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RESEARCH ARTICLE

Study of medicinal and allelopathic effect of different weeds of Odisha, India

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Abstract

The term "allelopathy" refers to a biological process in which one organism produces biochemicals that impact another organism's growth, survival, and reproduction. Weeds pose a considerable risk to agricultural output because they prevent or stunt crop growth and development, resulting in substantial yield losses. Here, we examine the wide range of weeds in farming and other non-forested areas of Odisha's coastal districts. As many as 63 weed species, representing 31 families, were discovered here. The Asteraceae family has the most weed species (11), followed by the Euphorbiaceae family (9 species) and the Poaceae family (6 species). Amaranthaceae and Cucurbitaceae are also commonly found in the area of study. The data combing from the field with those from academic studies, this study improved our understanding of weeds. The paper also discusses the myriad ways natives have found to put weeds to good use. Many common weeds in the study area have long histories of use as a primary source of basic medical care. Most skin ailments, diarrhoea, jaundice, piles, and urinary problems treated with ethnomedicinal weeds are caused by parasites. Traditional cultures often used weeds in various ways, including food, animal feed, and medicine. Some plants have allelopathic impact in addition to their ethnomedical benefits. The authors of this paper present a complete and up-to-date inventory of the weed species detected in Odisha's coastal districts. It will be put to work protecting the region's unique plant and animal life. The allelopathic impacts on crops and the ethnobotanical uses of weeds have been uncovered through research.

Keywords

Allelopathic effect; coastal districts; ethnobotany; weeds; traditional medicine

Introduction

Odisha is located on the eastern coast of India, around 26°.00′ N latitude and 94°.20′ E longitude. There are 480 km of pristine coastline between the southern marshes of Ichhapuram and the northern coast of Suvarnarekha. Because of how often cyclones hit the coasts of Odisha, the districts of Kendrapara, Jagatsinghpur, Balasore, Bhadrak, and Jajpur are frequently featured in the media (1). In terms of weather, Odisha has a tropical monsoon climate. Odisha's location on the coastal strip means the ocean strongly impacts the state's climate. Extreme heat is typical in April and May due to the region's tropical environment. Summer highs average between 35 and 40°C, with lows averaging between 12 and 14°C. The southwest monsoon causes an average rainfall of 150 cm between July and September (2).

Allelopathy is the plant-to-plant interactions, whether direct or indirect, beneficial or deleterious by releasing certain biochemical compounds into the environment (3) (Fig. 1). Allelochemicals are the name given to these biochemicals (4). Over time, "Allelopathy" has been defined in various ways. Multiple definitions of allelopathy have been proposed. However, the concept has lately been broadened by the International Allelopathy Society (IAS) which states "any process involving secondary metabolites produced by plants, bacteria, viruses, and fungi that influence the growth and development of agricultural and biological systems" (IAS, 1996) (5).

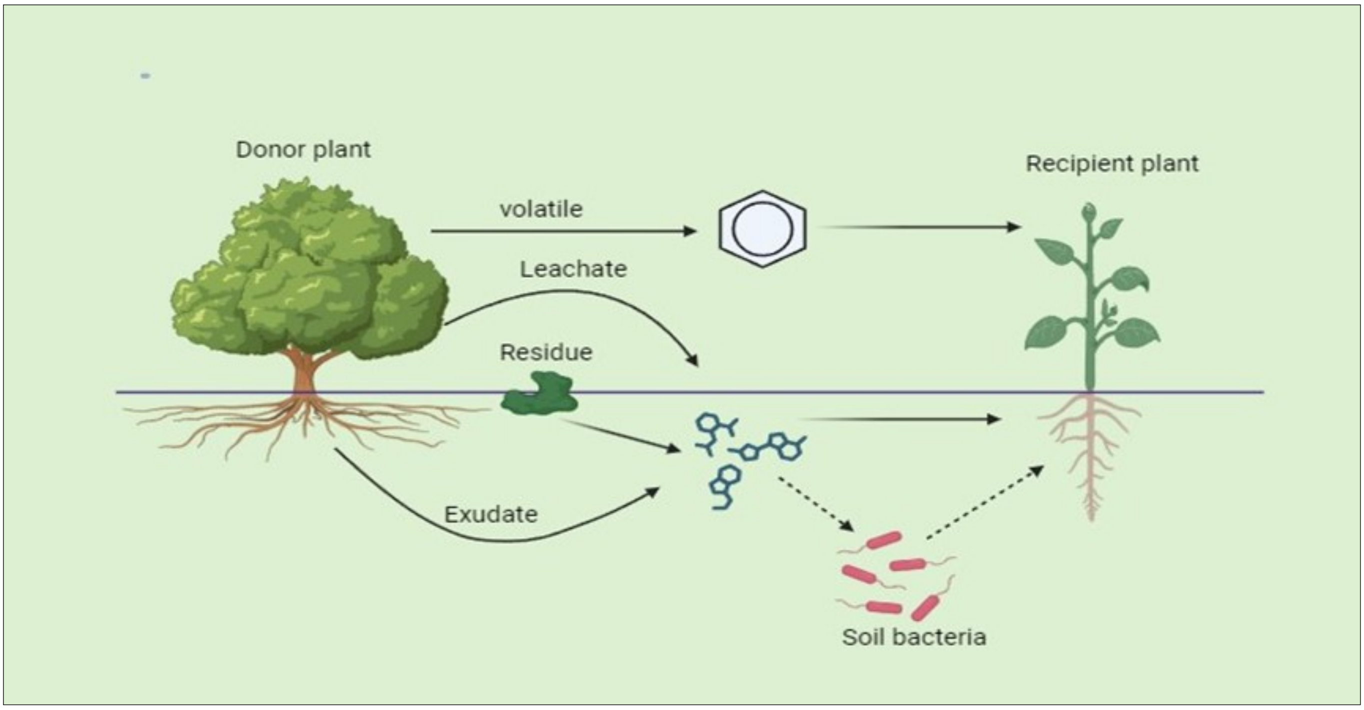


Fig. 1. Allelopathic effects on the neighbouring plant.

Leaching, root exudation, volatilization, residue decomposition, and other processes release allelochemicals from plant components in both natural and cultivated systems (6). Allelochemicals may prevent cell division or decrease shoot and root growth (7). Root and shoot length are shortened by allelochemicals such as phenolic substances (8). These allelochemicals presumably restrict growth by interfering with plant growth pathways. Released allelochemicals can inhibit shoot/root growth and nutrient uptake, or they might attack a plant's natural symbiotic relationship, causing damage to the plant's food supply (7). The presence of one or more allelochemicals is responsible for all allelopathic manifestations. The efficacy of allelopathy is largely determined by the allelochemicals involved and their characteristics. In grasslands and forests, scientists have identified and named a wide range of allelochemicals over the past few decades. These allelochemicals can generally be broken down into phenolics, terpenoids, and nitrogen-containing compounds (9).

Plants that are unwelcomed in a particular environment and spread where they are not wanted are called weeds. Weeds grow in the natural environment and eventually threaten crops since they are part of dynamic ecosystems (10). Unwanted plant species known as "weeds" increase in areas where they are not wanted after erupting from cultivated crops. Only 250 of the 8,000 species of weeds are considered important for agriculture on a global scale (11). Weeds decreasing the quality of fertile lands, and reducing the capacity of crop seeds to germinate due to phytotoxins or allelochemicals (12). Short seed dormancy, rapid germination rates, environmental adaptability, rapid seedling growth and reproduction capacity, short life cycles, self-compatibility, efficient and well-organized seed desperation methods, and the production of a wide range of allelochemicals are some of the characteristics that set weeds apart (10, 13) and make possible for weed species to thrive and spread in a range of natural areas. As a result, weeds spread (11, 14) and pose threat to local biodiversity (15, 16).

Climate change has the potential to affect weeds. In general, competitive interactions between weeds and crops change due to any direct or indirect effect of rising CO_2 levels or climatic change on the development or fitness of weeds and crops. In addition, it profoundly impacts the prevalence, distribution, population dynamics, and life cycle of most of the weeds in agriculture. The species composition of weeds and their relative abundance within weed and crop communities is also influenced by atmospheric CO_2, rainfall, and temperature changes. Depending on the severity of climate change, farmers may need to adjust their agronomic methods, which might knock on weed development and spread. Weeds that rely on vegetative dispersal to carry seeds or pollen colonised new habitats more slowly than those that have efficient seed-dispersal systems (wind, water, and birds) due to the increased frequency of extreme events linked with climate change (17).

India, a nation with various Landforms, shows notable regional differences in climate, height and vegetation. To create long-term land use plans, the nation is divided into 60 agro eco-sub regions, each further into district-scale agro-ecological units (18). From the very start of agricultural production, weeds have been a significant obstacle to global agriculture, resulting in over 80% output loss when unchecked (19). The term "Weed" is frequently used negatively when discussing agricultural production; weeds have been a significant obstacle to global agriculture, decreasing crop yields and resulting in substantial economic losses (20). Due to their poisonous characteristics, weeds pose a threat to human and animal health, contaminate water resources, and disrupt and damage natural ecosystems (21). Growing weeds wastes many valuable resources, such as nutrients, water, sunlight, and labour, and takes them away from cultivated crops (22).

Materials and Methods

Study area

Odisha is located at 26°.00′ N latitude and 94°.20′ E longitude. The Bay of Bengal, Chhattisgarh, and Andhra Pradesh border it on the east, west, and south. The study area shown in Fig. 2 consists of Odisha's coastal districts (Balasore, Bhadrak, Kendrapara, Jagatsinghpur, Puri, Ganjam). Around 450 km make up its shoreline. Taking up about 4.87% of India's total land area, the coastline area runs from the border with West Bengal to the river Rushikulya in the south and the river Subarnarekha in the north (1).

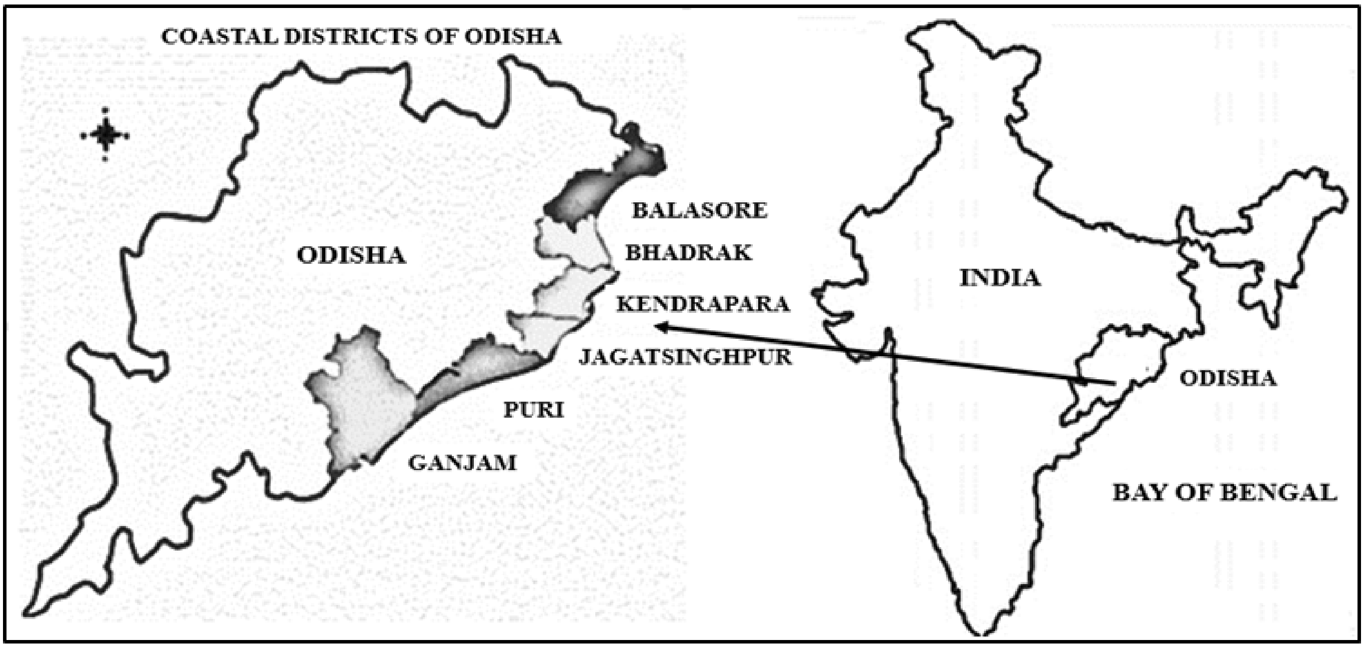


Fig. 2. The survey area consists of 6 coastal districts of Odisha.

Data collection

The research was conducted in and around Odisha's coastal areas (Balasore, Bhadrak, Kendrapara, Jagatsinghpur, Puri, and Ganjam) from May 2022 to July 2023. During the survey, data were collected from a variety of habitats of coastal districts of Odisha. A sufficient number of observed plant species were collected. Representative, mature, intact and undamaged specimens were collected, and the specimens were identified as soon as possible after collection. The filed labels affixed to the collected materials contain basic information about the collection site**.** Key informant surveys with farmers and locals were used to collect data regarding the medicinal properties of weeds and their allelopathic effect on other plants**.** To ascertain whether weed species were present in the study area, data from the response forms was evaluated. Standard herbarium procedures were used for routine field notes, laboratory descriptions, identification, and classification. To find locals with specialized knowledge of the usage of medicinal plants, door-to-door visits were conducted throughout the study. Local farmers, older adults, and knowledgeable people provided the majority of the information on weed species with the help of a self-prepared questionnaire (Fig. 3). Specific details regarding the plants were discovered through individual interviews and group discussions in the native tongue, which were then compared and cross-checked (23, 24). The field investigation included documented names, components and ethno-medical use of the plants (25).

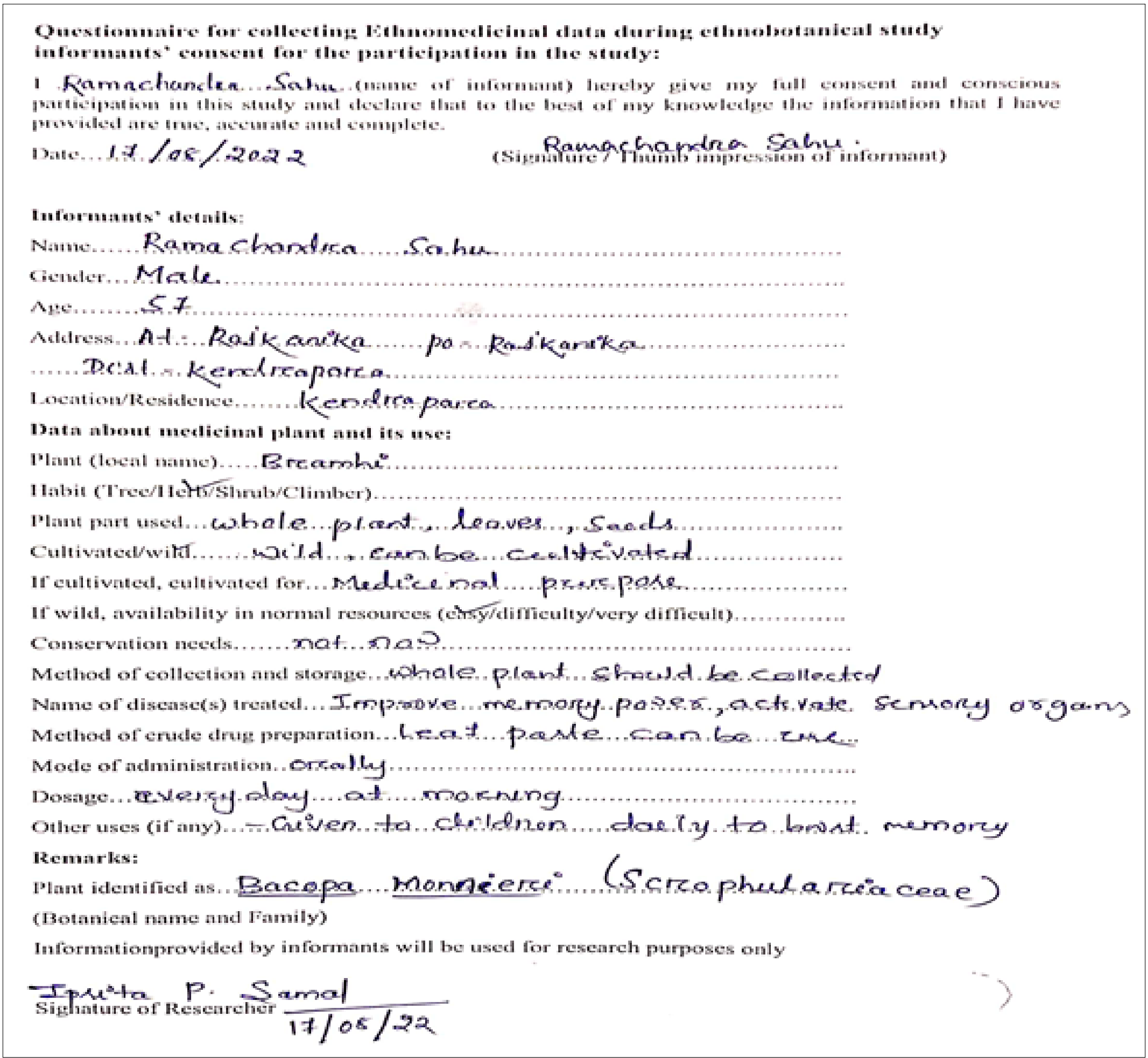
Plant identification and collection

The observed plant specimens were identified, collected, and preserved in the herbarium. Identification was done by local flora and books (26–31).

Results

The study revealed that 63 weed species from 31 families were collected from various coastal areas of Odisha. The weed species that were collected and identified are listed in Supplementary Table 1. The table represents the list of weeds by scientific name, family name, distribution, medicinal uses, and allelopathic effect (Supplementary Table 2).

Fig. 3 depicts the percentage of weeds with an allelopathic effect and those without. Fig. 4 shows the major dominated families studied regarding the number of species. Weeds were collected and identified after a thorough survey of the region. Preplanned questions were used in the conversation with the farmers. Review articles found in places like PubMed and Google Scholar provided secondary data on weeds' therapeutic properties and allelopathic effects. The originality of the survey can be seen in the collected weed species. The medical data and allelopathic effect reviewed here will aid future crop enhancement and drug discovery investigations.



Questionnaire for collecting Ethnomedicinal data during ethnobotanical study
informants' consent for the participation in the study:

I ...Ramachandra...Sahu...(name of informant) hereby give my full consent and conscious participation in this study and declare that to the best of my knowledge the information that I have provided are true, accurate and complete.

Date...17/05/2022 Ramachandra Sahu. (Signature / Thumb impression of informant)

Informants' details:
Name.....Rama chandra.....Sahu.....
Gender...Male...
Age.......57...
Address...At:...Rajkanika.....po:..Rajkanika...
......Dist.:..Kendrapara...
Location/Residence........Kendrapara...
Data about medicinal plant and its use:
Plant (local name).....Bramhi...
Habit (Tree/Herb/Shrub/Climber)...
Plant part used...whole...plant,..leaves..,.Seeds...
Cultivated/wild......wild..,..can be...cultivated...
If cultivated, cultivated for...Medicinal.....purpose...
If wild, availability in normal resources (easy/difficulty/very difficult)...
Conservation needs.......not...need...
Method of collection and storage...whole..plant...should.be.collected
Name of disease(s) treated...Improve...memory..power.,activate. sensory organs
Method of crude drug preparation...leaf...paste...can.be...use...
Mode of administration..orally...
Dosage...every.day....at....morning...
Other uses (if any)...-..Given..to..children.....daily..to..boost. memory
Remarks:
Plant identified as...Bacopa...Monnieri.....(Scrophulariaceae)
(Botanical name and Family)
Informationprovided by informants will be used for research purposes only

Ipsita P. Samal
Signature of Researcher 17/05/22

Fig. 3. Questionary for collecting data from local farmers and knowledgeable people.

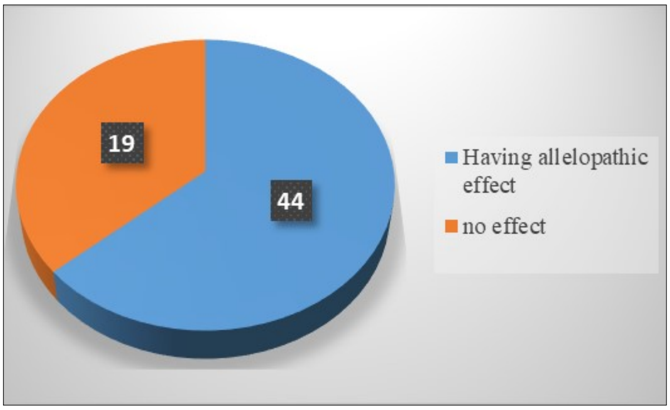


Fig. 4. Pie chart showing number of weeds having an allelopathic effect and no effect.

Discussion

Weed species diversity in non-forested open fields and crop fields served as the basis for this survey. This report extensively documents the variety of weeds in Odisha's coastal regions. Many plant species in the study region have significant ecological and economic significance as they serve as bio-resources for humans and other animals in the wild. On the other side, some species here are invasive and spread rapidly, and in a few years, weeds will outcompete the natural flora. From various literature reviews, 44 out of the 63 species surveyed were found to have an allelopathic influence on other plants (Fig. 4) (38, 41, 42). Therefore, it is assumed that these species cause problems. As with the rest of India, the coastal districts of Odisha are experiencing rapid economic and population growth, which may put unnecessary strain on the environment in the form of increased modern farming (including the use of fertilizers, irrigation, and chemical spray), housing, road construction, and overgrazing. The groups *Asteraceae* (nine), *Euphorbiaceae* (seven), and *Poaceae* (five) were determined to be the most numerous (6). The most dominant weed families in coastal areas are *Amaranthaceae* and *Cucurbitaceae,* each consisting of 4 weed species (Fig. 5) (55, 56, 62). Many of the weeds that can be found in the study region are consumed or used as fodder or as traditional medicines. According to a survey, 63 species were used to treat things like diabetes, gastrointestinal disorders, fever, gynaecological disorders, cardiovascular issues, skin ailments, rheumatism, and dental cavities.

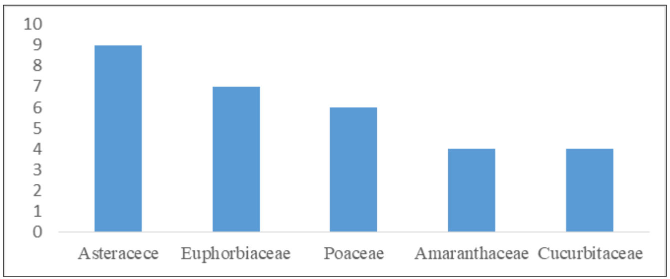


Fig. 5. Major dominating families studied with a number of species.

Prospects

Many environmental conditions affect allelopathic interactions, including soil type, moisture levels, and temperature. Due to its intricacy, allelopathy is difficult to implement reliably in agricultural or gardening contexts. Even helpful microbial species like mycorrhizal fungi can be negatively impacted by allelopathy. It might be challenging to strike a balance that fosters beneficial relationships and encourages the growth of desirable plants. Incorporating allelopathy into an overarching pest management approach that uses pesticides and other forms of control can be difficult. There is still a lot about allelopathy that scientists do not fully understand, such as how it works and which allelopathic substances different plants generate. This calls for constant study and testing.

Allelopathy can be used to manage weeds organically and lessen the heavy reliance of agriculture on synthetic herbicides. Natural herbicides like allelochemicals can be very useful for weed management because they are less harmful to the environment than synthetic herbicides while still effective against weeds. Understanding new modes of action can be gained from studying allelechemicals, which have been exploited as leads in synthesizing synthetic herbicides. In the future, we may be able to discover new medications derived from weeds, as weeds are already used to treat many ailments.

Conclusion

This study focused on several allelopathic species that generate significant allelochemicals with conventional and organic farming applications. Forty-four of the 63 species surveyed were found to have an allelopathic influence on other plants, and 58 were used to cure a variety of medical conditions, including diabetes, gastrointestinal problems, fever, gynaecological problems, cardiovascular illness, skin problems, rheumatism, and even dental caries. The allelopathic action of plants can be harnessed to create bioherbicides, while the therapeutic characteristics of plants can be studied further in the pursuit of new medicines. These investigations will reveal the allelopathic impacts on agricultural products and the diverse ethnobotanical values, which are necessary because the flora of Odisha's coastal districts has not been examined in depth.

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Authors contributions

IPS helped in writing, data collection, interpretation and arrangement of data. GM worked on the conceptualization of the experiment and critically revising the manuscript. SJ, SA, RB helped in writing and reviewing the manuscript. All authors read and approved the final version of the manuscript.

Compliance with ethical standards

Conflict of interest: Authors do not have any conflict of interests to declare.

Ethical issues: None.

Supplementary data

Supplementary Table 1. Weeds with scientific name, family name, distribution and allelopathic effect.

Supplementary Table 2. Weeds with scientific names, local uses, parts used for medicine preparation and medicinal uses.

References

1. Sahu SC, Pattnaik SK, Sahoo SL, Lenka SS, Dhal NK. Ethnobotanical study of medicinal plants in the coastal districts of Odisha. Current Bot. 2011;2(7):17-20.
2. Mahala A, Jayasingh SK, Kabat MR. Weather monitoring and prediction system: A case study on Odisha. In: International Conference on Communication and Computational Technologies. Singapore: Springer Nature. 2023;pp. 509-17. https://doi.org/10.1007/978-981-99-3485-0_40
3. Jali P, Samal IP, Jena S, Mahalik G. Morphological and biochemical responses of *Macrotyloma uniflorum* (Lam.) Verdc. to allelopathic effects of *Mikania micrantha* Kunth extracts. Heliyon. 2021;7(8). https://doi.org/10.1016/j.heliyon.2021.e07822
4. Singh PA, Chaudharv BR. Allelopathic potential of algae weed *Pithophora oedogonia* (Mont.) ittrock on the germination and seedling growth of *Oryza sativa* L. Bot Res Int. 2011;4(2):36-40.

5. Aci MM, Sidari R, Araniti F, Lupini A. Emerging trends in allelopathy: A genetic perspective for sustainable agriculture. Agronomy. 2022;12(9):2043. https://doi.org/10.3390/agronomy12092043

6. Chou CH. The role of allelopathy in agroecosystems: Studies from tropical Taiwan. In: Gliessman SR (eds) Agroecology. Ecol Stud. New York, NY: Springer New York. 1990;pp. 104-21. https://doi.org/10.1007/978-1-4612-3252-0_7

7. Gholami BA, Faravani M, Kashki MT. Allelopathic effects of aqueous extract from *Artemisia kopetdaghensis* and *Satureja hortensison* growth and seed germination of weeds. J Appl Environ Biol Sci. 2011;1(9):283-90.

8. Hussain MI, Reigosa MJ. Allelochemical stress inhibits growth, leaf water relations, PSII photochemistry, non-photochemical fluorescence quenching and heat energy dissipation in three C3 perennial species. J Exp Bot. 2011;62(13):4533-45. https://doi.org/10.1093/jxb/err161

9. Xu Y, Chen X, Ding L, Kong CH. Allelopathy and allelochemicals in grasslands and forests. Forests. 2023;14(3):562. https://doi.org/10.3390/f14030562

10. Baker HG. The evolution of weeds. Annual Review of Ecology and Systematics. 1974;5(1):1-24. https://doi.org/10.1146/annurev.es.05.110174.000245

11. Holm L, Pancho JV, Herberger JP, Plucknett DL. A geographical atlas of world weeds. John Wiley and Sons; 1979.

12. Algandaby MM, Salama M. Management of the noxious weed; *Medicago polymorpha* L. via allelopathy of some medicinal plants from Taif region, Saudi Arabia. Saudi J Biol Sci. 2018;25(7):1339-47. https://doi.org/10.1016/j.sjbs.2016.02.013

13. Koornneef M, Bentsink L, Hilhorst H. Seed dormancy and germination. Current Opinion in Plant Biol. 2002; 5(1): 33-36. https://doi.org/10.1199/tab.0119

14. Holm LG, Plucknett DL, Pancho JV, Herberger JP. The world's worst weeds. Distribution and biology. University Press of Hawaii; 1977.

15. Duke JA. *Ananas comosus* (L.) Merr. Handbook of Energy Crops; 1983.

16. Tilman D. Causes, consequences and ethics of biodiversity. Nature.2000;405(6783):208-11. https://doi.org/10.1038/35012217

17. Amare T. Review on impact of climate change on weed and their management. Am J Biol Environ Stat. 2016;2:21-27. https://doi.org/10.11648/j.ajbes.20160203.12

18. Gajbhiye KS, Mandal C. Agro-ecological zones, their soil resource and cropping systems. Status of Farm Mechanization in India, cropping systems, status of farm mechanization in India. 2000;1-32.

19. Cousens R, Mortimer M. Dynamics of weed populations. Cambridge University Press; 1995. https://doi.org/10.1017/CBO9780511608629

20. Martín-Forés I, Guerin GR, Lowe AJ. Weed abundance is positively correlated with native plant diversity in grasslands of southern Australia. PLoS One. 2017;12(6):e0178681. https://doi.org/10.1371/journal.pone.0178681

21. Travlos IS, Cheimona N, Roussis I, Bilalis DJ. Weed-species abundance and diversity indices in relation to tillage systems and fertilization. Front Environ Sci. 2018;6:11. https://doi.org/10.3389/fenvs.2018.00011

22. Ampong-Nyarko K, De Datta SK. Effects of light and nitrogen and their interaction on the dynamics of rice-weed competition. Weed Res. 1993;33(1):1-8. https://doi.org/10.1111/j.1365-3180.1993.tb01911.x

23. Cunningham AB. Applied ethnobotany: People, wild plant use and conservation. Routledge. 2014. https://doi.org/10.4324/9781849776073

24. Dalasingh BK, Parida S, Bhattacharyay D, Mahalik G. Diversified Hydrophytes in Different Aquatic Habitats of Puri District, Odisha, India. Adv Zool Bot. 2019;7(3):53-60. https://doi/10.13189/azb.2019.070303

25. Mallick SN, Maharana MR, Acharya BC. Weed flora of Rourkela and adjoining areas of Sundargarh district, Odisha, India. J Econ Taxon Bot. 2015;39(1):130-37.

26. Haines HH. The Botany of Bihar and Orissa, 6 parts, London (1921-25). Calcutta: Botanical Survey of India; 1921.

27. Gamble JS. Flora of Madras Presidency. Adlard & Son, London; 1935. https://doi.org/10.2307/4107113

28. Saxena HO, Brahmam M. The Flora of Orissa, Regional Research Laboratory (CSIR), Bhubaneswar, Orissa.

29. Mishra AM, Gautam V. Weed species identification in different crops using precision weed management: A review. In ISIC. 2021;180-94.

30. Zhang Y, Wang M, Zhao D, Liu C, Liu Z. Early weed identification based on deep learning: A review. Smart Agricultural Technology. 2023;3:100123. https://doi.org/10.1016/j.atech.2022.100123

31. Krishnan GH, Rajasenbagam T. A comprehensive survey for weed classification and detection in agriculture lands. J Inf Technol. 2021;3(4),281-89. https://doi.org/10.36548/jitdw.2021.4.004

32. Etna B. An assessment of the morphological variations on the pollen grains of *Abelmoschus esculentus* L. caused by chemical and biological pesticides (Doctoral dissertation, St Teresa's College (Autonomous), Ernakulam). 2022.

33. Andhare AA, Shinde RS. *Abutilon indicum* and *Prosopis juliflora* as a source of antibiotic and herbicidal agents. Natural Pharmaceuticals and Green Microbial Technology: Health Promotion and Disease Prevention. 2021;11. https://doi.org/10.1201/9781003003229-2

34. Motmainna M, Juraimi AS, Ahmad-Hamdani MS, Hasan M, Yeasmin S, Anwar MP, Islam AM. Allelopathic potential of tropical plants—A review. Agronomy. 2023;13(8):2063. https://doi.org/10.3390/agronomy13082063

35. Nyantika MM, Sudoi V, Okeyo-Owuor JB, Kisinyo P, Mwasi S. Effects of organic and inorganic fertilizers on weed diversity and population in tobacco (*Nicotiana tabacum* L.) farms in Migori county. J Crops, Livestock Pest Manag. 2023;1(2):1-19. https://orcid.org/0000-0002-7274-7125

36. Sidhu HK, Malik IA, Varun M, D'souza RJ. Allelopathic effect of leaf extracts of some common weeds on seed germination characteristics and growth of *Oryza sativa* L. In Biological Forum-An Intern J. 2023;15(1):475-81.

37. Khamare Y, Chen J, Marble SC. Allelopathy and its application as a weed management tool: A review. Front Plant Sci. 2022;13:1034649. https://doi.org/10.3389/fpls.2022.1034649

38. Hu SY, Gao H, Li J, Wang YH, Gao AG, Wen JH et al. The latitudinal and longitudinal allelopathic patterns of an invasive alligator weed (*Alternanthera philoxeroides*) in China. Plos one. 2023;18(1):e0280866. https://doi.org/10.1371/journal.pone.0280866

39. Dafaallah AB, Yousif MH, Abdelrhman AO. Allelopathic effects of pigweed (*Amaranthus viridis* L.) on seed germination and seedling growth of some leguminous crops. Int J Inn App Agr Res. 2019; 3(4),566-77. https://doi.org/10.29329/ijiaar.2019.217.3

40. Mushtaq W, Siddiqui MB, Hakeem KR. Allelopathy. Springer International Publishing; 2020. https://doi.org/10.1016/j.rhisph.2023.100667

41. Abdullah IK, Khan MI, Ibrahim M, Fawad M. Management studies of noxious weed (*Asphodelus tenuifolius* Cav.) in chickpea growing areas of district Karak, Khyber Pakhtunkhwa, Pakistan. Pak J Weed Sci Res. 2023;39(2):64-71. https://dx.doi.org/10.17582/journal.PJWSR/2023/29.2.64.71

42. Packialakshmi M, Divya MP, Baranidharan K, Parthiban KT, Geetha S, Ganesan KN, Ravi R. Floristic composition and structural analysis of flora in Nilgiris biosphere reserve, Western Ghats of Southern India. J Trop For Sci. 2023;35(3):270-82. https://doi.org/10.26525/jtfs2023.35.3.270

43. Thang PT, Vien NV, Anh LH, Xuan TD, Duong VX, Nhung NT et al. Assessment of allelopathic activity of *Arachis pintoi* Krapov. & WC Greg as a potential source of natural herbicide for paddy rice. Applied Sci. 2023;13(14):8268. https://doi.org/10.3390/app13148268

44. Mistica DJP, Magsino NJS, Tanjusay ZC, Paclibar GCB. Allelopathic effect of *Lantana camara* aqueous leaf extract on the seedling germination of *Zea mays* (maize). Asian J Agric. 2023;7(2).

45. Pathak J, Sahoo HB, Agrawal OP. Preliminary phytochemical standardization of Medik *Abelmoschus moschatus*. 2023;8(2):48-53. https://doi.org/10.31024/apj.2023.8.2.3

46. ArunRamnath R, Murugan S, Sanjay MR, Vinod A, Indran S, Elnaggar AY et al. Characterization of novel natural cellulosic fibres from *Abutilon indicum* for potential reinforcement in polymer composites. Polym Compos. 2023;44(1):340-55. https://doi.org/10.1080/1023666X.2015.1018737

47. Chekuri S, Vyshnava SS, Somisetti SL, Cheniya SBK, Gandu C, Anupalli RR. Isolation and anticancer activity of quercetin from *Acalypha indica* L. against breast cancer cell lines MCF-7 and MDA-MB-231. 3 Biotech. 2023;13(8):289. https://doi.org/10.1007/s13205-023-03705-w

48. Patel MA, Patel B, Pandya PA. Review on ethnomedicinal claims of *Acanthospermum Hispidum* DC. 2022;5(6),112-18. https://doi.org/10.47223/IRJAY.2022.5617

49. Verma KK, Sharma A, Raj H, Kumar B. A comprehensive review on traditional uses, chemical compositions and pharmacology properties of *Achyranthes aspera* (Amaranthaceae). J Drug Deliv Ther. 2021;11(2-S):143-49. https://doi.org/10.22270/jddt.v11i2-S.4789

50. Kavitha B, Yasodamma N. Bioactives and pharmacology of *Aeschynomene aspera* L. and *Aeschynomene indica* L. Bioact Pharmacol Legumes. 2023;485-95. https://doi.org/10.1201/9781003304555-37

51. Kotta JC, Lestari AB, Candrasari DS, Hariono M. Medicinal effect, *in silico* bioactivity prediction and pharmaceutical formulation of *Ageratum conyzoides* L.: A review. Scientifica. 2020;1-12. https://doi.org/10.1155/2020/6420909

52. Hwong CS, Leong KH, Aziz AA, Junit SM, Noor SM, Kong KW. *Alternanthera sessilis*: Uncovering the nutritional and medicinal values of an edible weed. J Ethnopharmacol. 2022;115608. https://doi.org/10.1016/j.jep.2022.115608

53. Kumar A, Katiyar A, Gautam V, Singh R, Dubey A. A comprehensive review on anticancer properties of *Amaranthus viridis*. J Res Applied Sci Biotech. 2022;1(3):178-85. https://doi.org/10.55544/jrasb.1.3.23

54. Meeran MW, Sami A, Haider MZ, Umar M. Multivariate analysis for morphological traits of *Amaranthus viridis*. Bull Biol Allied Sci Res. 2023;2023(1):46-46. https://doi.org/10.54112/bbasr.v2023i1.46

55. Ekwealor KU, Echereme CB, Ofobeze TN, Okereke CN. Economic importance of weeds: A review. Asian Plant Res J. 2019;3(2):1-11. https://doi.org/10.1016/j.cropro.2018.01.007

56. Singh R, Upadhyay SK, Rani A, Kumar P, Sharma P, Sharma I et al. Ethnobotanical study of weed flora at district Ambala, Haryana, India: Comprehensive medicinal and pharmacological aspects of plant resources. International Journal of Pharmaceutical Research. 2022. https://doi.org/10.31838/jipr/2020.SP1.223

57. Zahara M. Description of *Chromolaena odorata* LRM King and H Robinson as medicinal plant: A review. IOP Conf Series: Mater Sci Eng. 2022;506(1):012022. https://doi.org/10.1088/1757-899X/506/1/012022

58. Issa M, Chandel S, Singh HP, Batish DR, Kohli RK, Yadav SS, Kumari A. Appraisal of phytotoxic, cytotoxic and genotoxic potential of essential oil of a medicinal plant *Vitex negundo*. Ind Crops Prod. 2020;145:112083. https://doi.org/10.1016/j.indcrop.2019.112083

59. Steinhoff B. Quality of herbal medicinal products: State of the art of purity assessment. Phytomed.2019;60:153003.https://doi.org/10.1016/j.phymed.2019.153003

60. Datta SC. Weed plant act as vaccine against plant and COVID-19 diseases: Enriched agriculture health development socioeconomy sciences technology communication application. BR Nahata Smriti Sansthan Int J Phramac Sci Clinical Res. 2021;1(1). https://doi.org/10.22377/ijpscr.v1i1.10

61. Wangpan T, Tasar J, Taka T, Giba J, Tesia P, Tangjang S. Traditional use of plants as medicine and poison by Tagin and Galo tribe of Arunachal Pradesh. J App Pharm Sci. 2019;9(9):098-104. http://dx.doi.org/10.7324/JAPS.2019.90914

62. Salmerón-Manzano E, Garrido-Cardenas JA, Manzano-Agugliaro F. Worldwide research trends on medicinal plants. Int J Environ Res Pub He. 2020;17(10):3376. https://doi.org/10.3390/ijerph17103376

63. Mandal U, Mallick SK, Mahalik G. Ethnomedicinal plants used for the treatment and healing of skin diseases in Odisha, India: A review. Shodh Sanchar Bull. 2020;10:100-08.

64. Mintah SO, Asafo-Agyei T, Archer MA, Junior PAA, Boamah D, Kumadoh D et al. Medicinal plants for treatment of prevalent diseases. Pharmacogn Med Plants. 2019;1-19.

65. Anand U, Jacobo-Herrera N, Altemimi A, Lakhssassi N. A comprehensive review on medicinal plants as antimicrobial therapeutics: Potential avenues of biocompatible drug discovery. Metabolites. 2019;9(11):258. https://doi.org/10.3390/metabo9110258