

Anacardiaceae of Uttarakhand, India with special emphasis on Diversity and Distribution

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ABSTRACT

Aim of the study was to assess the diversity and ground truthing of distribution of family Anacardiaceae in Uttarakhand. In past literature, no precise locality of different species of Anacardiaceae has been mentioned. In the present study, extensive survey was made in the different locations of the Uttarakhand to trace the diversity and distribution of different species of Anacardiaceae. Earlier 16 species from the Uttarakhand have been reported. However, in the present only 12 species belonging to 8 genera species were traced with their exact locations. Out of this, 5 species are present in the plain regions and 7 exist in hilly parts of state. Findings of the study will be of immense use for researchers, students, state forest department officials etc. for tracing locations of the different species of Anacardiaceae for carrying out future research and management work.

Keywords: Species diversity, Distribution, Conservation

INTRODUCTION

The Anacardiaceae consists of trees, shrubs, lianas, or rarely perennial herbs. The family has resin ducts which are allergenic in some taxa (Simpson, 2010). The Anacardiaceae has a wide distribution in tropical to temperate regions of the world. There are number of economic values such as fruit and seed tree species (*Mangifera indica*: Mango; *Anacardium occidentale*: Cashew; *Buchanania cochinchinensis*: Chironzi; *Pistacia vera*: Pista; *Pistacia integerrima*: Kakarshingi; *Spondias pinnata*: Amara), tanning yielding species (*Rhus punjabensis*: Tatri; *Semicarpus anacardium*: Bhilawa), ornamental cultivars (e.g., *Schinus* spp.) and various timber species.

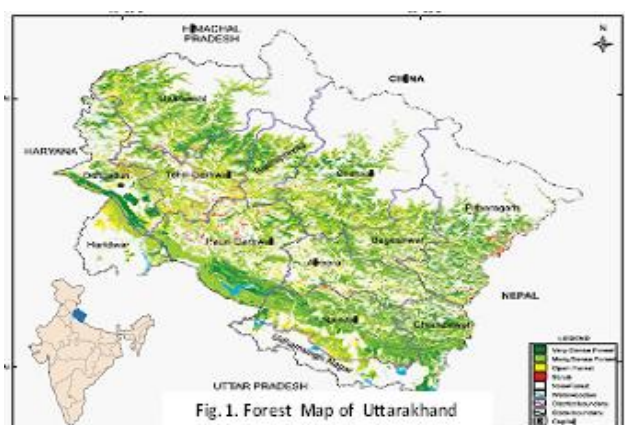
Most of the workers have placed Anacardiaceae under order Sapindales (Bentham and Hooker, 1862; Engler and Prantl, 1882; Hutchinson, 1973; Cronquist, 1988; Reveal, 2012; AGP-IV, 2016), however, Takhtajan (2009) and Thorne & Reveal (2007) preferred to keep it under order Rutales. Cronquist (1988) placed it with the Julianiaceae and Bueseraceae because

only these three families have biflavonyls and vertical intercellular secretory canals in their primary and secondary phloem.

Various authors have mentioned total number of species of family Anacardiaceae viz. 83 genera 860 species (The Plant List, 2013), 77 genera and 700 species (Chandra and Mukherjee, 2000), 82 genera and 950 species (Christenhusz and Byng, 2016), 82 genera and 950 species (Mabberley, 2017) etc. Family is usually found in the tropics of Africa, Asia and America with a small number of species occurring in subtropical and temperate areas.

Uttarakhand is one the states of India. The total geographical area of the state is 53,483 km² which accounts 1.69 per cent area of the country (FSI, 2019). The state has great physical and climatic diversity. Anacardiaceae is distributed throughout Himalayan hills and lower subtropical parts of the state. Exact location of species is not only useful to trace the distribution of species but also help in collection of material for study of systematic and in other plant related disciplines. Precise locations of different species of Anacardiaceae is not mentioned in the existing literatures. Therefore, in the present study efforts have been made to assess the diversity and distribution of members of family Anacardiaceae in Uttarakhand.

MATERIALS AND METHODS



The state of Uttarakhand is situated in the eastern most part of the Western Himalaya. It shares its borders with Himachal Pradesh on the West, Uttar Pradesh in South, Nepal in the East and China in North. It lies between the longitudes of 77°35'3" – 81°2'25" E

and the latitudes of 28°43'45" – 31°8'10" N. The state has recorded forest area of 38,000 km², which is 71% of its geographical area. The Reserve, Protected and Unclassified Forests are 69.86%, 26.01% and 4.13% respectively of the recorded forest area (Fig. 1). The forest cover in the state is 24,295 km² which is 45.43% of the total geographical area of the state. On the basis of density classes, 4,969 km² is under very dense forest, 12,884 km² under moderately dense forests and 6,442 km² under open forest (FSI, 2019).

Comprehensive review of literature was concerned Extensive field survey was carried out throughout the Uttarakhand state. Species occurring in the area were collected and Herbarium records were prepared with geo-coordinates following Jain and Rao (1977). The species were identified with the help of concerned floras (Kanjilal, 1928, Osmaston, 1921) and matched with DD Herbarium specimens. Plant nomenclature was updated as per latest available literature (Uniyal et al., 2007; Plant List, 2013).

RESULTS AND DISCUSSION

According Chandra and Mukherjee (2000), in India about 23 genera and 68 species are found in the tropical and subtropical parts of country. Karthikeyan et al. (2009) mentioned about 19 genera and 67 species. In Uttarakhand, Uniyal et al. (2007) listed 10 genera and 18 species and Pusalkar & Srivastava (2018) reported 9 genera and 16 species from the Uttarakhand. Members of family Anacardiaceae with their distribution with geo-coordinate and other details are given below:

1. *Buchanania cochinchinensis* (Lour.) Almeida

Synonym: *B. lanzan* Spreng.; *B. latifolia* Roxb.

Vernacular Name: Piyal, Kath Bhilawa

General Distribution in Uttarakhand: Occurs in Sal forest of Garhwal and Kumaon

Precise Surveyed sites: Surai Range, East Tarai Division, Udham Singh Nagar (Lat.: 28°53'27.5" N; Long.: 79°59'13.7" E; Alt. 206m); Com- 28, Lokot Beat, Surai Range, East Tarai Division, USN (Lat.: 28°50'27.7" N; Long.: 79°59'02.5" E; Alt.: 190m); Kilpura Beat, Surai Range, East Tarai Division, USN (Lat.: 28°50'59.8" N; Long.: 79°58'27.1"E; Alt.: 207m); Kansaro Range, Rajaji National Park, Haridwar (Lat.: 30°03'97.1" N; Long.: 78°01'55.5" E, Alt.: 504 m);

Joansol Beat, Timli Range, Kalsi Soil Conservation Division (Lat.: 30°33'.892"N; Long.: 77°71'80.6"E; Alt.: 372m).

2. *Cotinus coggygia* Scop.

Synonym: *Rhus cotinus* Linn.

Vernacular Name: Jal-Tunga, Tung, Tungoi

General Distribution in Uttarakhand: Occurs throughout between 1000m to 2000m.

Precise Surveyed sites: Kali Kumaon Range, Champawat (Lat.:29°29'59.3" N; Long.: 80°25'55.9"E; Alt. 821m); Loaghat Range, Champawat (Lat.: 29°27'36.7"N; Long.: 80°04'45.4"E; Alt. 1255m); Ghat Range, Pithoragarh (Lat.:29°29'37.1"N; Long.: 80°07'43.7"E; Alt.: 575m); Didihat Range, Pithoragarh Forest Division (Lat.: 29°41'41.7"N; Long.: 80°16'02.7"E; Alt. 1683m); Dharasu Range, Uttarkashi Forest Division (Lat.: 30° 37' 34.1"N; Long.: 78° 19' 40.2"E; Alt. 972m); Binsar Wildlife Sanctuary, Almora (Lat.: 29°41'45.0"N; Long.: 79°45'38.2"E; Alt. 2118 m); Kempty Range Mussoorie Forest Division (Lat.: 29°29'59.3"N; Long.: 78°00'44.0"E); Deogarh Range, Chakrata Forest Division (Lat.:30°92'97.03"N; Long.: 77°84'22.55"E); Devprayag, Narendra Nagar Forest Division (Lat.: 30°11'01.7"N; Long.: 78°37'27.3"E; Alt. 551m); Kankhara Range, Rudraprayag Forest Division (30°14'35.3"N; 78°52'15.2"E; Alt. 631m); Agastaumunia Range, Rudraprayag Forest Division (Lat.: 30°15'00.8"; Long.: 78°55'39.8"; Alt. 721m); South Jakholi Range, Rudraprayag Forest Division (Lat.:30°24'30.3.2"N; Long.:78°52'22.4"E; Alt.1706m); South Jakholi Range, Rudraprayag Forest Division (Lat.:30°22'36.8.N"; Long.: 78°53'31.4"E; Alt. 1183m); Dhanpur Range, Kedarnath Wildlife Sanctuary (Lat. 30°17'09.6."N; Long. 79°07'34.5"E; Alt. 802m); Paukhal Range, Tehri Forest Division (Lat. 30°24'49.8."N; Long.: 78°37'01.0"E; Alt. 894 m); Nand Prayag Range, Badrinath Forest Division (Lat. 30°13'07.3."N, 79°18'01.7"E; Alt. 913 m); Nailchami Dam Range, Tehri Dam –I Forest Division (Lat. 30°23'28.3."N; Long. 78°49'08.7"E; Alt. 2047 m).

3. *Lannea coromandelica* (Houtt.) Hook.f.

Synonym: *Odina wodier* Roxb., *L. grandis* Engl.

Vernacular Name: Jhinghan, Jhingini

General Distribution in Uttarakhand: Throughout in plain and low elevation in hills upto 1200m.

Precise Surveyed sites: Rameshwar, Kali Kumaon Range, Champawat (Lat.: 29°29'59.3" N; Long.:

080°25'55.9" E); Alt.: 821m); Sherki Village , Maldevata, Raipur Range, Mussoorie Forest Division (Lat.: 30°20'53.1" N; Long.: 78°08'11.8" E); Kali Kumaon Range, Champawat (Lat.: 29°31'13.18" N; Long.: 080°05'05.3" E; Alt.: 551m); Rameshwar Beat, Kali Kumaon Range, Champawat (Lat.: 29°30'48.4" N; Long.: 080°06'52.1" E; Alt.: 480m); Surai Block, Surai Range, East Tarai Division (Lat.: 28°48'29.1"N; Long.: 79°58'55.9" E; Alt.: 204m); Ghat Range, Pithoragarh (Lat.: 29°29'37.1" N; Long.: 80°07'43.7" E; Alt.: 575 m), Dabaka Block, Dehchauri Range, Ram Nagar Forest Division (Lat.: 29°22'08.8" N; Long.: 79°14'30.4" E; Alt.:468m); Bhandarpani Beat, Kota Range, Ram Nagar Forest Division (Lat.: 29°25'24.4" N; Long.: 79°13'00.3" E); Tilor Beat, Kaladungi Range, Ram Nagar Forest Division (Lat.: 29°19'08.3" N; Long.: 79°21'34.6" E; Alt.: 609m); Machaliovan, Nandhaur Wildlife Sanctuary (Lat.: 29°09'17.1" N; Long.: 79°42'33.0" E; Alt.: 369 m); Kathgodam, Nainital (Lat.: 29°17'42.5" N; Long.: 79°32'26.1" E; Alt.: 619 m); Kosi Range, Ram Nagar Forest Division (Lat.: 29°25'23.7" Long.: N 79°09'32.8" E ; Alt.: 396 m); Shukhi Dang, Champawat Forest Division (Lat.: 29°45'45.3" N; Long.: 80°16'47.8" E; Alt.: 1673m); Dunda Range, Uttarkashi Forest Division (Lat.: 30° 40'52.7"N; Long.: 78° 21'00.3"E; Alt.: 973m); Dharasu Range, Uttarkashi Forest Division (Lat.: 30° 37' 34.1"N; Long.: 78° 19' 40.2"E; Alt.: 972m); Khatima Range, East Tarai Forest Division (Lat.: 28°56'31.0" N; Long.: 80°01'06.9" E; 216m); Surai Range , East Tarai Division (Lat.: 28°50'41.7" N; Long.: 80°00'49.9" E; Alt.:190m); Kempty Range, Mussoorie Forest Division (Lat.: 29°29'59.3" N; Long.: 78°00'44.0" E); Raipur Range, Mussoorie Forest Division (Lat.: 30°24'32.8" N; Long.: 78°07'36.8" E); Deogarh Range, Chakrata Forest Division (Lat.: 30°92'97.03" N; Long.: 77°84'22.55"E); Kankhara Range, Rudraprayag Forest Division (Lat.: 30°14'35.3" N; Long.: 78°52'15.2" E; Alt.:631m); Agastaumunia Range; Rudraprayag Forest Division (Lat.: 30°15'00.8" N; Long.: 78°55'39.8" E; Alt.: 721m); Chamoli Range, Badrinath Forest Division (Lat.: 30°16'09.3"N; Long.: 79°09'50.0" E; Alt.: 822m); Devprayag , Narendra Nagar Forest Division (Lat.: 30°11'01.7" N; Long.: 78°37'27.3" E; Alt.:551 m); Dhanpur Range; Kedarnath Wildlife Sanctuary (Lat.: 30°17'09.6." N; Long.: 79°07'34.5" E; Alt.:802 m); Rudraprayag Range, Rudraprayag Forest Division (Lat.: 30°17'43.3" N; Lon.: 79°04'07.5" E; Alt.:781m); Bhilangana Range, Tehri Dam –I Forest Division (Lat.: 30°23'46.0" N; Long.: 78°43'18.6" E; Alt.:1168m); Patiyaldhar, Alaknanda Soil Conservation

(Lat.:30°24'17.8"N; Long.: 79°18'45.8" E; Alt. 1251m); Manora Range, Nainital Forest Division (Lat.: 29°20'05.8"N; Long.: 79°27'00.4" E; Alt.:1580m); Dogaon, Nainital Forest Division (Long.: 29°19'30.5" N; Long.: 79°29'32.9" E; Alt.:618m); Devta Range, Tons Forest Division (Lat.: 30°59'25.7" N; Long.: 78°00'54.5" E; Alt.:1165m);

4. *Mangifera indica* L.

Synonym: *M. austroyunnanensis* Hu.

Vernacular Name: Aam

General Distribution in Uttarakhand: Occurs wild throughout upto 1300m. Also planted abundantly upto 1000m.

Precise Surveyed sites: Kali Kumaon Range, Champawat (Lat.: 29°31'13.18" N; Long.: 080°05'05.3"E; Alt.:551m); Dehchauri Range, Ram Nagar Forest Division (N29°23'38.00"; E79°15'33.00"; 561m); Machaliovan, Nandhaur Wildlife Sanctuary (29°09'17.1" N; 79°42'33.0" E; Alt.: 369m); Kathgodam, Nainital (Lat.: 29°17'42.5" N; Long.: 79°32'26.1" E; Alt.: 619m); Manora Range, Nainital Forest Division (Lat.: 29°20'05.8" N; Long.: 79°27'00.4" E; Alt.: 1580m); Motichur Range, Rajaji National Park (Lat.: 30°02'13.0" N; Long.: 78°09'77.7" E; Alt.: 410m); Devprayg, Narendradev Forest Division (Lat.: 30°13'16" N; Long.: 78°40'44.0" E; Alt.: 530m); Devta Range, Tons Forest Division (Lat.: 30°59'39.4." N; Long.: 78°01'06.1" E; Alt.:1137m); Patiyaldhar, Alaknanda Soil Conservation (Lat.: 30°24'17.8" N; Long.: 79°18'45.8" E; Alt.: 1251m)

5. *Pistacia chinensis* subsp. *integerrima* (J. L. Stewart ex Brandis) Rech. f.

Synonym: *Pistacia integerrima* J. L. Stewart ex Brandis

Vernacular Name: Kakkar, Kakakrsinghi

General Distribution in Uttarakhand: Occurs throughout in hills between 900m to 1800m.

Precise Surveyed sites: Kali Kumaon Range, Champawat (Lat.: 29°30'48.4"N; Long.: 80°06'52.1"E; Alt. 480 m); Devta Range, Tons Forest Division (Lat.: 30°59'39.4."; Long.: 78°01'06.1"; Alt. 1137m); Molta Range, Chakrata Forest Division (Lat.: N30°58'36.0."; Long. 77°58'09.0"E; Alt. 1077 m); Saklana Range, Tehri Forest Division (Lat. N30°19'30.5"; Long.: 78°09'27.3"E; Alt. 559 m); Dunda Range, Uttarkashi Forest Division (Lat.: 30° 40' 52.7"N; Long. 78 ° 21' 00.3"E; Alt. 973m), Kapkot Range, Bageshwar Forest Division (Lat.:29° 54' 57.8"N; Long.:79° 51' 09.5"E; Alt. 997m); Bageshwar Range, Pithoragarh (Lat.:

29°47'57.4"N; Long.: 79°46'18.5"E; Alt. 1221m); Dogaon, Nainital Forest Division (Lat.: 29°19'30.5"; Long.: 79°29'32.9"; Alt. 618m); Khurpa Tal, Nainital Forest Division (Lat.:29°22'10.5"N; Long.: 79°25'23.8"E; Alt. 1675m); Kempty Range, Mussoorie Forest Division (Lat.:29°29'22.2"; Long.: 78°02'20.0"); Devprayg, Narendradev Forest Division (Lat.:30°11'01.7"N; Long.:78°37'27.3E"; Alt. 551m); Patiyaldhar, Alaknanda Soil Conservation (Lat.:30°24'17.8"N; Long.:79°18'45.8"; Alt.: 1251m); Kankhara Range, Rudraprayag Forest Division (Lat.:30°14'35.3."N; Long.:78°52'15.2"E; Alt. 631m); Agastaunia Range, Rudraprayag Forest Division (Lat.: 30°28'36.3."N; Long.: 79°04'57.7"E; Alt.: 980 m); Nand Prayag Range, Badrinath Forest Division (Lat.: 30°17'57.7."; Long.: 79°18'00.1"E; Alt. 837 m); South Jakholi Range, Rudraprayag Forest Division (Lat.: 30°22'36.8."N; 78°53'31.4"E; Alt. 1183 m); Rudraprayag Range, Rudraprayag Forest Division (Lat.: 30°17'43.3."N; Long.: 79°04'07.5"E; Alt. 781 m); Devta Range, Tons Forest Division (Lat.: 30°59'39.4."; 78°01'06.1"E; Alt. 1137 m); Nailchami Dam Range, Tehri Dam –I Forest Division (Lat.: 30°23'05.1."N, Long.: 78°46'29.3"E; Alt. 1586m).

6. *Rhus parviflora* Roxb.

Synonym: *Searsia parviflora* (Roxb.) F.A.Barkley

Vernacular Name: Ninas, Tungla

General Distribution in Uttarakhand: Occurs throughout hills between 900m to 2100m.

Precise Surveyed sites: Asedi Gaon-Com. 2B, Kali Kumaon Range, Champawat Forest Division (Lat.: 29°31'13.2"N; Long.: 80°05'05.5E" 562 M); Ghat Range, Pithoragarh Forest Division (Lat.: 29°29'37.1"N; Long.: 80°07'43.7"E; Alt. 575 M); Dharasu Range, Uttarkashi Forest Division (Lat.: 30° 37' 34.1"N; Long.: 78° 19' 40.2"E; Alt. 972m); Binsar Wildlife Sanctuary, Almora (Lat.: 29°41'45.0"; Long.: E79°45'38.2"E; Alt. 2118 M); Kankhara Range, Rudraprayag Forest Division (Lat.: 30°14'35.3."N; Long.: 78°52'15.2"E; Alt. 631 M); Dhanpur Range, Kedarnath Wildlife Sanctuary (Lat.: 30°17'09.6."; Long.: 79°07'34.5"E; Alt.: 802m); Paukhal Range, Tehri Forest Division (Lat.: 30°24'49.8.0" N; Long. 78°37'01.0"E; 894 m)

7. *Rhus chinensis* Mill.

Synonym: *Rhus semialata* Murray

General Distribution in Uttarakhand: Occurs throughout hills between 900m to 2100m

Precise Surveyed sites:

Kathiyan: Chakrata Forest Division (Lat.: 30°56'56.0" N; Long.: 77°05'42.0" E, Alt.: 1802m); Binsar Wildlife Sanctuary, Almora (Lat.: 29°41'44.10" N; Long.: 79°45'37.3" E; Alt. 2118m).

8. *Rhus punjabensis* Stewart

Vernacular Name: Almora, Tituri

General Distribution in Uttarakhand: Occurs in inner hills between 1800m to 2700m.

Precise Surveyed sites: Gobindghat en route to Valley of Flowers (Near Hellipad), Joshimath Forest Division; (Lat.:30°37'.21" N; Long.: 79°33'.42" E; Alt. 1828m); En route to Kathiyan, Chakrata Forest Division (Lat.: 30°46'19.0" N; Long.: 77°50'55.0" E).

9. *Toxicodendron wallichii* (Hook.f.) Kuntze

Synonym: *Rhus wallichiana* Hook f.

Vernacular Name: Arkhoi, Archoi, Konki

General Distribution in Uttarakhand: Occurs throughout the hills between 1000m to 2400m.

Precise Surveyed sites:

Mussoorie Forest Division (Lat.:30°46'19.0" N; Long.: 78°03'23.0" E); Kali Kumaon Range, Champawat Forest Division (Lat.: 29°17'14.2" N; Long.:80°05'2.3" E; Alt. 1725 m); Dharchula Range, Pithoragarh Forest Division (Lat.:29°8'33.4" N; Long.: 80°36'32.9" E; Alt. 2082m); En route to Kathiyan, Chakrata Forest Division (Lat.: 30° 53'52.0" N; Long.: 77° 53'3.0" E).

10. *Rhus scucedanea* Linn.

General Distribution in Uttarakhand: Occurs inner hills 1200m to 2100m.

Vernacular Name: Arkhol

Precise Surveyed sites: Taluka, Govind Pashu Vihar National Park and Wildlife Sanctuary (Lat.: 30°04'10.9" N; Long.: 78°30'58.6' E; Alt. 661m); Jarmola Range, Tons Forest Division (Lat.: 30°57'32.2" N; 78°05'18.9" E; Alt. 1767m).

11. *Spondia pinnata* (L.f.) Kurz.

Synonym: *Spondias mangifera* Wild.

Vernacular Name: Amara

General Distribution in Uttarakhand : Occurs in open dry miscellaneous forests. Also planted in homestead, road side etc.

Precise Surveyed sites: Narendra Nagar Forest Division (Lat.: 30°11'112" N; Long.: 78°17'572" E; Alt. 789m).

12. *Semicarpus anacardium* L.f. (Kurz.)

Vernacular Name: Bhilawa

General Distribution in Uttarakhand : Occurs throughout sub-himalayan tract and out ranges of hills upto 1300m.

Precise Surveyed sites: Surai Range, East Tarai Division (Lat.: 28°53'27.5" N; Long.: 79°59'13.7" E; Alt.: 206 M); Kota Range, Ram Nagar Forest Division (Lat.: 29°27'5.4"N; Long.: 79°12'34.1" E; Alt. 567 M); Champawat Forest Division (Lat.:29°9'5.0" N, Long.: 80°5'21.29" E, Alt. 1063 m); Kaladungi Range, Ram Nagar Forest Division (Lat.: 29°18'47.9" N; Long.: 79°19'39.9" E; Alt.: 495m).

In the present only 12 species belonging to 8 genera were traced with their exact locations. Out of this, 5 species are present in the plain regions and 7 species exists in hilly parts of state. Study is of immense use for researchers, students, state forest department officials etc. for tracing locations of the different species of Uttarakhand. *Choerospondias auriculata* D. Chandra is the synonyms of *Ailanthus altissima* (Mill.) Swingle and belongs to family Simarubiaceae. It was wrongly placed in Anacardiaceae. Species such as *Mangifera sylvatica* Roxb., *Pegia notida* Colebr., *Pistacia chinensis* Stocks, *Rhus sinuata* Thunb. and *Rhus himalaica* (Hook.f.) D. Chandra & Mukherjee could not be traced from forest area during the survey. Hence, further investigation should be under taken to confirm existence of these species in the state. Findings of the present study will not only be useful for different disciplines such as genetics, ecology, physiology, pathology etc. for tracing the exact locations of different species but also be used for making effective conservation and utilization strategies for future.

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