllus</i> Lam.	Wood	Yellow	Morin	Singh and Bharati.2014	Commonly cultivated, but naturalised. Bombay, Nasik, Pune, Raigad, Ratnagiri, Satara, Sindhudurg, Thane. Common in forest areas. Sindhudurg.
<i>Artocarpus lacucha</i> Buch. -Ham. ex D. Don.	Flowers	Yellow			
<i>Ficus amplissima</i> Sm.	Bark	Light, Red			In forest areas, common.
<i>Ficus benghalensis</i> L.	Bark	Red, Brown			Along road sides in towns and villages also found in low land forests, common.
<i>Ficus racemosa</i> L.	Bark	Auxillary			Along streams and also along rocky hill-slopes, common.
<i>Ficus religiosa</i> L.	Bark	Green, Brown, Black			Forest outskirts, mostly near villages and usually planted near temples. Worshipped by Buddhists and Hindus
<i>Morus alba</i> L.	Leaves	Yellow	Morin	Singh and Bharati.2014	Planted in Kitchen gardens for lacidu lour. sweet edible sorosis. Bombay, Dhule, Kolhapur, Marathwada (Naik, op. cit.), Pune, Satara, Thane.
<i>Plecosperrum spinosum</i> Trécul.	Bark, Wood	Yellow			In low land forests, rare. Bombay.

**Musaceae**

<i>Musa × paradisiaca</i> L.	Stem, Flower	Black, Red			Amba, Borbet, Chandgad, Dindewadi, Here, Kolhapur, Radhanagari.
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**Myrsinaceae**

<i>Ardisia solanacea</i> Roxb.	Fruits	Yellow			Frequent. Bombay, Kolhapur, Pune, Ratnagiri, Sindhudurg.
<i>Psidium guajava</i> L.	Fruit	Black, brownish red	Guajanoic acid, carotenoids, lectins, leucocyanidin	Sutradhar et al. 2015	Cultivated in gardens
<i>Syzygium cumini</i> (L.)	Bark, Seeds	Black, Purple, Indigo.			In deciduous and semi-evergreen forests. Common throughout.

<i>Bougainvillea glabra</i> Choisy.	Flowers with ivory white bracts	Yellow	Quercetin- xyloside, Isorhamnetic.		Planted. Thane. Native of Brazil, widely cultivated in subtropics and tropics. Much profusely Flowersed climber as an ornamental in plains and also grown as dwarf pot plant. Grown in garden. Ahmednagar.
<i>Mirabilis jalapa</i> L.	Flowers	Pink Red			
<b>Oleaceae</b> <i>Jasminum sambac</i> (L.) Aiton <i>Nyctanthes arbor-tristis</i> L.	Corolla	Green, Yellow, Orange	Nyctanthin, carotenoids. Iridoid glycoside.	Sutradhar et al. 2015	Grown in gardens. Rare, wild and abundant in dry deciduous forests at Pench (Nagpur). Also found in Ahmednagar (cultivated), Nasik, Pune (cultivated), Yavatmal.
<b>Oxalidaceae</b> <i>Oxalis corniculata</i> L.	Leaves	Yellow, Orange, Red, Brown.			Occurring as weed in gardens and on wet soil of waste places. Common throughout
<b>Papaveraceae</b> <i>Papaver rhoeas</i> L. <i>Papaver somniferum</i> L.	Flowers Flowers	Grey, Red Purple			Usually under cultivation. Nagpur, Pune. It is widely cultivated and also grown in gardens for the poppy Seeds used as food and to produce an oil which is used for making medicines, candles and soaps. Pune.
<b>Phyllanthaceae</b> <i>Bridelia stipularis</i> (L.) Blume <i>Cleistanthus collinus</i> (Roxb.) Benth.	Fruit Bark, Leaves, Fruit	Black Black, Brown			Kolhapur, Raigad, Ratnagiri, Sindhudurg. Scarce. Bhandara, Chandrapur, Nagpur, Yavatmal.
<i>Phyllanthus emblica</i> L.	Fruit pulp	Green, Brown, Red	Flavonoids, kaempferol, ellagic acid and gallic acid	Sutradhar et al. 2015	Common.
<b>Piperaceae</b> <i>Piper betle</i> L.	Leaves	Black, Blue	Piperitol, piperbetol, eugenol, piperol	Sutradhar et al. 2015	Cultivated for its leaves. Latur, Osmanabad, Pune, Sangli, Thane.
<i>Rumex nepalensis</i> Spreng.	Root	Yellow green			Bhandara, Pune.
<b>Proteaceae</b> <i>Grevillea robusta</i> A.Cunn. ex R.Br.	Flowers	Yellow, Green			Introduced in gardens & planted along road.sides &parks. Ahmednagar, Dhule, Kolhapur, Satara, Sindhudurg.
<b>Rhamnaceae</b> <i>Ventilago denticulata</i> Willd. <i>Ventilago madraspatana</i> Gaertn.	Stem, root, bark Root, Bark	Red violet Chocklet	Ventilagin.	Gokhale et al. 2004.	Common in deciduous forests. Common in moist deciduous forests.

<i>Ziziphus jujuba</i> Mill.	Fruits	Pink Red	Carotene, Tannins.	Gokhale et al. 2004.	Bombay; Dhule & Jalgaon.
<b>Rhizophoraceae</b>					
<i>Bruguiera gymnorhiza</i> (L.) Savigny	Bark				Rare, along the estuaries. Ratnagiri, Sindhudurg.
<i>Ceriops tagal</i> (Perr.) C.B. Rob.	Bark	Red			Common along tidal swamps. Bombay (Cooke, op. cit.), Raigad, Ratnagiri, Sindhudurg, Thane.
<i>Rhizophora apiculata</i> Blume	Bark	Brown			Rare in mangrove forests. Ratnagiri, Sindhudurg.
<i>Rhizophora mucronata</i> Lam.	Bark	Chocklet			Common along mangrove forests. Raigad, Ratnagiri, Sindhudurg, Thane. Common along mangrove forests. Raigad, Ratnagiri, Sindhudurg, Thane.
<b>Rosaceae</b>					
<i>Prunus persica</i> (L.) Batsch.	Leaves	Green			Native of China. Cultivated in Satara
<i>Pyrus communis</i> L.	Leaves	Yellow			An ornamental plant, commonly planted in Mahabaleshwar, Satara
<i>Rubus niveus</i> Thunb.	Fruits	Purple to Blue			Restricted to high ghats. Satara.
<i>Gardenia jasminoides</i> J. Ellis	Fruits	Yellow			Native of China. Pune, Sindhudurg.
<i>Morinda citrifolia</i> L.	Root, Bark	Red, Yellow	Morindone.	Gokhale et al. 2004.	Usually cultivated, grows as an escape. Akola, Bombay, Jalgaon, Nagpur, Pune, Ratnagiri, Thane
<i>Morinda pubescens</i> Sm.	Root, Stem, Bark	Yellow, Red	Morindone.		Common throughout
<i>Rubia cordifolia</i> L.	Stem, Root	Reddish Brown, Brick red.	Manjistin, Purpurin	Sutradhar et al. 2015	Frequent in shady places in deciduous forests. Ahmednagar, Kolhapur, Nasik, Pune, Ratnagiri, Satara, Sindhudurg, Thane.
<b>Rubiaceae</b>					
<i>Hymenodictyon orixense</i> (Roxb.) Mabb.	Leaves	Yellow			Infrequent in deciduous forests. Amravati, Chandrapur, Dhule, Nasik, Pune, Raigad, Satara, Thane.
<b>Rutaceae</b>					
<i>Chloroxylon swietenia</i> DC.	Bark	Yellow			Occasional in dry deciduous forests. Ahmednagar, Chandrapur, Nagpur, Nanded, Pune, Raigad, Yavatmal.
<i>Citrus medica</i> L.	Bark	Black, Blue	Citronetin	Singh and Bharati. 2014	Commonly cultivated probably for its rind.
<i>Toddalia asiatica</i> (L.) Lam.	Roots	Yellow	Toddaline.	Siva R, 2007	Kolhapur, Pune, Satara, Sindhudurg.
<b>Sapotaceae</b>					
<i>Madhuca longifolia</i> (J. Koenig ex L.) J.F. Macbr.	Bark	Yellow, Ochre to grey, Red brown, Bright red.	Myricetin	Singh and Bharati. 2014	Occasional in moist forests. Thane.
<i>Manilkara hexandra</i> (Roxb.) Dubard	Bark	Red			Common in dry deciduous and moist deciduous forests. Ahmednagar, Bombay, Chandrapur, Jalgaon, Pune, Raigad, Thane-Economic.

<i>Mimusops elengi</i> L.	Bark	Brown, Grey	Myricetin	Singh and Bharati.2014	Found in semi evergreen forests. Bombay, Nasik, Osmanabad, Pune, Raigad, Ratnagiri, Yavatmal. Planted along roadsides and in gardens for its fragrant Flowers and edible fruits.
<b>Sapindaceae</b> <i>Dodonaea viscosa</i> Jacq.	Bark, Leaves	Yellow, Brown			Common in dry deciduous and scrub forests, also planted as a hedge plant
<b>Solanaceae</b> <i>Capsicum annuum</i> L.	Fruits	Yellow, Red	Capsanthin	Singh and Bharati.2014	A native of tropical America. Cultivated for its edible berries. Nagpur, Nasik, Pune.
<i>Nicotiana tabacum</i> L.	Leaves	Green			A striking garden plant and also important commercially as the source of tobacco. Cultivated in some parts of the region. Jalgaon, Kolhapur, Nasik, Osmanabad, Pune, Raigad, Satara, Thane.
<i>Santalum album</i> Lam	Wood	Red			Ahmednagar, Akola, Buldhana, Nasik, Pune, Ratnagiri, Raigad, Solapur, Thane, Yavatmal.
<i>Solanum anguivi</i> Lam.	Fruit	Black			Common in moist deciduous forests.
<i>Solanum nigrum</i> L.	Fruits	Black	Gallic acid, catechin, caffeic acid, epicatechin, rutin, and niringenin	Sutradhar et al. 2015	Common throughout as a weed in open situations.
<b>Symplocaceae</b> <i>Symplocos cochinchinensis</i> (Lour.) S. Moore	Bark	Yellow			Frequent in moist deciduous and semi. evergreen forests along higher ghats. Kolhapur, Pune, Raigad, Ratnagiri, Satara, Sindhudurg.
<i>Symplocos racemosa</i> Roxb.	Leaves	Yellow			Scattered in moist deciduous and semi. evergreen forests. Ahmednagar, Pune, Ratnagiri, Satara, Sindhudurg, Thane.
<b>Tamaricaceae</b> <i>Tamarix aphylla</i> (L.) H. Karst.	Bark, Flower	Auxillary			Bombay (Cultivated tree, on alluvial sandy soils), Marathwada.
<b>Verbenaceae</b> <i>Duranta repens</i> L.	Leaves, Seeds	Green, Orange			Common.
<b>Vitaceae</b> <i>Ampelocissus latifolia</i> (Roxb.) Planch. <i>Vitis vinifera</i> L.	Fresh roots Leaves	Black Yellow, green			Common throughout in dry deciduous forests. Kolhapur, Jaisingpur, Kondigre, Nimshirgaon, Tamadalage.
<b>Zingiberaceae</b> <i>Alpinia galanga</i> (L.) Willd.	Roots, Stalk	Yellow Brown	Galangin, dioxylavonol	Gokhale et al. 2004	Sindhudurg.
<i>Curcuma angustifolia</i> Roxb.	Tuber	Yellow			Rare. Pune.



<i>Curcuma aromatic</i> Salisb.	Dried rhizome	Yellow	Curcumin	Siva, 2007.	Mumbai, Satara, Sindhudurg. Cultivated for the turmeric obtained from the Rhizomes, but is doubtfully wild. Kolhapur, Nagpur, Osmanabad, Sindhudurg.
<i>Curcuma longa</i> L.	Dried Rhizome	Yellow			
<i>Curcuma zedoaria</i> (Christm.) Roscoe	Rhizome	Yellow	Curcumin, arabins and albuminoids	Sutradhar et al. 2015	Cultivated. Bombay, Chandrapur, Raigad, Satara.  Grown extensively in Ahmednagar, Nagpur, Osmanabad, Sindhudurg, Thane.
<i>Zingiber officinale</i> Roscoe.	Rhizome	Brown			

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