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INVESTIGATION OF ARBUSCULAR MYCORRHIZAL FUNGI FROM WEEDS PLANTS GROWN IN *TRITICUM AESTIVUM* FIELDS IN DISTRICT CHARSADDA, PAKISTAN

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ABSTRACT

Arbuscular mycorrhizal (AM) symbiosis is a reciprocal association between fungi and more than 80% of terrestrial plants, and the association play an important role in plant growth and development. Arbuscular mycorrhizal fungi (AMF) colonization have been explored in various crops such as wheat and maize, however, AMF colonization in weeds has been poorly investigated. In order to explore the AMF colonization in weeds grown in wheat fields, a study has been conducted in which we identified first the weeds species and then AMF spores and colonization in wheat (*Triticum aestivum* L.) fields at four localities viz Ghazgai, Palosa, Sardeheri and Mangha dargi in District Charsadda, Khyber Pakhtunkhwa, Pakistan. Fifteen species belonging to 12 families were found distributed as wheat's weeds in the study areas. The most important families in terms of species representation were Asteraceae (3 genera and 3 species) followed by *Fabaceae* (1 genus and 2 species) *Euphorbiaceae*, *Cryophyllaceae*, *Leguminaceae*, *Papaveraceae*, *Poaceae*, *Brassicaceae*, *Cannabinaceae*, *Chenopodiaceae*, *Convolvulaceae* and *Polygonaceae*. The increase of AMF root colonization was high in Mangha dargi (25-119 %) followed by Ghazgai (40-90%), Sardeheri (34-80%) and Palosa (24-80%). Moreover, Great AMF (TSD) per hundred gm-1 of soil abundance were recorded in Ghazgai (65-131 gm-1) followed by Mangha dargi (40-119 gm-1), Palosa (46-115 gm-1) and lowest was in Sardheri (40-107 gm-1). The present investigation highlights the AMF colonization, identification, classification and documentation of weeds in different localities of district Charsadda, Pakistan.

Keywords: Arbuscular mycorrhizal fungi, *Titicum aestivum*, Weeds, District Charsadda

INTRODUCTION

Arbuscular mycorrhiza (AM) is symbiotic association between Arbuscular mycorrhizal fungi (AMF) and plant roots, which provides and shared advantages to both partners in terms of nutrients. Approximately, 85-90% of the land plants can be colonized by AM fungi as the remaining are weeds (Jordan *et al*., 2000) which are not relying on AMF for nutrient uptake presumably due to deep and extensive rooting system (Wang and Qiu, 2006; Brundrett, 2009). Although AMF has been used for weeds control (Cameron, 2010; Jordan *et al*., 2000), but the exact mechanism how they interact with weeds is not known. There are reports that AMF can change the structure and nature of weeds. It was further documented that these fungi are not always detrimental to weeds plants but minimize the crop yield loss arising

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Phytochemical Assessment, *in vivo* Hepatoprotective and Nephroprotective Evaluation of *Aerva javanica* Crude Methanolic Extract

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Authors' contributions

This work was carried out in collaboration among all authors. Authors Wisal, JNA and WK designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors MFB, YK, MA, MII and IIJ managed the analyses of the study. Authors UM and FA managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

The current study was carried out to assess the effect of the crude methanolic extract of *Aerva javanica* for hepatoprotective and nephroprotective assessment along with their antioxidant potential against 2,2-azinobis(3-ethylenbenzthiazolin)-6sulfonic acid (ABTS) and 2,2diphenyle-1-picrylhyzyl

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Ethno Botanical Study of Wild Medicinal Plants of Peerano Valley, District Malakand, Khyber Pakhtoonkhwa, Pakistan

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Authors' contributions

This work was carried out in collaboration among all authors. Author AZ performed survey work. Authors AZ and SS carried out the research work. Authors YK and TY wrote the paper. All authors read and approved the final manuscript.

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ABSTRACT

The ethno medicinal study play a key role in the control of various disorders and provide a base for further study on scientific lines. The purpose of the survey was to observe the traditional medicinal plants and their uses for the various common disorders in Peerano Valley, district Malakand Khyber Pakhtoonkhwa, Pakistan. The study was carried out from March, 2015 to April, 2016 and collected the data from the local inhabitants through questionnaires, interviewed regarding the available medicinal plants. The total 35 plants are recorded as medicinal belonging to 31 families. The study showed that 20 plants species were herbs, 8 tress and 7 were shrubs. The common parts were leaf, fruit, and whole plant, which were used in greater numbers. The inhabitants used them for stomachache, fever, cough, healing of wounds, diuretic, antiseptics, hepatic disorders, diarrhea and digestive disorders. The survey aims to aware about valuable plants and to protect them from extinction. The old people are aware of the accurate knowledge of medicinal plants, it is needed to preserve this knowledge for the next generation.

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Review

Ethnomedicinal, pharmacological and phytochemical evaluation of *Xanthium strumarium* L.

Yaseen Khan[1*], Sulaiman Shah[2], Shakir Ullah[3]

Abstract— *Xanthium strumarium* is a common medicinal plant belong to family Asteraceae. It is broadly dispersed in North America and south Asia. It is a dominant plant specie in southern region of China and in northern areas of Pakistan. Usually, it's appear in spring, the plant parts i.e. leaves, root, stem and seed are used in traditional medicine for the treatment of various health problem such as 'leucoderma, epilepsy, salivation, malaria, rheumatism, tuberculosis, allergic rhinitis, sinitis, urticaria, rheumatoid arthritis, constipation, diarrhoea, leprosy, lumbago, pruritis, bacterial and fungal infections'. The plant contains various bioactive compounds including proteins, carbohydrates, phenols, tannins, flavonoids, saponins, sesquiterpene, lactones, glycoside and polysterols. This comprehensive study provide the description, phytochemical constituents and pharmacological activities of the *X. strumarium*. Moreover, the antibacterial, antitumor, antitussive, antifungal, anti-inflammatory, ant nociceptive, hypoglycemic, antimitotic, antioxidant, antitrypanosomal, insecticidal and herbicidal activities has been reviewed. The current review aims at pharmacological and phytochemical properties of *X. strumarium*. This review will serve as a base for further inquiry and exploitation of *X. strumarium*.

Keywords— Ethnomedicinal study, Medicinal constituent, Phytochemical property, *Xanthium strumarium*

Introducation

Asteraceae is a massive plant family, it is also called Compositae. This family of the flowering-plant order Asterales, with more than 1,620 genera and 23,600 species having herbs, shrubs, and trees dispersed throughout the world. *Xanthium strumarium* is a medicinal plant, generally called 'cocklebur or bur weed' commonly found as a weed in roadsides, rice fields, gounds, hedgerows throughout the tropical parts in Pakistan [1, 2]. The word "xanthium" is derived from an ancient greek word "xanthos" meaning yellow and "strumarium" means "cushion like swelling," with reference to the seed pods, which turn from green to yellow as they ripen (later they become deep yellow to brown) [3]. Nearby, this plant is recognized by numerous names such as Geshkay in Pakistan, Cang er zi in China and Woolgarie bur in North America.

X. strumarium is an annual plant, having 1 to 1.2 m height. The stems is stout, rough, green or brownish in color, frequently red-spotted and hairy. The leaves are alternate, dull green on the upper surface and paler below, with short bristly hairs on both surfaces [Fig. 1]. The plant is broad, and 3-5 lobed, 30-180 mm long by 30-180 mm wide on long petioles (stalks). *X. strumarium* flowers are yellowish green, located in spherical apical capitula, inconspicuous, in the leaf axils. The corolla is true, tubular; stamens free. The involucre upon fruiting turns into dense ligneous prickly pericarp. The fruit is called a bur (geshkai), its oval in shaped and it is about 1.3-3.5 mm long, brown in color [Fig. 2].

Each bur has two stout, curved or straight horns and is covered with hooked spines. The seed have capability to spread easily dispersed through animals as the fruits have hooked bristles and two strong hooked beaks [4]. Flowering time in Pakistan is from August to September. The flowering session of *X. strumarium* is from July to October, and the seeds ripen from August to October. The flowers are monoecious, and pollinated by insects. The plant is self-fertile. The fruits are reaped when ripe and dehydrated for use [5]. Usually herbivores eat young plants, various plants found to be toxic, and can be poisoned if the animals consume them in sufficient quantity. In Western literature, xanthium is not labelled as a medicinal plant, but it is recognized as a toxic plant especially for grazing animals [3]. It has been documented to cause huge destruction in cattle, horses, goats, pigs and sheep [6], and reduced weight gain in poultry [7]. The plant produces allergic contact dermatitis in susceptible humans. *X. strumarium* has many medicinal properties like cooling, laxative, fattening, anthelmintic, tonic, digestive, antipyretic, improves appetite, voice, complexion anodyne, Ant rheumatic, appetizer, diaphoretic, diuretic, emollient and sedative [8]. The plant is considered to be useful in treating long-standing cases of malaria, rheumatism, diseased kidneys, and tuberculosis. It is also used as an adulterant for *Datura stramonium*. The fruits of *X. strumarium* has the properties like anodyne, antibacterial, antifungal, antimalarial, Antirheumatic, antispasmodic, antitussive, cytotoxic, hypoglycemic and stomachic [9]. They are used internally in the treatment of allergic rhinitis, sinusitis, catarrh, rheumatism, rheumatoid arthritis, constipation, diarrhea, lumbago, leprosy and pruritus [10]. A decoction of the root has been used in the treatment of high fevers and to help a woman expel the afterbirth and a decoction of the seeds has

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ORIGINAL ARTICLE

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Arbuscular mycorrhizal fungi promote plant growth of *Leymus chinensis* (Trin.) Tzvelev by increasing the metabolomics activity under nitrogen addition

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Abstract

Nitrogen (N) deposition has been influencing ecological process, for instance N addition can affect plant growth and then alter plant community composition. Arbuscular mycorrhizal fungi (AMF) is one of the important soil microbiota, which play a key role in plant growth, especially under harsh environmental conditions. However, the effects of AMF on plant growth under N addition are still not well understood. To investigate the mechanism how AMF affect plant growth under N addition, a microcosm experiment was conducted with four N addition levels. The results showed that AMF increased aboveground biomass of *Leymus chinensis* by 21.5% and 4.8% under with and without N addition, respectively. AMF expressively improved the net photosynthetic rate by 44% and 29%, soluble protein by 65% and 40% under with and without N additions, respectively. The chlorophyll a, chlorophyll b, chlorophyll a + b and carotenoids content in leaves treated by AMF were greater than those without AMF treatment. AMF also significantly increased the metabolomics enzymes glutamate dehydrogenase, glutamine oxoglutarate aminotransferase, alanine transaminase and nitrogen reductase activity under N addition. However, the level of glutamine synthetase and soluble carbohydrates increased significantly under N addition in non-inoculated AMF plants. The result showed that the response of AMF to *L. chinensis* was stronger than nitrogen deposition, which indicates that AMF could increase plant growth by improving photosynthetic characters and affecting metabolomics enzymes of *L. chinensis* under N addition.

KEYWORDS

arbuscular mycorrhizal fungi, *Leymus chinensis*, metabolism, nitrogen addition, photosynthesis

1 | INTRODUCTION

Nitrogen (N) deposition is one significant driver for determining plant community structure in terrestrial ecosystems (Vellend et al., 2017). In the latter epoch, boosted productions of nitrogenous amalgams have increased atmospheric N deposition across the world (Erisman et al., 2013), with parallel concerns for the biodiversity and plant community structure. Latest studies have shown that N addition decidedly reduced plant diversity and species abundance (Stevens, Dise, Mountford, & Gowing, 2004). Although, some studies revealed that N addition affected plant growth, plant community construction, nutrient cycling and plant species diversity (Fenn et al., 1998).

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Ethno botanical study of medicinal plants of district Charsadda, Khyber Pakhtoonkhwa, Pakistan

Sulaiman Shah, Shariatullah, Tabassum Yaseen, Mia Fazli Basit, Yaseen Khan and Tao Zhang

Abstract
The ethnomedicinal study play a key role in the control of various disorders and provide a base for further study on scientific lines. This survey, observed traditionally medicinal plants uses their therapeutic uses for the various common ailments in District Charsadda KP. The regular 7 trips were arranged in each season from January, 2018 to April, 2019 and collect the data from the local inhabitants through questionnaires interviewed regarding the available medicinal plants. The total of 105 respondents (90 males, 15 females) were distributed. Family importance value (FIV), Relative Frequency of Citation (RFC) and conservative status help to find the most common used plants. The total 81 plants are recorded as medicinal belonging to 45 families and 75 genera. The life form showed that 48 species were herb, 24 Tress and 9 were a shrub, the common parts were Leaf, fruit, and whole plant which were used in greater numbers. The inhabitants used them for pain relief, fever, rheumatism, spasmodic, inflammation, respiratory, digestive, and cordial disorders. The conservation status shows that some species of the area is going to be extinct due to high biotic and abiotic factors. The study aims to bring awareness among the people, to save this precious knowledge and protect these plants, for the next generation.

Keywords: Medicinal plants, family importance value, family citation, conservative status, district Charsadda

1. Introduction
The ethno botanical study is as old as human civilization but the term ethno botany was first coined by an American botanist, John Hershberger in 1896. It is the science, which studies the relationship between a given society and its environment, particularly the plant world [1]. These studies have become increasingly valuable in the development of health care and conservation programs in different parts of the world [2] amongthe world population about 80% of people depend on medicinal plants use, which purely comes from medicinal plants [3]. More than 5000 plant species belonging to angiosperms are used worldwide for medicinal purposes [4]. Epidemiological studies have shown that many of the phytochemicals from medicinal plants possess anti-inflammatory, ant atherosclerotic, antitumor, ant mutagenic, ant carcinogenic, antibacterial, or antiviral activities, they are also associated with reduced risks of cancer, cardiovascular disease, diabetes and lower mortality rates of several human diseases [5]. Over 422,000 plant species worldwide possess the medicinal value of which 52,885 species are traded globally [6]. According to the International Union for Conservation of Nature and the World Wildlife Fund, there are between 50,000 and 80,000 flowering plant species used for medicinal purposes worldwide. Among these, about 15,000 species are threatened with extinction from overharvesting and habitat destruction [7], however, the use of these plants by locals is decreasing with time to time. During the last few years, the habitat of medicinal plants across this region has been under pressure due to urbanization and exploitation of raw materials by pharmaceutical companies [8]. The attention must be given to these plants before the lost forever. The present research aims to bring awareness among the people, therapeutic uses, control the diseases, and store the knowledge and medicinal uses of plants present in district Charsadda Khyber Pakhtonkhwa Pakistan. The study aimed were, to provide awareness among the people about the use of the plants for medicinal purposes and to record ethnomedicinal profile and conservation status

2. Material and Methods
2.1 Study area
District Charsadda is the district of KP, Pakistan. It is located in the west of Khyber Pakhtonkhwa and is bordered with Malakand District on the north, Peshawar and Nowshehra districts on the south, district Mardan on the east, and Mohmand Agency on the west. District

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Ethno botanical studies of Tatta Pani Valley, Kotli, Azad Jammu and Kashmir (AJK) Pakistan

Ayesha Azeem, Anwar Zeb, Shakeela Umer, Gohar Ali and Yaseen Khan

Abstract
A comprehensive ethno botanical survey was conducted in valley Tatta Pani, Kotli Azad Jammu and Kashmir, during 2015-2016. The area is floristically very rich with dense vegetation cover. Semi-structured interviews and questionnaires were used to ethno botanical data from local inhabitants of Tatta Pani. A total number of 70 species belonging to 33 families were recorded. Of these 70 species 50 (71.42%) are medicinally important, followed by feed 25 (35.71%), fuel 17 (24.28%), marketing 15 (21.42%), timber wood 7 (10%), fencing/hedge 6 (8.57) and ornamental 5 (7.1%). The most frequently used plant part was leaf 48 (70%) followed by stem 39 (67.1%), fruit 23 (32.85%), seeds 17 (24.28%) and flower 7 (7.1%). Habit wise classification of the plant species of the study area revealed 27 (38.57%) trees followed by 26 (37.14%) herbaceous, 12 (17.14%) shrubs and 8 (11.42%) climbers. The community of the area depends on natural resources for firewood, feed, housing, timber and medicine due to lack of basic facilities. This is the first-ever exploration of the study area which will assist new researcher in future especially in the field of ecology and ethno botany.

Keywords: Ethno botanical uses, taxonomic databases, conservation status tatta pani, azad kashmir

1. Introduction
Ethnobotany is the study of the dynamic association among environment, humans and plants. In broad terms, ethnobotany is how people give names, recognize plants, use and organize traditional knowledge about plants [1]. People living near vegetation depend on them or their products to meet their needs, such as food, livestock, housing, wood, fuel, household appliances, farm tools, furniture, protecting fields from erosion, medicines, ornamental, fences, and religious uses [2]. Ethnobotany plays an important role in understanding the dynamic relationships between biological diversity and social and cultural systems [3]. Unfortunately, very little attention has been paid to the ethnobotanical aspects of plants as only hakims are associated with medicinal plants [4]. The country has about 6,000 species of wild plants of which about 400 to 600 are considered to be medicinally important. Ethnobotanists aims to document, describe and clarify complex relationships between cultures and plants. Ethnobotanical studies investigate the structural relationships between society and environment, using socio-anthropological methods and hence can be used as a useful tool to quantify ecosystem services [5]. Azad Kashmir in Pakistan is considered a biodiversity hotspot because of the diverse habitats of springs, streams, rivers, lakes, grasslands, roads and steep slopes, arable land, and wasteland. Especially in hilly areas like Kotli, a very high variety of economically important plants are found [6]. The area of Tatta Pani is less studied, and the current study was carried out to explore the indigenous knowledge of local vegetation, to create awareness among native people for sustainable usage of economically significant flora, and collect information about relationships between people and plants in the area.

2. Materials and methods
2.1 Study area
Tatta Pani is a valley of tehsil & District Kotli located 25km north of the city Kotli. Tatta Pani is a mountainous area that gradually climbs to the high mountainous area of Pooch, is very near to the Line of control (LOC) between AJK and Indian- occupied Kashmir. Its average elevation is 682-730 meters above sea level. It is located between the longitudes 33°50'06.51" to 33°61'412.6N° and between the latitudes 73°56'47.82" to 73°89'043.0°E. The average yearly precipitation is 1146.08 mm. July and August receive extreme rainfall (236.38 and 218.82mm respectively).

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Research Article

Variation and distribution of freshwater algae (Chlorophyta) of District Mardan, Khyber Pakhtunkhwa, Pakistan

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Abstract

Freshwater algae (Chlorophyta) had been studied poorly in district Mardan, Pakistan, especially on the taxonomic basis. The taxonomic study was carried out during 2017-2018 to evaluate the seasonal variation and the distribution of freshwater algae, i.e., Chlorophyta in the different regions of the district Mardan, Pakistan. A total of 55 species belonging to 15 other genera were recorded from other localities of district Mardan. The most dominant genus was Spirogyra with 17 species (30.91%), followed by Tetraedron, Cosmarium, Closterium with 5 (9.09%) and 4 (7.3%) species respectively. Moreover, Cladophora, Zygnema, Mougeotia, Oedogonium and Stigeoclonium were found with 3 species (5.45%), while Chaetophora, Rhizoclonium and Microspora each with 2 species (3.64%). Furthermore, Closteriopsis, Ulothrix, and Uronema were 1 species each (1.8%). Among the studied regions, the Arabi Kallay stream showed the highest numbers of species followed by Umar Khan and Kalpani streams. In contrast, Baizai stream and Takht Bhai canal sites showed the lowest numbers of species. Besides, the fluctuation in temperature also varies the distribution of Chlorophyta species, i.e., in summer; the numbers of species were higher, while in winter the decreasing level of species was noticed. The optimum temperature in summer was 35-40ºC, while in winter ranged 22-27ºC. This study not only gives information about the Chlorophyta freshwater algae in district Mardan but also can provide a baseline in the algal distribution for future studies in district Mardan.

Keywords: Chlorophyta distribution; District Mardan; Freshwater Algae; Seasonal variation

Introduction

Geographical history

Mardan is the second-largest city after Peshawar in the Khyber Pakhtunkhwa province, Pakistan. The district lies Latitude 340 12' 7.02" North and Longitude 72° 03' 9.14" East. The total area of the district is (1632) 2 kilometres, with a population of 1.46 million, according to the 1998 census [1]. Mardan district broadly divided into two parts, northeastern hilly area and southwestern plain. The district is bounded with Bunir and Sawabi on the northeast and north site covered by Malakand agency, while on west and south by Charsadda and Nowshera can be seen respectively (Fig. 1) [2]. Among the seasons, summer is scorching and the temperature reaches 43.5ºC.

Algae have been found an exciting collection for research work due to their intuitive nature and distribution worldwide, which may be due to their ability to exist in different environmental conditions [3].

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Research Article

Arbuscular Mycorrhizal Fungi spores diversity and AMF infection in some medicinal plants of District Charsadda KPK

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Citation

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Abstract

An investigation has been made about the Arbuscular Mycorrhizal Fungi (AMF) spore population and root colonization in 20 medicinal plants selected and collected from district Charsadda at early winter and summer seasons during session 2014-2015. The spore density of AMF ranged from 80 spores per 100gm^{-1}, and root colonization from 20-80%. The lowest spore density was recorded in *Cestrum nocturnum, Ficus carica*, *Aquilaria agallocha* and the highest spore density was recorded in *Sedum dendroideum, Cannabis sativa, Triticum aestivum,* and *Mentha longifolia, Withania somnifera* while absent in *Brassica campestris*, *Amaranthus viridis.* The spore density of AMF and root colonization by these fungi varied from species to species, season to season, and also affected by host plant growth stages (vegetative-fruiting).AM fungi association was more observed at fruiting stage and low at vegetative and flowering phases of host. The most dominant species of AMF were *Glomus* followed by *Sclerocystis* and *Acaulospora* species.

Keywords: Arbuscular mycorrhizal fungi; Root infection; Spores density; Medicinal plants

Introduction

Mycorrhiza is a symbiotic relationship between a fungus and the roots of higher plants [1]. ''Mycorrhiza, is a mutualistic association between fungi and higher plants, has been documented extensively, but much less is known about the development of Arbuscular Mycorrhizal (AM) fungi'' [2]. AM Fungi is a diverse group of associations which are formed by the co-evolution between fungi and plants and benefits to both partners [3]. The term of mycorrhiza describes symbiotic associations between plants and fungi, these associations are assumed to play an important role in the land colonization by plants due to the ability

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Research Article

Investigating the floristic diversity indices of plant species in district Charsadda, Khyber Pakhtunkhwa, Pakistan

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Abstract

The floristic study carried out during 2017-2019 revealed that, district Charsadda comprised total of 146 plant species belonging to 58 families and 127 genera. The leading families were Asteraceae with 14 species (9.58%), Poaceae 12 species (8.21%), Solanaceae 8 species (5.47%) and Cucurbitaceae 7 species (4.79%). Apiaceae, Brassicaceae, Lamiaceae, Moraceae, Papilionaceae contribute by 5 species each (3.42%), Chenopodiaceae, Rosaceae having 4 species each (2.73%), Amaranthaceae, Euphorbiaceae, Malvaceae, Polygonaceae, Pteridaceae contributed by 3 species each (2.05%), Alliaceae, Arecaceae, Asclepiadaceae, Cyperaceae, Ebinaceae, Equisetaceae, Fabaceae, Genetaceae, Geraniaceae, Mimosaceae, Myrtaceae, Oleaceae, Pinaceae, Rhamnaceae, Rutaceae contributed by 2 species each (1.36%). The rest of the 27 families contributed by 1 species each (0.68%). The most dominant life form was therophytes having 66 species (45.20%), Microphanerophytes 22 species (15.06%), and Chaemophytes 18 species (12.32%). Hemicryptophyte 14 species (9.58%) Nanophanerophyes 10 species (6.84%), Geophytes 9 species (6.16%), Megaphanerophytes 4 species (2.75%) followed by Mesophanerophytes having 2 species (1.36%). Leaf size spectra of the flora showed that the most dominant leaf size class were microphyll having 54 species (36.98%), nanophyll 32 species (21.91%), mesophyll 29 species (19.86%), leptophylls 17 species (11.64%), megaphyll contributed by 8 species (5.47%) followed by macrophyll which represent 5 species (3.04%) and the one species is aphyllus. The dominant therophytic life form showed that the flora of the area is under severe anthropogenic activity. This study not only gives information about the flora of Charsadda but can provide a baseline for future studies and plantation of this area.

Keywords: Floristic diversity; Life forms; Leaf spectrum; District Charsadda

Introduction

A huge number of plant species are yet to be uncovered by the botanist. Therefore, the floristic report is the only source to get botanical information about the area and it may help in starting for detailed study [1]. The word floristic is derived from flora which means to list all types of plant species or plant taxa within specific geographical area [2]. To improve conservation stratagems for plants of any area, it is necessary to have a comprehensive floristic record of the area

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Research article

Metabolomics and its physiological regulation process reveal the salt-tolerant mechanism in *Glycine soja* seedling roots

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ABSTRACT

Wild soybean (*Glycine soja*) is an excellent germplasm resource and has strong resistance and wide adaptability to different environments. Hence, the physiology and metabolomics characteristics of wild soybean under different types of salt stress were determined to improve understanding of salt-tolerant mechanisms of wild soybean in the field. Two types of wild soybean seedlings were exposed to two different types of salt stress for 14 d. The photosynthesis of wild soybean seedling extracts were analyzed using metabolomics based on gas chromatography-mass spectrometry. The wild soybean root extracts used metabolomics to quantify the metabolic changes and ion contents. The assimilative function of photosynthesis in salt-tolerant wild soybean was less inhibited than in common wild soybean, and it regulated accumulation of toxic ions and maintained the accumulation of K^+ and Mg^{2+} to alleviate salt stress. Moreover, in resisting salt stress the salt-tolerant wild soybean has showed improved amino acid and carbohydrate and polyol metabolisms under neutral-salt stress and organic acid, amino acid and tricarboxylic acid metabolisms under alkali-salt stress. Our results provide valuable insights into the response of salt-tolerant wild soybean to two types of salt stress by linking stress-related physiological responses to changes in metabolites.

1. Introduction

Soybean (*Glycine max*) is widely cultivated and one of the most important crops in the world (Chen et al., 2013). However, cultivated soybean is generally sensitive to high-salt soils, and the salinity of farmland reduces soybean yields (Phang et al., 2008) and cultivated plants need improvement to make better utilization of limited resources. Wild soybean (*G. soja*) is the ancestor of cultivated soybean (Duanmu et al., 2015). It has more genetic diversity than cultivated soybean, and possesses a greater adaptability to various environmental stresses (Farag et al., 2012; Xue et al., 2014).

Salinization of soil has become a global environmental problem and affected crop yields worldwide (Xu et al., 2012; Jiang et al., 2013). There is evidence that many plants with tolerance to such abiotic stresses are potentially invasive, and there is an effort to develop salt-resistant crops and use them to restore saline land (Grierson et al., 2011). Therefore, development and utilization of salt-tolerant wild soybean may be very important (Tester and Davenport, 2003) and useful to broaden the genetic base of soybean, enhance its ability to resist adversity and ensure its continuous production.

The root system plays a very important role in plant salt tolerance (Li et al., 2017). Plants can adjust to saline conditions, mainly by reducing accumulation of inorganic ions to avoid harm from salinity or regulating their physiological metabolism to resist ions that have entered cells (Xue et al., 2011). Wild soybean responds to salt stress through a series of resistant mechanisms including reducing the transport of toxic ions to leaves by accumulating it in roots (Wei et al., 2008), accumulating higher levels of antioxidant enzymes to counteract large amounts of reactive oxygen species (Gill and Tuteja, 2010) and changes in secondary metabolism (Dona et al., 2016) – these are

Abbreviations: AS, Alkali-salt stress; BSTFA, Bis-(trimethylsilyl)trifluoroacetamide; *Car*, carotenoids; *Chl* a, chlorophyll a; *Chl* b, chlorophyll b; *Chl* t, total chlorophyll content; *Ci/Ca*, CO_2 concentration difference; CK, Control treatment; DW, dry weight; *E*, Transpiration rate; EI-MS, Electron Impact Ion Source-Mass Spectrometer; EP tubes, Eppendorf Micro Test Tubes; GC-MS, Gas Chromatography-Mass Spectrometer; g_s, Stomatal conductance; GS/GOGAT, Glutamine oxoglutarate aminotransferase/Glutamine synthetase; IQR, Interquartile Range; KEGG, Kyoto Encyclopedia of Genes and Genomes; NS, Neutral-salt stress; OPLS-DA, Orthogonal Projections to Latent Structures-Discriminant Analysis; PC1, the first principal component; PC2, the second principal component; PCA, principal component analysis; PLS-DA, Partial Least Squares Discriminant Analysis; p_N, Net photosynthetic rate; RGR, the relative growth rates; TCA, the tricarboxylic acid cycle; TMCS, Trimethyl Chlorosilane; W1, Common wild soybean; W2, Salt-tolerance wild soybean; *WUE*, Water-use efficiency

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Quantifying the Estimation and Abundance of Plant Diversity of Shigar Valley, Gilgit-Baltistan, Pakistan

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ABSTRACT

The studies were carried out from July 2017 to March 2018 in Shigar valley different Union Councils. The area lies between 7444 feet to 11694 feet from Above sea level in the Alpine zone including, Niali Nallah, Laxar Nallah, Nallah, Markuja union, Marapi union, Chorkah union, Gulapur. The study sites were randomly selected based on (1) herbs or shrubs land on the field periphery, (2) open grassland and arable land associated with sparse vegetation on rocks, stones, (3) forest land and open lands associated with sparse tree vegetation catchment of river and (4) forest land and arable land associated with dunes and rocky terrain. The quadrate method was used to record of vegetation from the selected study sites. A total of 59 plants species both medicinally and economically important were recorded at four study sites of CKNP and revealed that 30 herbs followed by 14 trees, 11 kinds of grass, and 4 shrubs respectively the dominant tree species recorded from all habitat types were *Juniper sexcelsa, Elaeagnus ambulate, Morus alba, Salix Wilhelmina* and *Populus nigra*. The most common herbs recorded were *Artimisa brevifolia, Tanacetum, Echinops echinatus, Capparis sponsia, Ephedra intermedia, Peganum harmala, Daucus carota, Medicago sativa, Typha lotifuliya* and *Astragalus rhizanthus*. The dominant shrubs were *Rosa webbina, Hippophae rhamnoides, Sophora Molis* and *Myricaria germanica*. The grasses recorded in the study area were *Poa Alpina, Setaria Viridis, Hetropogon contortus, Cynodon dactylon, Taraxacum oritinlis, Trifolium repens* and *Cascuta reflexa*. These plants are also used by local communities for fuelwood and timber. This study will be beneficial for locals and governments for the protection and conservation of this indigenous flora as well as fauna in the future.

Keywords: *Gilgit Baltistan; Shigar Valley; Ethnobotanical study; Floristic Diversity*

INTRODUCTION

Mountain landforms shield about one-quarter of the land surface and host 12% world's population [1]. These landforms have excessive influence on the climatic, biological, ethnic, cultural, and linguistic diversity of any region. In Pakistan, a substantial rural population is existing in the mountain ranges of the Karakorum, Himalaya, and Hindu Kush. The Karakorum ranges frame profound incised valleys in the extreme north of Pakistan, and afford several services to dwellers such as timber, fuel wood, fodder, herbal medicines, etc. Because, harsh climate, remoteness, and challenging access hamper progress in elementary services chiefly, education and health [2].

Therefore, mountain people are measured as the poorest and deprived population. Additionally, the residents of high mountain areas are more susceptible to several diseases owing to the unsympathetic mountains' environment with unpredicted variations in seasonal temperature, light intensity, ultraviolet (UV) radiation, and poor domestic hygiene [3]. The health services delivered by government and non-governmental organizations (NGOs) are next to nothing for the residents living in these distant areas. Accordingly, in such environments plant founded old-fashioned therapies are the primary health care cause to diminish numerous health syndromes. Baltistan is a conventional mountainous region of Northern Pakistan with an average altitude of 3555 m above sea level. Traditionally, it has often been mentioned as "Western Tibet" or "Little Tibet" [4,5].

The regions of the Baltistan region lie sporadically at acclivities and in the unfathomable mountains of Karakorum and Himalaya with the distinctive landscape, climate, flora, and fauna. However, remoteness, difficult access, and insufficient funding may be the

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