Libyan Journal of Ecological & Environmental Sciences and Technology
(LJEEST)

LJEEST
ISSN: 2710-5237
www.srcest.org.ly/jou

DOI: https://doi.org/10.63359/1k6dx240

Parasitic Plant Flora Associated with Crops and Wild Vegetation in Abyan, South Yemen

Madleen Abdullah Obel[1] Rania F. M. Ali [2] Yaser Saeed Bahurmuz [3]

ARTICLE INFO

Vol. 7 No. 3 Dec., 2025

Pages (10- 17)

Article history:
Revised form 07 Sebtember 2025
Accepted 12 October 2025

Authors affiliation
Biology Dept. Faculty of Education-Abyan University. Yemen
Botany department, Faculty of science, Omar Al-Mukhtar University. Libya.
Science Dept, Faculty of Education Mukalla, Hadhramout University. Yemen.

Email: raniafarag2012m@gmail.com

Keywords:
Parasitic plants. ،Orobanchaceae. ، Chorotype ، Yemen

ABSTRACT

This study documents the diversity and host associations of parasitic and hemiparasitic plants in Abyan Governorate, South Yemen, focusing on both crops and wild vegetation. Conducted over January 2024 to December 2024, the study covered four districts: Zinjibar, Al-Wadheea, Lawdar, and Mudiyah. Field surveys, GPS mapping, and interviews with local farmers and agricultural staff were used to collect data.A total of 15 parasitic species were recorded from four families, with Orobanchaceae dominating (≈80%), followed by Loranthaceae. Root-parasitic species, particularly Striga hermonthica and Orobanche spp., heavily affected tomato, maize, millet, and watermelon, while other species mainly parasitized wild plants. Diversity indices (Shannon–Wiener and Simpson) revealed Lawdar and Mudiyah as hotspots of parasitic plant diversity, while Zinjibar had the lowest diversity. Species distribution was strongly influenced by host availability, habitat characteristics, and phytogeographical factors (Saharo-Sindian and Sudano-Zambezian elements). These findings indicate that parasitic plants, especially Orobanchaceae, pose significant threats to both agricultural productivity and natural vegetation in arid regions. Sustainable management strategies, including resistant crop varieties, crop rotation, and monitoring of parasitic species, are recommended to mitigate their impact.

النباتات الطفيلية المرتبطة بالمحاصيل والنباتات البرية في محافظة أبين جنوب اليمن

مادلين عبد الله عوبل[1]، رانيا ف. م. علي[2]، ياسر سعيد باهرمز[3]

توثق هذه الدراسة التنوع والعلاقات العائلية للنباتات الطفيلية ونصف الطفيلية في محافظة أبين، جنوب اليمن، مع التركيز على المحاصيل والنباتات البرية. أجريت الدراسة خلال الفترة من يناير 2024 إلى ديسمبر 2024، وشملت أربع مديريات: زنجبار، الوضيع، لودر، ومودية. تم جمع البيانات من خلال المسوحات الحقلية وتحديد المواقع بنظام GPS والمقابلات مع المزارعين والكوادر الزراعية. سُجل ما مجموعه 15 نوعاً طفلياً تابعاً لأربع فصائل نباتية، حيث سيطرت الفصيلةالهالوكية((Orobanchaceaeبنسبة تقارب 80%، تلتها الفصيلة اللورانثية (.(Loranthaceae)وقد تبيّن أن الأنواع الطفيلية الجذرية، خاصةً الحامول الأفريقي ((Striga hermonthicaوأنواع الهالوك ((.Orobanche spp)، كانت الأكثر تأثيراً على محاصيل الطماطم والذرة والدخن والبطيخ، في حين ارتبطت الأنواع الأخرى أساساً بالنباتات البرية. أظهرت مؤشرات التنوع (شانون–وينر وسيمبسون) أن مديريتي لودر ومودية تمثلان بؤراً ساخنة لتنوع النباتات الطفيلية، في حين سجلت زنجبار أدنى مستوى من التنوع. كما تأثرت أنماط توزيع الأنواع بشكل كبير بتوفر العوائل وخصائص الموائل والعوامل الجغرافية النباتية (العناصر الصحراوية–السندية والعناصر السودانية–الزامبيزيه). تشير النتائج إلى أن النباتات الطفيلية، وخصوصاً الفصيلة الهالوكيه، تمثل تهديداً كبيراً للإنتاج الزراعي والغطاء النباتي الطبيعي في المناطق الجافة. ويوصى باعتماد استراتيجيات إدارة مستدامة تشمل استخدام أصناف مقاومة من المحاصيل، والدورة الزراعية، والمراقبة المستمرة للأنواع الطفيلية للحد من آثارها.

INTRODUCTION

Parasitic plants represent one of the most serious constraints to agricultural productivity and biodiversity conservation in arid and semi-arid regions. Globally, more than 4,000 parasitic angiosperm species have been described, many of which belong to the families Orobanchaceae and Loranthaceae (Joel et al., 2013; Nickrent, 2020). These species employ specialized haustoria to extract water, nutrients, and assimilates from their hosts, often leading to severe yield reductions in staple crops such as sorghum, maize, millet, and tomato (Parker, 2021). Among them, Striga spp. (“witchweeds”) and Orobanche spp. (“broomrapes”) are considered major agricultural threats in Africa, the Middle East, and Asia due to their cryptic life cycles, prolific seed production, and persistence in soils (Rubiales & Fernández-Aparicio, 2020; Westwood, 2010).

Recent studies have emphasized the economic and ecological impact of parasitic weeds. For example, Striga hermonthica alone threatens food security for over 300 million people in sub-Saharan Africa (Rodenburg et al., 2021). Similarly, Orobanche ramosa and related species are highly destructive to solanaceous and cucurbitaceous crops, causing losses of up to 80% in tomato and eggplant under severe infestations (Habimana et al., 2022). Beyond agriculture, parasitic plants also play important ecological roles in natural ecosystems, where they influence plant community dynamics, nutrient cycling, and host diversity (Těšitel et al., 2021).

Furthermore, recent research has highlighted the diversity and ecological significance of parasitic angiosperms in forest ecosystems. A study in Odisha, India, documented a wide range of host plants for forest parasitic species, revealing their complex roles in ecosystem dynamics and emphasizing the importance of understanding host-parasite interactions for conservation and sustainable management (Mishra, Kumar, & Rath, 2025).

Such findings underscore that parasitic plants arenot only agricultural pests but also integral components of natural ecosystems ,with implications for both biodiversity and ecosystem health.

In the Arabian Peninsula, floristic surveys have recently highlighted the significance of parasitic flora. Al-Robai (2023) documented the dominance of Loranthaceae species in southwestern Saudi Arabia, while (Atif et al. 2024) reported that Orobanchaceae species are highly represented in southern Yemen, particularly within Saharo-Sindian and Sudano-Zambezian phytogeographical zones. Despite this, information on parasitic plant diversity in Abyan Governorate remains scarce, even though it represents a key agricultural hub with diverse agroecological systems.

The present study aims to fill this gap by documenting the parasitic plant flora associated with both crops and wild vegetation in Abyan, South Yemen. Specifically, it focuses on species composition, host associations, geographic distribution, and biodiversity indices. This research is intended to provide baseline data to support future ecological, agricultural, and management strategies in arid environments threatened by parasitic weeds.

MATERIALS AND METHODS

This study was conducted to document the diversity of parasitic and hemiparasitic plant species and their host associations in selected districts of Abyan Governorate, southeastern Yemen. The surveyed districts included Zinjibar, Al-Wadheea (Al-Wadi’), Lawdar, and Mudiyah. Abyan is located approximately 427 km southeast of the capital Sana’a and covers a total area of 16,943 km² (Nasser et al., 2022). The study area included agricultural lands in Abyan such as Al-Kawd and Amoudiyah, as well as farmlands in Al-Wadheea district, and extended to dry zones with sparse vegetation, semi-arid valleys, degraded lands, and low-altitude plateaus in both Mudiyah and Lawdar. These regionsrepresent a range of environmental habitats(fig 1.).

At each site, systematic transect walks (approximately 500 meters in length) were conducted to record the presence of parasitic and hemiparasitic plant species. For eachencountered specimen, data were collected on habitat type, elevation (measured using a portable altimeter), and GPS coordinates. Whenever possible, associated host plant species were identified in the field, and relevant observations were recorded.

In addition to field sampling, interviews were conducted with local farmers and staff at the Agricultural Research Center in Al-Kawd, Abyan Governorate, to document their observations and experiences with parasitic plants affecting their fields and crops. These interviews provided supplementary information on species occurrence, host range, and local knowledge of management practices.

Plant specimens were carefully collected, pressed, and dried using standard herbarium protocols. Each specimen was assigned a collection number, and relevant metadata were recorded. Plant identification was carried out using the following references: Ghazanfar (1994), Al-Khulaidi (2013), Parker & Riches (1993), and Wood (1997)their geographic distribution was verified using the Plants of the World Online database (POWO, 2024).

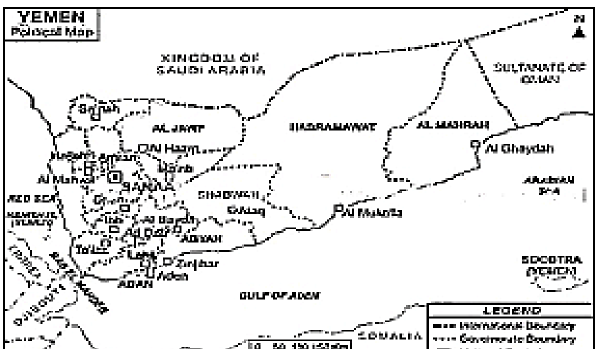


Fig (1). Map of Abyan governorate (FAO,2013)

Calculation of Biodiversity Indices

Diversity Indices Calculation

The Shannon–Wiener index (H′), Simpson's index (D), and Evenness (E) were calculated to assess the diversity of parasitic plant species in each study area. The Shannon–Wiener index was calculated as:

$H' = -\sum_{i=1}^{S} p_i \ln(p_i)$ where is the proportion of species and is the total number of species in the area.

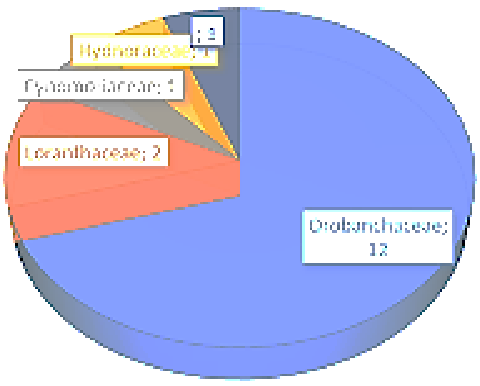
Simpson's index was calculated as:

$D = 1 - \sum_{i=1}^{S} p_i^2$ Evenness was calculated as:

$E = \frac{H'}{\ln(S)}$ (Spellerberg & Fedor, 2003)All calculations were performed usingMicrosoft Excel (2019) based on field survey data.

RESULTS AND DISCUSSION

A total of 15 parasitic plant species were recorded in the study area, belonging to 6 genera and 4 plant families. The majority of these species (12 species; 80%) are members of the family Orobanchaceae, while Loranthaceae is represented by 2 species (13.3%). The families Cynomoriaceae and Hydnoraceae were each represented by a single species (6.6%). Table (1).



Fig(2)."Dominant Host Plants of Parasitic Species in the Study Area"

1. Taxonomic Composition and Host Associations

The dominance of Orobanchaceae (81.25%) underscores the ecological significance of root-parasitic plants that are entirely dependent on their hosts due to the absence of chlorophyll.

Species such as Striga hermonthica and Striga gesnerioides were identified as generalists with broad host ranges, parasitizing economically important crops including sorghum, maize, millet, watermelon, sesame, cotton, and okra.

Cistanche phelypaea and Cistanche rosea were observed parasitizing members of the Chenopodiaceae family, while Hydnora abyssinica and Plicosepalus acaciae targeted woody hosts such as Acacia and Commiphora species.

Orobanche species, particularly O. ramosa and O. mutelii, were associated with tomato (Solanum lycopersicum) and watermelon (Citrullus lanatus), suggesting their preference for solanaceous and cucurbitaceous crops.

2. Host Spectrum and Economic Implications

Tomato emerged as one of the most susceptible crops, being parasitized by four Orobanche species: O. cernua, O. minor, O. mutelii, and O. ramosa—accounting for 26.7% of the total parasitic flora.

An equal proportion of species (26.7%) parasitized maize, millet, and sorghum, including Striga angustifolia, S. asiatica, S. aspera, and S. hermonthica.

Watermelon was found to be highly vulnerable, with five parasitic species (33.3%) including Orobanche spp. and Striga aspera.

Striga hermonthica demonstrated the widest host range, attacking eight different crops, thus posing a significant threat to food security in arid agricultural systems.

Peanut (Arachis hypogaea) was parasitized only by S. hermonthica, representing 6.7% of the recorded parasitic species.

Wild plants served as the primary hosts for five species (Cistanche phelypaea, C. rosea, Cynomorium coccineum, Hydnora abyssinica, Plicosepalus acaciae), fig(7) highlighting the role of native flora in supporting parasitic plant biodiversity.

3. Growth Forms:

Perennial species (6 species): Included Cistanche spp., Cynomorium coccineum, Hydnora abyssinica, and Plicosepalus spp.

Annual species (9 species): Comprised all species of Orobanche and Striga, which complete their life cycle within one growing Table (2).

4. Geographic and Phytogeographical Distribution:

The distribution of parasitic species was largely concentrated in arid and semi-arid regions, corresponding to the Saharo-Sindian (SA-SI) and Sudano-Zambezian (SU-ZA) phytogeographical regions.

Some species exhibited narrow endemism, such as Cistanche rosea, confined to specific ecological niches.

The spatial distribution patterns of parasitic plants are strongly influenced by the availability of suitable host plants, whether cultivated or wild, indicating their strong ecological dependency Table (4).

Holoparasitic plants dominate the parasitic flora in the studied regions, making up nearly 87% of the total species identified, while hemiparasitic species are relatively few. The analysis revealed that the districts of Lawdar and Mudiyah harbor the highest proportion of parasitic plant species recorded inthe study area, indicating their significance as hotspots of parasitic plant diversity. Al-Wadheea also showed a notable representation, reflecting a considerable level of species richness. In contrast, Zinjibar exhibited the lowest diversity, suggesting a relatively limited presence of parasitic species in that region fig 4).

Table (1):Showing parasitic plant species, their host plants, geographic distribution, and growth form

Scientific Name	Plant Family	Host Plant	Life Span	Chorotype
Cistanche phelypaea (L.) Cout.	Orobanchaceae	Parasitizes the roots of wild plants from the family Chenopodiaceae Perennial	Per	ME + SA-SI
Cistanche rosea Baker	Orobanchaceae	Parasitizes the roots of wild plants from the family Chenopodiaceae Perennial	Per	N.Endmic
Cynomorium coccineum	Cynomoriaceae	Parasitizes the roots of wild plants such as species from the family Zygophyllaceae	Per	SA-SI+SU-ZA
Hydnora abyssinica	Hydnoraceae	Parasitizes the roots of wild plants such as Acacia and Commiphora	Per	SA-SI+SU-ZA
Orobanche cernua Loefl.	Orobanchaceae	tomato, melons	An	SA-SI+AR+IR-IT
Orobanche minor Sm.	Orobanchaceae	tomato, melons	An	IT + ME + SU - ZA + SA - SI
Orobanche mutelii F.W.Schultz	Orobanchaceae	tomato, melons	An	ME+,SA+Si, SU+ZA
Orobanche ramosa L.	Orobanchaceae	tomato, melons	An	ME+, +, SA-SI+, Su-ZA,
Plicosepalus acaciae(Zucc.) Wiens & Polh	Loranthaceae	Parasitizes the roots of wild plants such as Acacia sp. and Commiphora sp ،Ficus sp	Per	SU – ZA
Plicosepalus curviflorus(Benth. ex Oliv.) Tieghem	Loranthaceae	Salvadora persica) Balanites aegyptiaca Commiphora sp.)،	Per	SU – ZA
Striga angustifolia (D.Don) C.J.Saldanha	Orobanchaceae	Sorghum, millet, maize	Ann	SA-SI+IT
Striga asiatica (L.) Kuntze	Orobanchaceae	Sorghum, millet, maize	Ann	SA-SI+SU-ZA
Striga aspera (Willd.) Benth.	Orobnchaceae	Sorghum, millet, maize ،Cantaloupe ،	Ann	SU+ZA , SA-SI
Striga gesnerioides (Willd.) Vatke	Orobanchaceae	Sorghum, millet, maize	Ann	SU-ZA
Striga hermonthica (Del.) Benth.	Orobanchaceae	Sorghum, millet, maize Watermelon ،Sesame Okra ،Arachis hypogaea annuum، .Cotton	Ann	Tropic

abbreviations: SA-SI = Saharo-Sindian; SU-ZA = Sudano-Zambezian; ; IT = Irano-Turanian; ME = Mediterranean; AR=Arabian Peninsula.IR=Iran ; Tropic = Tropical; N.END =Near Endemic to Yemen; Life span abbreviations: Per.: perennial; Ann.: annual.

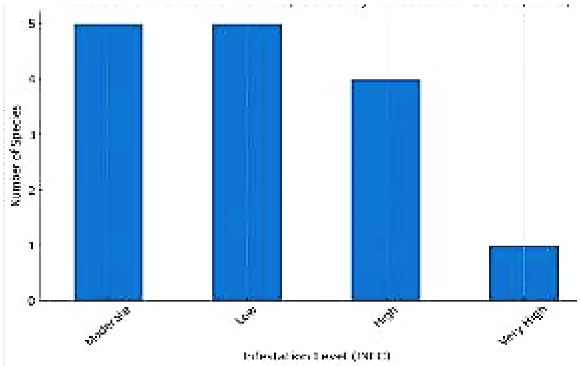
Table (2)showing the distribution, parasitic type, and infection frequency of parasitic plants in Abyan Governorate

Scientific Name	Plant Family	Parasitic Type	INFC	Estimated Distribution
Cistanche phelypaea (L.) Cout.	Orobanchaceae	Holop	Moderate	, Al-Wadheea , Lawdar, and Mudiyah.
Cistanche rosea Baker	Orobanchaceae	Holop	Low	Al-Wadheea
Cynomorium coccineum	Cynomoriaceae	Holop	Low	Mudiyah,Al-Wadheea),
Hydnora abyssinica	Hydnoraceae	Holop	Low	Mudiyah,Al-Wadheea lawder
Orobanche cernua Loefl.	Orobanchaceae	Holop	High	Mudiyah,Al-Wadheea ', lawder
Orobanche minor Sm.	Orobanchaceae	Holop	Moderate	
Orobanche mutelii F.W.Schultz	Orobanchaceae	Holop	Moderate	Lowder
Orobanche ramosa L.	Orobanchaceae	Holop	High	Mudiyah,Al-Wadheea
Plicosepalus acaciae(Zucc.) Wiens & Polh	Loranthaceae	Hmip	Low	Zinjibar, Al-Wadheea Lawdar, and Mudiyah.
Plicosepalus curviflorus(Benth. ex Oliv.) Tieghem	Loranthaceae	Hmip	Low	Lowder andMudiyah
Striga angustifolia (D.Don) C.J.Saldanha	Orobanchaceae	Holop	Moderate	Al-Wadheea , Lawdar, and Mudiyah.
Striga asiatica (L.) Kuntze	Orobanchaceae	Holop	High	Al-Wadheea , Lawdar, and Mudiyah.
Striga aspera (Willd.) Benth.	Orobnchaceae	Holop	Moderate	Lowder
Striga gesnerioides (Willd.) Vatke	Orobanchaceae	Holop	High	Lawdar, and Mudiyah.
Striga hermonthica (Del.) Benth.	Orobanchaceae	Holop	Very High	Zinjibar, Al-Wadheea Lawdar, and Mudiyah.

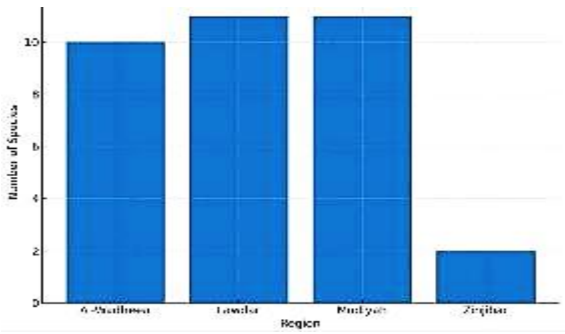
Table(3)The majority of the species identified are holoparasitic, with a smaller proportion being hemiparasitic

Parasitic Type	No.	Count Percentage (%)
Holoparasitic	13	86.67%
Hemiparasitic	2	13.33%

The analysis of the risk level of parasitic plants in the study areas revealed a clear variation in the extent of distribution among different species. Some species, such as Striga hermonthica, exhibited a very high distribution, indicating their significant potential impact on the host plant communities in the region. Other species with high distribution, including Orobanche cernua, Orobanche ramosa, Striga asiatica, and Striga gesnerioides, also highlight their ecological importance and potential pressure on host plants. In contrast, species such as Cistanche rosea, Cynomorium coccineum, Hydnora abyssinica, and Plicosepalus acaciae showed low distribution, suggesting a limited impact on the local ecosystem. Species with moderate distribution, including Cistanche phelypaea, Orobanche minor, Orobanche mutelii, Striga angustifolia, and Striga aspera, represent an intermediate level of influence, with potential effects on host plants under favorable environmental conditions. Overall, this analysis reflects the diversity of risk levels among parasitic plants in the area, contributing to a better understanding of their interactions with host species and the importance of managing them to maintain ecological balance. Fig (3).



Fig(3).Number of Parasitic Plant Species by Infestation Level (INFC)



Fig(4) .Distribution of Parasitic Plant Species by Region

Table (4) Chorological types spectrum of Parasitic plants

Chorotype	Number of Species Mono-Regional	Percentage (%)
N.END	1	6.6
SU-ZA	3	20
SUBTOTAL	4	26.6
	Bi-regional	
SA-SI+SU -ZA	4	26.6
ME + SA - SI	1	6.6
SA-SI+IT	1	6.6
SUBTOTAL	6	66.6
	Pluri-regional	
SA-SI+AR +IR-IT	1	6.6
ME+, +, SA-SI+, Su-ZA	2	13.3
IT + ME + SU - ZA + SA - SI	1	6.6
Tropic	1	6.6
SUBTOTAL	5	33.3
Total	15	100%

Biodiversity Indices

The Shannon–Wiener (H′) and Simpson (D) indices were calculated to assess the diversity of parasitic species across the four study areas (Zinjibar, Al-Wadheea, Lawdar, and Mudiyah). The results indicated that Lawdar and Mudiyah exhibited the highest diversity values (H′ = 2.40, D = 0.91), followed by Al-Wadheea (H′ =2.20, D = 0.89), while Zinjibar recorded the lowest diversity values (H′ = 0.69, D = 0.50). Evenness (E) values were high (E = 1.00) across all areas, indicating a relatively uniform distribution of species within each area. Figure (6) presents a comparison of the diversity indices among the study areas.

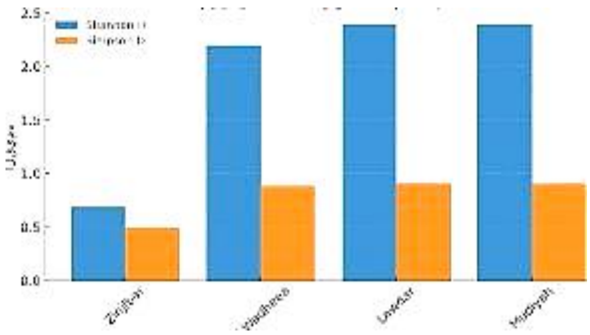


Fig (6) illustrating the comparison of diversity indices among the study sites, clearly indicating that Loder and Mudiyah exhibit the highest levels of plant diversity, while Zinjibar demonstrates the lowest.

DISCUSSION

The results of this study underscore the significant threat posed by parasitic species of the Orobanchaceae family, particularly the genera Striga and Orobanche, to agricultural productivity in arid regions such as southern Yemen. These findings are consistent with prior studies. For instance, Parker (2009) highlighted the devastating impact of Striga hermonthica on staple crops like sorghum, maize, and millet across Africa and Asia, while Joel et al. (2007) documented the serious agricultural challenges caused by Orobanche spp., especially due to their cryptic growth and difficulty of control post-attachment.

Additionally, Hydnora abyssinica and Cynomorium coccineum represent diverse parasitic strategies. The former targets woody shrubs, whereas the latter parasitizes a wide range of hosts in desert environments, reflecting remarkable ecological adaptability. Similarly, Plicosepalus acaciae (family Loranthaceae) parasitizes perennial trees such as Acacia and Commiphora, which may contribute to long-term degradation of native vegetation and biodiversity loss.

In contrast to the present findings, Al-Robai (2023) reported the dominance of Loranthaceae species in southwestern Yemen, particularly Phragmanthera austroarabica, which was the most ecologically prominent taxon based on its high Importance Value Index (IVI). Conversely, in the current study, Orobanchaceae was the dominant family, with Striga hermonthica emerging as the most impactful species on host plants.

Orobanche cernua and Loranthella deflersii were mainly found in arid, lowland habitats, while other species exhibited broader distribution across the study area. The findings also indicate that the Saharo-Sindian (SA–SI) and Sudano-Zambezian (SU–ZA) phytogeographical elements dominate the parasitic flora of Abyan.

This pattern supports regional studies. For example, Abbas et al. (2020) observed that bi-regional phytogeographical elements accounted for the highest percentage of plant species in Jabal Fayfa, Saudi Arabia (35.48%). Similarly, Aljedaani et al. (2023) found Saharo-Arabian/Sudanian elements to comprise 18.7% of desert flora near Jeddah. In Yemen's Lahj Governorate, (Atif et al. 2024) also found that parasitic and rare species were strongly associated with SA–SI and SU–ZA elements, indicating a shared ecological framework.

Moreover, Farah & Al-Abdulsalam (2014) reported a diverse range of parasitic angiosperms across Saudi Arabia, with host specificity and geographic distribution being especially pronounced in the southern regions. Their findings align with the present study, which records high diversity and concentration of parasitic species—particularly in the districts of Al-Wuday', Mudiyah, and Lawdar—reinforcing the ecological and biogeographical continuity between southern Yemen and adjacent parts of the Arabian Peninsula.

Finally, a study by Hatab et al. (2024) in the Saharo-Arabian zone of Egypt revealed floristic connections with the Sudano-Zambezian region, suggesting an ecological expansion and integration of phytogeographical zones across northeastern Africa and the Arabian Peninsula.

The diversity index values indicate that Loder and Mudiyah represent two major hotspots of parasitic plant diversity in Abyan Governorate, which may be attributed to the heterogeneity of habitats and the availability of a wide range of host species, including both cultivated crops and wild plants. In contrast, Zinjibar exhibited the lowest diversity, likely due to limited natural habitats or intensive agricultural activity, which reduces the opportunities for establishment and spread of parasitic species.

These findings are consistent with previous studies that employed Shannon and Simpson indices to assess plant diversity in arid and semi-arid regions (Magurran, 2004; Spellerberg & Fedor, 2003), which emphasized that higher diversity index values are generally associated with increased habitat complexity and host heterogeneity.

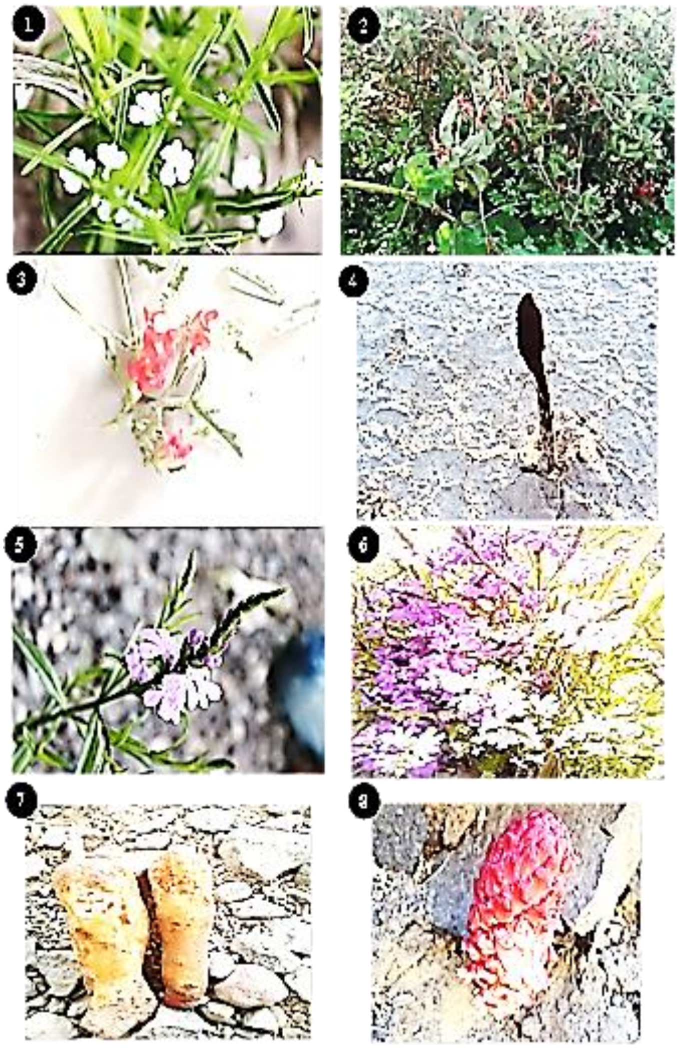


Fig. (7) 1-Striga angustifolia 2-Plicosepalus acaciae 3-Striga asiatica 4-Cynomorium coccineum 5-6-Striga hermonthica. 7-Hydnora abyssinica 8-Cistanche rosea

CONCLUSION

This study documented 16 parasitic plant species in Abyan Governorate, with the dominant family being Orobanchaceae. The findings confirm that parasitic plants—particularly those belonging to the Orobanchaceae family—pose a significant threat to both natural vegetation and economically important crops in arid environments. Accurate documentation and identification of these species are crucial for understanding parasitic dynamics and for developing effective and sustainable control strategies. These may include the use of resistant crop varieties, crop rotation with non-host species, and the implementation of integrated weed management approaches.

RECOMMENDATION

1.Accurate field survey using technology: It is necessary to adopt remote sensing technologies (UAVs/drones) and spectral indicators to accurately identify and map (GIS) the hotspots of parasitic plant infestations (such as *hollyhock or hyrax*) and their infestation levels in Abyan farms.

2. Develop a local geographic information system that integrates soil, climate, and history of parasitic infestations to provide risk maps and identify areas requiring urgent and targeted intervention.

3. Conduct an intensive field survey in Abyan and neighboring areas to identify and isolate local pathogens, fungi, and microorganisms that naturally parasitize the seeds or roots of the identified parasitic plants, with the aim of using them as biocontrol agents.

4.Recommending the incorporation of crops that act as traps or attractants for the parasite into the crop rotation (such as some types of clover or legumes), as they stimulate the parasite seeds to germinate without allowing them to attach, which leads to their “suicide” and thus reduces the parasite seed stock in the soil.

5.Enhancing agricultural awareness programs for farmers and local communities on the risks and spread of parasitic plants, with a focus on high-risk species such as *Striga hermonthica* and *Orobanche spp*

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