

**ETHNO-FLORISTIC STUDY, VEGETATION
STRUCTURE AND NUTRACEUTICAL ASPECT OF
SELECTED PLANTS OF DISTRICT BANNU, PAKISTAN**



**Ph.D THESIS
BY
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**DEPARTMENT OF BOTANY
UNIVERSITY OF PESHAWAR**

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ETHNO-FLORISTIC STUDY, VEGETATION STRUCTURE AND NUTRACEUTICAL ASPECT OF SELECTED PLANTS OF DISTRICT BANNU, PAKISTAN



*A Thesis Submitted to the Department of Botany, University of Peshawar,
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IN
BOTANY**

**BY
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CERTIFICATE OF APPROVAL

This thesis, entitled “Ethno-Floristic Study, Vegetation Structure and Nutraceutical Aspect of Selected Plants of District Bannu, Pakistan” submitted by Ihsan Ullah is hereby approved and recommended as partial fulfillment for the award of Degree of Doctor of Philosophy in Botany.

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DECLARATION

The materials contained within this thesis are my original work and have not been previously submitted to this or any other university.

HSAN ULLAH



DEDICATION

Sincerely dedicated to
My parents and teachers

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ABSTRACT

In the present ethno-floristic study, vegetation structure and nutraceutical aspect, 193 plant species of 155 genera belonging to 54 families of district Bannu were recorded. Out of 193 species, 146 species were dicotyledons and 47 species of monocotyledons. Poaceae was the leading family and having highest number of species (19.16%) while the lowest percentage was found in numbers of families having only one species. Seasonal variation showed that spring season was floristically rich having 156 species (41.37%) as compared to the other seasons. Therophytes (60.62%) were dominant plants in the area. Leaf size spectra showed that the plants with nanophyllous leaves were dominant (48.18%). The plants having simple leaves were dominant (76.16%). Spiny species were (9.32%) while non-spiny were (90.69%) in the area.

Ethnobotanical analysis showed that fifty eight species are used for different medicinal purposes. Which were being used conventionally for several daily life needs. Asteraceae was the leading family (7 spp.) while the rest of families have only one species. Out of 58 plants 14(12.73%) are used as fodder, 8(7.3%) as astringent, 6(5.45%) as diuretic, 6(5.45%) as urinary problems, 5(4.45%) as purgative, 5(4.45%) as cooling agents, 4(3.63%) as diarrhea, dysentery, inflammation, stomach problems, asthma, and tonic. While 3(2.73%) plants were being used for vomiting, furniture, laxative, kidney problems, rheumatism, skin diseases, expectorant, pain of joints and ornamental purposes. Two species (1.81%) used for antiseptic, epilepsy, carminative, vegetables, constipation and heart diseases and 1(0.90%) are used for hair loss, diabetes, night blindness and earache.

On the basis of soil variables and their macro and micro elemental composition, the area was divided into three sites. In each site, pH, electric conductivity (EC), organic matter, macro and micro elements were studied. Six different plants communities were established in each site. At site one 60 plant species of 29 families with species diversity (3.814) and species richness (54) were listed. At site two total 65 plant species of 26 families with species diversity (3.74) and species richness (51) were recorded. Similarly, at site three total 85 plant species of 28 families with species diversity (4.083) and species richness (72) were recorded. Density, frequency, cover and importance values (IV) of area increased with rain fall. It is evident from

principal component analysis that nitrogen (N) is correlated with Lead (Pb) while Magnesium (Mg) is negatively correlated with Sulphur (S).

Correlation of different soil variables with total density, frequency, cover and IV of the area was documented. Similarly, correlations of different soil variables with herbs density, frequency, cover and importance value (IV) during four seasons were also documented. In this area, palatable species were 80.83% and non-palatable species were 19.17%. Out of 193 plant species, 8 plants were selected for nutritional analysis. Most of them belongs to Poaceae. These species occur naturally in the area and used as fodder for livestock. Elemental composition of each plants, moisture contents, ash, fibers, fats, proteins and gross energy were also calculated. In the present study, the maximum amount of protein (8.06%) contents were in *Astragalus scorpiurus* while minimum amount in *Aristida adscensionis* (3.15%). Similarly, the higher gross energy was calculated in *Aristida adscensionis* (396.50Kcal/100g) while lowest in *Rostraria cristata* (356.45Kcal/100g).

CHAPTER – 1

INTRODUCTION

1.1 Study area

Bannu is one of the Southern district at distance (197.5 km) from the capital of Khyber Pakhtunkhwa, Pakistan. It is located in between 32.43° to 33.06° North latitude and from 70.22° to 70.57° East longitude and surrounded at North by Frontier Region of Bannu and adjacent to the North Waziristan agency, at East by District Karak, at South-East by Lakki Marwat and at South-West by South Waziristan Agency. The total area of Bannu is 1,227 Km² (Population Census report, 1999) (Fig. 01).

i. Demography

Bannuchi and Wazir are the main tribes of District Bannu. The other tribes of the area are Marwat, Dawar, Mehsood, Khattak, Bettani, Bangush and Hindus. Total population of the area is 677,346 (Population Census report, 1999).

ii. Rivers and streams

The general slope of the area is from North to the South-west side. There are two main rivers, one is called Kurram River and the other is Tochi River. Most of the area of District Bannu is irrigated from these two rivers. Kurram River enters at North-Western side to the district and passes through the area in South-East direction. Tochi River enters in south side of the district and flow out first to east and then to South-Eastern direction. The area, between these two rivers is known as Doab. Canal systems is used for irrigation of Doad. The well-known tributaries, which are joining to Kurram on its side are Tarkhobi Algad, Khalboi Khawara, Nallah Kashoo, Tangai Algad. Baran are the prominent Nallah of the district, which is halfway to between Touchi and Kurram rivers. A large number of small hill-streams also irrigate the district and join the Kurram River. The stream, which flows in this area has wide channels, filled the valley with deposits from clay to boulders.

iii. Agriculture

The irrigated Portion of the district Bannu through canal is about 45% of total area. While remaining portion is of rain fed. There is patchy type of vegetation.

iv. Climate

The climatic condition of District Bannu is cold in winter while warm in summer. The summer season starts in May, Which continues till mid of August. June is the hottest month. The climate, in July and August, is hot but moist. In June, the mean minimum and maximum temperature is 26° and 40°, respectively, while the climate in January, February and December are usually cold.

Table 1. Rainfall (mm) data during the 2012-2014.

Months	Rainfall (mm) in 2012-2013	Rainfall (mm) in 2013-2014
January	Nil	Nil
February	140 mm	37.4 mm
March	82.8 mm	61.6 mm
April	36.60 mm	58.0 mm
May	Nil	18.2 mm
June	93.4 mm	Nil
July	107.00 mm	106.2 mm
August	190.9 mm	114.0 mm
September	58.00 mm	41.8 mm
October	82.8 mm	Nil
November	12.4 mm	Nil
December	Nil	Nil

Agricultural Research Station Serai Naurang (Bannu), Khyber Pakhtunkhwa, Pakistan.

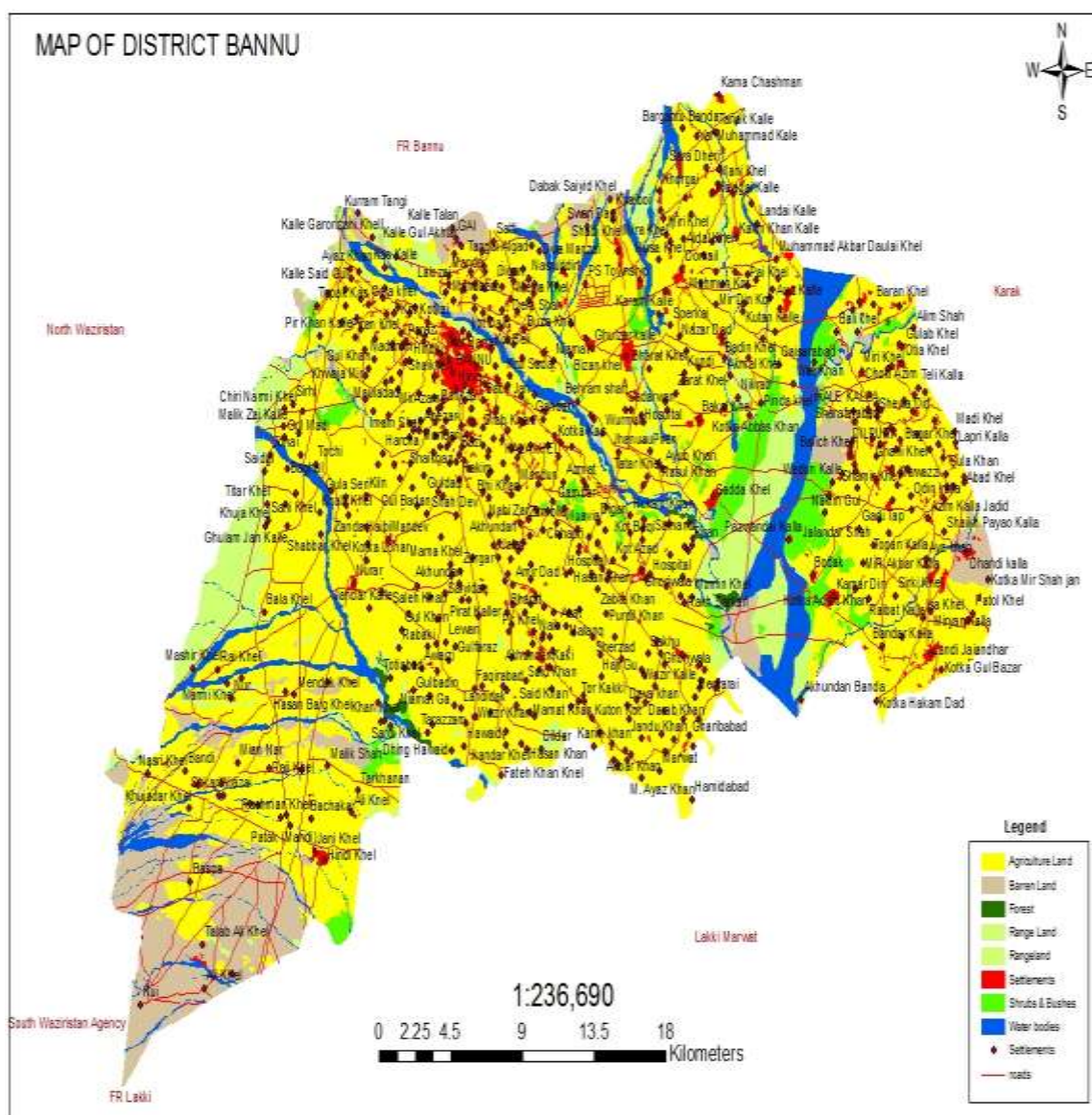


Fig 01: Map of District Bannu

1.2 Introduction to Ethnobotany

The term Ethnobotany was coined in 1895 by the U.S. Botanist (J. W. Harshberger, 1896). An Ethnobotany is the scientific study of people and plant relationships. An ethno-botanist tries to document, explain and clarify the relationships between people and plants for food, medicine, dye, construction, clothing, cosmetics, currency and a lot more (Deepak and Anshu, 2008). Common medicinal plants of Humzoni, their ethnobotany and indigenous knowledge for various purposes i.e. food, fodder, fuel, timber and agriculture purposes were documented by Rehman *et al.* (2013). Similarly, medicinal plants of Bannu were reported by Khan *et al.* (2013). The traditional uses of medicinal plants, in Pakistan, have been increasing during the last

few years. Medicinal plants have been reported from different parts of Khyber Pakhtunkhwa (Zabihullah *et al.*, 2006; Khan and Khatoon, 2008 and Abbasi *et al.*, 2009).

The link between plants and human ethos is not partial to the use of plants for diet, outfit and housing but also includes their use for religious formalities, decoration and health carefulness (Schultes, 1992).

In the earlier, ethnobotanical research was predominately, a review of the plants used by inhabitants. A skilled botanist would identify plants and documented their usages. Occasionally an anthropologist was present to translate the disease explanations, but seldom was a physician accessible to detect the disease. The results made a list of plants and their usages which was printed in a specialized paper, usually in the state of the researcher. Nothing was connected or returned to the social set in discussion for their contribution in the study, neither any environmental nor traditional status and concerns, comprised in the survey were carried. Basic numerical and experimental ethnobotany contains basic records, quantitative evaluation of use and supervision and experimental calculation. Nowadays, ethnobotanical surveys contain practical schemes that have the prospective to ameliorate poverty levels of these people, allowing them to make more educated assessments about their future guidelines. These new attitudes improve the excellence of the science, deliver advantages for the cultural assemblages and take into account of ecological concerns. This new tactic is based on an interdisciplinary team, typically composed of an ethnobotanist, an anthropologist, an ecologist and a physician. Some of these group members are from remote area colleagues who have prepared the particulars of the expedition as well as the contractual arrangements for mutual programs of the village or community.

i. Brief history of ethnobotany

Harshberger, (1896) defined Ethno botany as “the study of the utilitarian relationship between human beings and vegetation in their environment, including medicinal uses”. Though the term "ethnobotany" was coined in 1895 by the US botanist John William Harshberger, the history of the field begins long before that. In 77 AD, the Greek surgeon Dioscorides published "De Materia Medica", which was a catalogue of about 600 plants in the Mediterranean. It also comprised information on how the Greeks used the plants, especially for medical purposes. This demonstrated herbal

contained information on how and when each plant was collected, whether or not it was noxious, its authentic use and whether or not it was edible (it even provided recipes). Dioscorides stressed the economic prospective of plants but did not really venture into the field till after the middle ages. In 1542, Leonhart Fuchs, a Renaissance artist, led the way back into the field. His "De Historia Stirpium" cataloged 400 plants native to Germany and Austria. John Ray (1686-1704) delivered the first demarcation of "species" in his "Historia Plantarum": a species is a set of individuals who give rise through reproduction to new individuals similar to themselves. In 1753, Carl Linnaeus wrote "Species Plantarum", which comprised information about 5,900 plants. Linnaeus is famous for developing the binomial method of nomenclature, in which all species get a two portion name (genus, species). The 19th century saw the peak of botanical investigation. Alexander von Humboldt collected data from the new world and the well-known Captain Cook brought back information on plants from the South Pacific. At this time major botanical gardens were going on, for instance, the Royal Botanic Gardens, Kew. Edward Palmer collected artifacts and botanical specimens from peoples in the North American West (Great Basin) and Mexico from the 1860s to the 1890s. Once enough data happened, the field of "aboriginal botany" was founded. Aboriginal botany is the study of all forms of the vegetable world which aboriginal peoples use for food, medicine, textiles, ornaments, etc.

The first individual who studied, the emic perspective of the plant world was a German physician working in Sarajevo at the end of 19th Century: Leopold Glueck. His publication work on traditional medical uses of plants was done by rural people in Bosnia (1896), has to be deliberated the first modern ethnobotanical work. At the outset of 20th century, the field of ethnobotany witnessed a shift from the raw accumulation of data to a greater methodological and conceptual reorientation. This was also the beginning of academic ethnobotany. The founding father of this discipline is Richard Evans Schultes. Today, the field of ethnobotany needs a variety of skills, botanical training for the identification and preservation of plant specimens, anthropological training to appreciate the cultural concepts around the perception of plants, dialectal training, at least, enough to transcribe local terms and know native morphology, composition and semantics. Native homoeopaths are often reluctant to share correctly their knowledge to foreigners (Martin, 1983). The

biological diversity of our world is great and we have only begun to explore her potential. In some areas, diversity may be more valued in its natural state than when used for grassland or timber (Peters, 1989). Methods to identify medicinal plant include accidental screening, taxonomic collecting (sampling by botanical family), or ethnobotanical collecting. It has been revealed that ethno botanically derived compounds have superior activity than compounds derived from random screening and therefore, a greater potential for product growth.

Another scholar, James W. Herrick, who studied under ethnologist, William N. Fenton, in his work, Iroquois Medical Ethnobotany, (1995) with Dean R. Snow (editor), professor of Anthropology at Penn State, explained that understanding herbal medicines in traditional Iroquois cultures is rooted in a solid and ancient cosmological acceptance system. Their work provides observations and conceptions of illness and differences which can clear in physical forms from benign maladies to serious diseases. It also contains a large compilation of Herrick's field work from numerous Iroquois authorities of over 450 names, uses, and provisions of plants for various ailments. Traditional Iroquois practitioners had (and have) a sophisticated viewpoint on the plant world that contrast strikingly with that of new medical science (Herrick, 1995).

1.3 Floristic

The word floristic is derived from flora, which means to list all types of plant species or plant taxa within specific geographic area. Flora of an area includes all types of plants either wild or cultivated one while vegetation refer to the numbers of individuals, their distribution pattern, size, relationship and their relative importance (Ali, 2008). Plant ecology is the branch of ecology which deals of the distribution pattern, relative abundance of plant species, environmental effects, interaction among themselves and other organism (Keddy, 2007). Phenology is the study of regular seasonal occurrence of various processes such as vegetative growth, photosynthesis, pollination, flowering, fruit formation, vegetation, their types, and diversity, inter relationships and productivity of vegetation (Campbell, 2006 and Wang *et al.*, 2013). Phytosociology is that branch of Ecology which deals with the plant communities, relationships among the plant species, their development and composition. The phytosociological system is specified for classifying the plant communities

(Rabotnov, 1970-1979). The study of flora is a common practice and plant taxonomists have the information about the plants throughout the world. Flora is a floristic checklist, complete taxonomic treatment with key, and morphological information of plant species growing in specific geographic area. The valuable data is collected through this practice for reference of future studies. The world is climatically diverse (Qureshi *et al.*, 2011).

1.4 Nutraceutical Aspects

DE Felice, in 1989, used the words “Nutraceutical for nutrition and pharmaceutical (Kalra, 2003). This term is applied to the products from isolated nutrient, dietary supplement and herbal yields, processed food e.g. cereals products, soups and beverages. Nutraceutical aspect is nonspecific biological interventions used for health encouragements, to protect the malignant processes and to control the symptoms. Due to their safety and possible nutritional and therapeutic values, nutraceuticals have attracted significant importance. Supplements are that products, which are derived from natural sources and incorporated with the diet with ingredient e.g. Vitamins, minerals, amino acids without any therapeutic property. The advantage of nutraceuticals is that they prevent the diseases and can be used as a usual food. The following, eleven elements (K, Ca, Zn, Cu, Fe, Mn, Cr, Ni, Br, Rb and Zr) were determined with Energy Dispersive X-ray Fluorescence (EDXRF) in selected Sudanese medicinal plants (Yagi *et al.*, 2013). The human body requires a number of minerals in order to retain good health (Ajasa *et al.*, 2004). Macro- and microelements control biochemical processes in the human organism (Kolasani *et al.*, 2011). Medicinal plants have their active constituent’s metabolic product of plant cells and a numbers of Mineral elements which play an important role in metabolism (Choudhury *et al.*, 2007). Some minerals act like chelate with the organic ligands and make them bioavailable to the body system. Some of the plants have their medicinal value and usually used in homeopathic system due to presences of Ca, Cr, Fe, Mg, K, and Zn (Vartika *et al.*, 2001.). The mineral elements present in plant play an important role in quality of food. The quality of medicine also depends upon mineral contents (Bahadur *et al.*, 2001) Malnutrition in tropical countries as well as in developing countries is due to deficiency essential nutrients. Excess of essential elements also causes disorders. Anemia is due to Iron deficiency, is one third of the world population (Leterme *et al.*, 2006) Zn deficiency can accelerate the pathogenesis of lungs cancer

(Cobanoglu *et al.*, 2010) The patients of breast cancer had low levels of Zn, Mn, Fe, Ca, Cu and Mg in their hair (Joo *et al.*, 2009).

Aims and Objectives

The purpose of this research work is;

- To list the flora of the selected areas of district Bannu.
- To study the ecological characteristics of plant communities.
- To carry out the soil analysis of plant communities.
- To list the medicinal plant species, used by local communities.
- To know the palatability of plants of the area.
- To study nutritional values of selected plants.
- To investigate elemental composition of the selected plants.

CHAPTER – 2

REVIEW OF LITERATURE

Ethnobotany

Kappelle *et al.* (2000) reported 590 plant species from Costa Rican Montane. Out of them, 23.8% of (189) plant species were used for remedial purposes, 39.7% for diet, and 24.3% for structure and equal amount as fuel wood. Less important uses included dye, decorative, fodder, gum, oil, and poisonous. A overall of 61.9% of the plants were used for one purpose only.

Gillani *et al.* (2003) listed 54 medicinal plant species from Kurram agency which had numerous local uses. Most of them were described as first relief for stomach diseases. They also recounted that during winter, nearly all the people in the area used Afghan fuel wood.

Macia (2004) stated that 37 palm species used by the Huaoranis in Huaorani in Amazonian Ecuador. Palm species used for different purposes and recorded in eight ethnobotanical groups. Among these (64.9%) were used for house building and human nutrition. Half of these species were used for home utensils (59.4%), for hunting and fishing trappings (54.6%).

Hussain *et al.* (2004) noted that 11 plants species were used for several timber purposes in South Waziristan agency Pakistan. *Populus afghanica*, *Cedrus deodara*, and *Pinus wallichiana* were declared as the top timber wood in South Waziristan Agency.

Wazir *et al.* (2004) reported 41 specie, of 29 families of an ethno-botanical significance from in Chapursan Valley Gilgit. The core objective of this paper was to explore the medicinal plants. Many herbs, shrubs and trees, were used for medicinal purposes by the populations in the valley.

Ahmad *et al.* (2004) noticed that the native people of Galliyat areas preferably use remedial plants for treating their common diseases by traditional approaches. They observed 41 wild plants species of 33 families used by local populations for homeopathic purposes.

Jabbar *et al.* (2006) reported 29 species among them *Lamium amplexicaule* L., *Mallotus philippinensis*, *Withania somnifera*, *Azadirachta indica* and *Citrullus colocynthis* were used to treat helminthosis in ruminants from southern Punjab, Pakistan

Tardio *et al.* (2006) collected 419 plant species of 67 families in Spain. A list of species, plant parts used, localization and process of depletion and harvesting time is presented. These plants were used in seven different food classes like; green vegetables were the prime group followed by plants used to make beverages, wild fruits, and plants used for seasoning, sweets, preservatives, and etc.

Wazir *et al.* (2007) observed 20 different medicinal halophytes plants belonging to 18 families found in District Karak and its adjacent area. These medicinal halophytes were used by the local inhabitant of the area.

Manan *et al.* (2007) reported that 52 plants of 35 families were used for different diseases in Upper Dir and have substantial role in the primary health care of area.

Arenas & Scarpa (2007) observed that Chorote folks use 57 plant species as a source of diet, which they consume in 118 different ways. A cross-cultural assessment with 4-neighboring ethnic groups revealed that one third of their plant foods were exclusive to the Chorote people, despite the fact that they share most of their palatable plants with the other groups.

Mizaraitė *et al.* (2007) reported that the potentials of increasing the use of timber from private forests in Lithuania for bioenergy drive. Potential wood fuel supply and feeding were examined using a literature review and study of statistical data. Prices of wood chips manufacture were designed applying economic simulation.

Okello & Ssegawa (2007) reported during the ethnobotanical review in Ngai subcounty and identified that roots were the most commonly harvested portions which have seriously affected the regeneration of medicinal plants. It was supposed that only the wild plants were effective. Though not intentional, plant parts not used for remedial purposes are sometimes damaged in the process of harvesting.

Khan & Khatoon (2007) reported that in Bugrote Valleys 48 plant species of trees and shrubs were used in ordinary life for medication, housing, agricultural tools and

firewood. The population of the region mainly depended upon plants for their livelihood.

Shah & Hussain (2008) noted that 76 plant species of 52 families were used for several purposes in Mount Elum, District Bunir. Among these 47 % plants were used for medicinal purposes, 21 % for fuel wood, 9 % for fruit species, 19 % for honeybee species, 20 % for wood yielding species and 4 % for poisonous species.

Qureshi & Bhatti (2008a) observed 51 plant species were distributed across 28 families to have medicinal uses by local populations of the Nara Desert. 21 plants of these species are suggested to have new uses not recorded in the Indo-Pak folk herbal medicinal literature. Boraginaceae and Amaranthaceae were the most leading families.

Khan *et al.* (2009) reported that 50 plant species were used locally for remedial and other purposes in FR Bannu. The leading families were Poaceae and Moraceae each with 5 species.

Akhtar & Begum (2009) recorded that 55 plant species of 38 families were used for more than 42 diseases in Jalala area District Mardan. *Calotropis procera* and *Boerhavia diffusa* had flexible medicinal uses. The information recounted is purely based on the knowledge of local populations without any scientific certification.

Sardar & Khan (2009) noted that 102 species of 62 families from Shakargarh, District Narowal, which were used by indigenous inhabitants as fuel, furniture, fodder, making baskets and mats, brushing teeth, remedial, vegetables and eatable fruits.

Kamal *et al.* (2009) reported that 50 plant species of 30 families are used medicinally and for other purposes in Bannu for curing several diseases like cough, diarrhea, dysentery, constipation and stomach complications etc.

Hazrat *et al.* (2010) conducted that ethnobotanical research in Ushera Valley and recorded 50 species of 32 families of wild herbs, shrubs and trees which were used as remedial plants by the people in the valley.

Ajaib *et al.* (2010) documented 38 species of 25 families from District Kotli, Azad Jammu & Kashmir, Pakistan, of economics rank. The local people used them as remedial, fuel, shelter, and in making agricultural utensils.

Tareen *et al.* (2010) reported that 61 species of 34 families from Kalat and Khuzdar, Baluchistan are conventionally used as medicines by the women for cure of various ailments. Maximum number of species belongs to family Lamiaceae (9 spp.) followed by Asteraceae (7 spp), Apiaceae, Papilionaceae, Solanaceae and Zygophyllaceae (3 spp. each).

Qasim *et al.* (2010) reported 48 wild plant species from 26 families used in Hub, Lasbela District, and Baluchistan for twelve diverse purposes. Plants were used, 56 % for fodder, 22% for medicine, 5% for food, 5% for household utensils, 3% for increasing milk production in cattle and 8% for other purposes. Most commonly used species were from Poaceae (29%) monitored by Amaranthaceae & Chenopodiaceae) (10%), Mimosaceae and Convolvulaceae (6%).

Shinwari *et al.* (2011) purposed of this study was to collect evidence on how people of a specific culture and area make use of native plants. For this determination, an ethno botanical study was directed in Kohat Pass, KP, and Pakistan. The study showed that there were 60 plants of 30 families which were used to overcome six use classes by the natives. Most of the species (90%) were used as medication, followed by nourishment (31.7%) and food & fuel (25%).

Sher *et al.* (2013) documented the ethno botanical values of the most frequently used plants of the Humzoni (North Waziristan Agency), Pakistan and reported on the local knowledge of diverse communities of the study area. A total of 51 species of 32 families were found to be valuable for remedial, diet, fodder/forage, fuel, wood, housing and agricultural tenacities. Local people used native plants for their communal day diseases. The largest families among these were Rosaceae. It was noted that most common part of the plant used were leaves and fruit. There is no tendency of farming of medicinal plants in this area.

Shahzeb *et al.* (2013) documented 35 Unani medicines and arranged systematically along with name of product, available form, company name, name of the plants/parts used in the drugs, family name and purpose of uses. Plants which were used

frequently in these medicines are *Ziziphus jujuba*, *Foeniculum vulgare*, *Solanum nigrum*, *Ocimum cannum* and *Zingber officinale*. It was noted that these products are generally available in syrup form. It is commonly assumed that these medicines have no side outcome. Fascinatingly one medicine is suggested for many diseases.

Daud *et al.* (2013) reported the 11 plants species of gymnosperms from North Waziristan agency. The aboriginal knowledge of local folks about the use of these native and cultivated plants were collected through interview during field visits by using questionnaire. During visits, it was found that the people of the area used these plants for diet forage, protections, manufacture and fuel purposes and also consumed as a medication and detergents.

Khan *et al.* (2013) reported the plants species which were used for treatment of diarrhea and dysentery in district Bannu. These plants were from the following families, *Apiaceae*, *Myrtaceae*, *Mimosaceae*, *Alliaceae*, *Lamiaceae*, *Rutaceae*, *Plantaginaceae*, *Amaranthaceae* having 2 species each. While *Euphorbiaceae*, *Moraceae*, *Rhamnaceae*, *Astraceae*, *Solonaceae*, *Cypraceae*, *Meliaceae*, *Oxaladaceae*, *Punicaceae*, *Poaceae*, *Chenopodiaceae* and *Caesalpinaceae* were with single species each. Out of these, 16 plant species were used for treatment dysentery and 8 plants were used for diarrhea and 4 plants were used for both diarrhea and dysentery.

Amjad *et al.* (2015) documented ethno botanical uses of 104 plant species of 51 families. Results revealed that most the plant species were used as medicinally. Leaves were found to be the most commonly used part for the preparation of local recipes and fodder.

Koleva *et al.* (2015) reported a broader ethno botanical survey conducted in diverse localities of Bulgaria during May-July 2013. The survey was carried out with 255 people by using the face-to-face interview method. The members were asked: 1) to list five used by them curative plants (excluding *Achillea millefolium*, *Hypericum perforatum*, *Thymus* sp., *Melissa officinalis* L., *Origanum vulgare* L.) and to present detailed information about local names of plants listed, ethno botanical use and the manner of use. Totally, 62 plant species were recorded by respondents.

Floristic

Mark *et al.* (2001) worked out on alpine zone at meso- and micro- scales in southern Tierra collected data on plant cover and life form. They specified that the richness of 80 local vascular taxa (18.6% of the regional flora), reduced with increasing altitude and also observed that chamaephytes and hemicryptophytes dominated throughout but microphanerophyte and megaphanerophytes were clearly lacking.

Antje (2002) explored the relationship between Inselberg floras in floristic and functional terms and their correlation with environmental variables at Macro-scale and landscape level. He decided that neither growth form nor dispersion spectra closely looked like the pattern that arose in the ordination of floristic composition. The effect of geographical position reduced when functional rather than floristic measures were introduced in the analysis.

Batalha & Fernando (2002) reported a extensive physiognomic range, from grasslands to tall woodlands in Brazil. They compiled Raunkiaer's life-form spectra. They indicated that in all Cerrado life-form spectra, the chief life-form classes were the hemicryptophytes and the phanerophytes, the former dominant in sites with open physiognomies and the latter prevailing in sites with closed physiognomies. The Cerrado sites illustrated themselves from the savanna sites by their under-representation of therophytes.

Gutkowski *et al.* (2002) noted 69 species with geobotanical significance from Dynów foothills, Poland. It comprised 14 mountain species (7 montane, 6 multizonal mountain species and 1 sub-montane species) and 7 species not native to the area (3 archaeophytes, 1 epeokophytes, 1 apophytes, 1 hemiagriophytes and 1 of unclear status).

Luis *et al.* (2002) reported that 46 vascular plant species, 32 being growing macrophytes, mostly Gramineae and Cyperaceae, five floating-leaved, three submerged, and one surface-floating and also five shrubs. Cluster analysis of the floristic data presented two main groups of inventories in both seasons.

Antje *et al.* (2003) noted the floristic composition of 14 mesas in southern African Nama Karoo along a latitude gradient. They indicated that mesas can act as sources for re-colonization as well as havens for species adjusted to mountain habitats and

that mesa habitats were richer in species than plains in the northern These findings stress the importance for the protection of mesa habitats in opinion of increasing human pressure on mountain habitats.

Musila *et al.* (2003) documented 156 plant species from coastal area of Kenya. Among them 60 families were recorded with Gramineae (17 spp.) and Papilionaceae (16 spp.) were dominant family in terms of species numbers.

Eilu *et al.* (2004) described a total of 5747 plant species, trees in 53 families, 159 genera, and 212 (spp). 22 families had only one species each, while the rest had between 2 and 25 species. Euphorbiaceae is one of the leading family having (25 spp) followed by Meliaceae and Rubiaceae (16 spp) each. Grounded on Rabinowitz's forms of rarity, 93% of the species were geographically well-known, 47% were limited to a single forest type, while 41% happened at densities of <1 individual ha⁻¹.

Durrani *et al.* (2005) reported 202 plant species of 45 families from Harboi rangeland Kalat. Asteraceae, Papilionaceae, Poaceae, Brassicaceae and Lamiaceae were the prominent families. *Juniperus macropoda* was the only tree species. They also indicated that the dominant life forms were therophyte and hemicryptophyte while nanophylls, microphylls and leptophylls were dominant leaf sizes. Some 83.6% plant species flowered during April to June while 63.3% plants bloomed during July to September.

Golluscio *et al.* (2005) documented that plant phenology and life form regulate the capability to use resources. The phenological heterogeneity within and among life forms of a single community may reveal key features of community organization, such as temporal niche separation within life forms or convergence of phenological and life form patterns. Grasses had higher autumn-winter phenological action than non-grass groups which differed in the date of beginning of vegetative growth and finish of the reproductive growth.

Muoghalu & Okeesan (2005) noted that 49 climber species containing of 35 liana (34%) and 49 (spp) were distributed over 28 families. Climber basal area, density, number of species, genera and families increased with height. Forty-two per cent of the trees in the forest carried climbers.

Muthuramkumar *et al.* (2006) reported the changes in tree, liana, and under story plant diversity and community structure in 5 tropical rain forest fragments in the Valparai plateau, Western Ghats. There were 312 (spp.) in 103 families: 1968 trees (144 spp.), 2250 lianas (60 spp.), and 6123 understory plants (108 spp.). Understory species density was highest in the highly disturbed portion, due to weedy invasive species occurring with rain forest plants.

Segawa & Nkuutu (2006) reported that 179 (spp.) of 70 families from Lake Victotia Central Uganda. Out of these, Rubiaceae was the richest with 40 species followed by Euphorbiaceae (13 spp.), Apocynaceae (10 spp.) and Moraceae (9 spp.). 58 herbaceous species, 39 lianas, 10 shrubs and 72 species of trees were noted.

Laidlaw *et al.* (2007) observed that local and regional variation in tropical rainforest and showed that the common families were Meliaceae, Euphorbiaceae, Lauraceae, Myrtaceae and Apocynaceae. The most common species were *Cleistanthus myrianthus*, *Alstonia scholaris*, *Myristica insipida*, *Normanbya normanbyi* and *Rockinghamia angustifolia*.

Yadav & Gupta (2007) counted the diversity of herbaceous species in relative to various micro-environmental settings and human disruption in the Sariska Tiger Project in Rajasthan, India. Several species sensitive to human disturbance have extinct from the disturbed areas. The species diversity index in the undisturbed Slopka forest was 3.051, followed by the Kalighati forest (3.415) and the Bharthari forest (3.027). However, in the Hajipur forest, species diversity index was high (3.564), due to the rise in species richness. It is proposed that the rich species diversity of the herbaceous vegetation of the Sariska Tiger Project may be sheltered only by in situ conservation.

Perveen *et al.* (2008) noted that the 79 plant species from Dureji Game Reserve that belonged to 32 families, which also comprised 3 rare species. Phenology and quantitative analysis of species diversity and phytosociological attributes were noted.

Francisco *et al.* (2009) prepared a checklist of Commelinaceae of Equatorial Guinea, comprising of 46 taxa in 12 genera. The largest genus was Palisota, with 11 (spp.). Commelinaceae having 11 (spp.) were noted for the first time in the country.

Hussain *et al.* (2009) described the 69 plant species of 29 families from District Chakwal. The vegetation transects in 4-sites of the rangelands comprised 20 species of grasses, 12 species of trees, 31 species of shrubs and 6 species of under shrubs and herbs.

Manhas *et al.* (2010) documented that the 206 species of 59 families from Pathankot, Hoshiarpur and Garhshanker, India. The contribution of dicot, monocotyledons and pteridophytes were 77.7%, 20.4% and 1.9%, respectively. *Ipomoea* was the most leading genus. Biological spectrum of the study site presented that therophytes (52%) were the most prevailing life form followed by phanerophytes (27%).

Durrani *et al.* (2010) calculated floristic composition and its ecological appearances in Aghberg range lands of Quetta Pakistan. The study indicated that the protected sites supported 123 plant species of 36 families, while unprotected sites had only 28 species. Asteraceae, Fabaceae, Poaceae, Brassicaceae, Lamiaceae and Boraginaceae were significant families in the protected area.

Jankju *et al.* (2011) reported that the flora of a region is fundamental for attaining other practical researches in biology. Different ecological and climatically conditions generate unique habitats which make it significant for floristic studies in Khorasan Province of Iran. Floristic list of the study area is valuable for protecting the natural resources and sustainable use of medicinal plants

Xu *et al.* (2014) noted that *Sapium baccatum* is measured a pioneer species. The *Sapium baccatum* - *Baccaurea ramiflora* forest in the low altitude zone shows that the vegetation of the nature reserve was also historically disturbed by anthropogenic activities such as traditional swidden practices. Before the Bulong Nature Reserve was recognized, the region had undergone rapid deforestation, with a massive proliferation in monoculture rubber tree plantations since the 1980s, as in other parts of the region.

Zhu *et al.* (2015) carried out floristic and vegetation surveys in a newly recognized nature reserve on a tropical mountain in southern Yunnan. Three vegetation types in 3-altitudinal zones were documented: a tropical seasonal rain forest under 1,100 m; a lower montane evergreen broad leaved forest at 1,100-1,600 m; and a montane rain forest above 1,600 m. A total of 1,657 species of seed plants in 758 genera and 146

families were documented from the nature reserve. Tropical families (61%) and genera (81%) contain the majority of the flora, and tropical Asian genera make up the maximum percentage, showing the close affinity of the flora with the tropical Asian flora, despite the high latitude (22°N). Floristic fluctuations with altitude are obvious. The transition from lowland tropical seasonal rain forest dominated by mixed tropical families to lower montane forest dominated by Fagaceae and Lauraceae occurs at 1,100 -1,150 m. Although the middle montane forests above 1,600 m have 'oak-laurel' grouping appearances, the temperate families Magnoliaceae and Cornaceae become dominant. Both the tree species diversities and the numbers of genera and families are higher in the lowlands and middle montane zones than in the lower montane. The lower diversity in the lower montane zone could reflect less precipitation and frequent fires in the historical past. The species structures of samples within each altitudinal zone show better horizontal turnover (β diversity) in the lowlands. Conservation struggles should focus on the species-rich lowland and middle montane forests.

Mashayekhan *et al.* (2015) reported that the floristic study of plants in each site is one of the most central roles in protecting natural resources of each country. Plant species were composed from field sites that representing major habitats of study area. Surveys were achieved during active growth periods in 2013-2014. A total of 140 medicinal plant species were recognized. These species were distributed in 39 families. Lamiaceae is one of the leading families and having 26 species followed by Asteraceae with 21 species and Rosaceae with 13 species were the most prevailing families of medicinal plants in the study area. Hemicryptophytes with 40%, therophytes with 18.4%, geophytes with 14.25%, phanerophytes with 13.57% and chamaephytes with 6.42%. These species belonged to the Irano-Turanian, Euro-Siberian and Mediterranean regions. The consequences of the present study indicated that medicinal plants and wild fruit as Non Timber Forest Products (NTFPs) recognized in this study, play significant roles in the rural community well-being and ecological forest management.

Karthik *et al.* (2015) documented totally, 185 plant species of 158 genera and 58 families. These plant species were counted in this sacred grove and followed by Angiosperm phylogeny Group III classification. The most leading families found were Fabaceae (24 spp.), Apocynaceae (13 spp.), Malvaceae (9 spp.), Rubiaceae (8 spp.), Convolvulaceae (8 spp.) and Rutaceae (8 spp.). Rich biodiversity is present in

the sacred grove. This has confirmed the protection and preservation of the vegetation of the sacred grove.

Vegetation structure

Claros (2003) observed that variations in forest structure and species diversity during secondary succession at two sites in the Bolivian Amazon. Canopy height species diversity and basal area improved with stand age, specifying that secondary forests rapidly achieve a forest structure. A total of 250 species were recorded of which 50 percent made up 87 percent of the sampled individuals. Species diversity increased with the lowest diversity in the canopy. The results of the correspondence analysis showed that species structure varied with stand age, forest layer, and site. The species composition of established forests recovered at different rates in the different forest layers, being the slowest in the canopy layer.

Kennedy *et al.* (2003) studied the link between grass species richness and ecosystem constancy in the Kruger National Park. A total of 135 to 489 individual grasses were recognized from 189 sites. After the drought had approved species richness, standing crop and percentage abundance recovered to 92.1%, 113.8% and 92.8% of their pre-perturbation values, respectively. The findings suggest that ecosystem stability may be negatively related to grass species richness in South African savanna grasslands.

Hurka (2004) examined plant species diversity and structure of life form categories in a tropical dry forest in Northwestern Costa Rica. The results accepted 328 plant species in 79 families and 247 genera of grasses, herbs, shrubs, lianas and trees. Species richness was highest after 15 years and declined significantly in older plots. The number of non-woody species was maximum after 3-years of succession.

Jorge *et al.* (2005) studied the vegetation structure and species richness through a 56-years Chrono sequence of 6-replicated age classes of dry tropical forest on the island of Providencia, Colombia, in the Southwest. They stated that woody species density touched a peak in stands from 32 to 56 years old while rarefaction analysis indicated that species richness increased linearly with stand age and was maximum in stands 56 years old or greater. Basal area and mean tree height were absolutely associated with age since rejection, while sprouting capacity indicated a negative relationship.

Karsten *et al.* (2005) determined the classification of 549 phytosociological relieves and gave 4-groups including of 39 plant communities. With declining moisture looked desert steppes with *Stipa glareosa* and *Allium polyrrhizum* and the desert steppe were diverse with lot of semi-desert scrub sparse dwarf *Anabasis brevifolia*, *Salsola passerina*, *Zygophyllum xanthoxylon* and *Haloxylon ammodendron*.

Malik & Hussain (2006) indicated that characteristic plant species of each community type are presented together with the evidence on dominance and sub-dominance species. Four plant communities were documented. Classification and ordination techniques providing very similar results based on the floristic composition. The results formed the base for the mapping spatial distribution of vegetation communities using image analysis techniques.

Gould *et al.* (2006) measured the species composition, diversity, conservation status, and ecological attributes of eight mature tropical forest plants. There were 374 species; 92% were native, 14% endemic, and 4% critical elements (locally endangered) to the island. The lowland moist forest communities, occurring within a matrix of urbanization, agriculture, and disturbance, had the highest degree of invasion by exotics. Community descriptions were nested within a change of hierarchies to facilitate extrapolation of community characteristics to larger ecosystem units.

Tripathi & Shukla (2007) designated two grassland communities of Gorakhpur, one on the managed and sheltered site and the other moderately grazed, open natural site of University campus for the comparison of various vegetation parameters. Out of the total 100 species, 65 were common to both sites, 9 species occurred exclusively at site I and 26 species at site II. *Cassia absus*, *Cassia tora* and *Hyptissu aveolens* were rare in abundance at managed site while *Coccinia indica* and *Crotalaria ferugenia* were rare at natural site.

Ahmad *et al.* (2008a) detailed the vegetation data during all the 4-seasons (autumn, winter, spring and summer) using quadrat method in Knotti Garden and Dape Sharif. Soil physical and chemical properties of each site had their own impacts on the species association. Most of the herbaceous species were common during summer and autumn due to appropriate temperature and accessibility of moisture and nutrients.

However, during winter sparse vegetation did not display grouping of plants due to severe cold temperature.

Arshad *et al.* (2008) studied vegetation types for density, frequency, and cover and importance value index in rangelands of the Cholistan desert. The association of certain plant species to certain soil types was common showing the influence of chemical composition of the soils. The result indicated marked important relations between soil physiognomies and plant species. *Suaeda fruticosa* and *Haloxylon recurvum* the high salinity levels and low organic matter. *Calligonum polygonoides*, *Aerva javanica*, *Dipterygium glaucum*, *Capparis decidua* and *Haloxylon salicornicum* indicated better organic matter.

Wahab *et al.* (2008) experimented vegetation structure, age and growth in 5-places of Dangan District of Afghanistan. Vegetation compositions of non-tree species were also presented. On the basis of floristic composition and importance value index of tree species, two mono-specific and one bispecific communities were documented in the study area. It is shown that in *Picea smithiana* (Wall.) Boiss dbh, age and growth rates were not significantly interrelated. Lack of tree seedlings specified poor regeneration status of the forests.

Guo *et al.* (2009) functioned on the, the biological spectrum and hierarchical-synusia structure of *T. sutchuenensis* community. There were 73.2% phanerophyte, 18% hemicryptophyte, 6% geophyte, 2% chamaephyte, and 0.8% annual plants. The leading leaf size was microphyllous (60.8%), and foremost leaf form was simple (86%).

Saima *et al.* (2009) reported that the floristic difference in Himalayan moist temperate coniferous forests in Pakistan is poorly assumed. Wet temperate forests of Pakistan are remarkable because at suitable heights it merge downward with the tropical thorn forests and uphill with the alpine meadows. The very condition of these forests thus make making them a kind of enclave in which the variety of natural sites has acceptable a number of relict species to persevere. We noted the vegetation pattern along a constant 18 Km long transect that crossed a mixed coniferous forest. Vegetation data was examined by multivariate statistics with cluster analysis, Detrended Correspondence Analysis (DCA) and Spearman's Rank Correlation Coefficient to detect relationship between environmental factors and species dispersal.

Soils were physically and chemically examined. Soil texture, pH and tree density were the major determinant of vegetation pattern in these forests. Plant diversities and accumulation with respect to environmental features in these broad forest categories were deliberated.

Ali & Malik (2010) calculated the vegetation communities of the exposed urban spaces viz., green belts, gardens and parks of Islamabad city. TWINSpan classified the floristic species composition into four-major community types which exposed some overlap in an ordination space, reflecting relatively homogenous nature of the vegetation. *Pinus roxburghii* and *Grewia asiatica* were more predominant in green belts while native vegetation dominated by *Dalbergia sissoo* and *Acacia nilotica* were present in uninterrupted green spaces. *Broussonetia papyrifera* and *Populus euphratica* indicated distribution along the drains/nullahs in the city.

Adam & Crow (2010) using TWINSpan examined the abundance and frequency data noted from 106 study plots. Six-cover types (CT) were defined: *Pinus strobus*–*Gaylussacia baccata* CT, *Fagus grandifolia*–*Ostrya virginiana* CT, *Pinus resinosa*–*Gaylussacia baccata*–*Vaccinium angustifolium* CT, *Tsuga canadensis* CT, *Acer rubrum*–*Dulichium arundinaceum* CT, and Ruderal CT. Sorensen's Index showed a 50.0% similarity with Bear Island, 51.1% with Rattlesnake Island, and 52.7% with Three Mile Island. The Simple Matching Index presented advanced levels of similarity.

Hussain *et al.* (2010) A study was carried out to assess the phytosociology and structures of National Park. For tree species, point center quarter method (PCQ) and understory vegetation, 1.5m circular plot at each PCQ point, while for bushes 20 quadrats 3x5 m were used. Five-stands lead by trees and eight-stands of bushes were noted. *Picea smithiana* and *Pinus wallichiana* form a community in two sites, related with *Juniperus excelsa*. These pine tree species were also spread as a pure stands in different sites with higher density and basal area. In pure stands, *Juniperus excelsa* attained lowest density ha with highest basal area m ha. Stands 1 21 of mixed species stands indication considerable low basal area. Diameter size class structure of tree species and bushes give the current status and future trend of these forests. These forests expression irregular and misbalanced size class distribution, therefore need special care to save and defend these forests and vegetation.

Sher *et al.* (2011) Reported that 40 species related to 21 families were identified as the weeds of wheat from village Lahor, District Swabi during 2005. The most common species with more than 45% average frequency were *Anagallis arvensis* L., *Arenaria serphyllifolia* L., *Chenopodium album* L., *Fumaria indica* (Hauskn) H. N. Pugsley., *Melilotus indica* (L.) All., *Rumex dentatus* (Meissn) Rich., and Linn. Based on importance value of 4 communities viz., *Arenaria -Anagallis-Chenopodium*, *Fumaria-Rumex-Chenopodium*, *Fumaria-ChenopodiumAnagallis*, *Arenaria-Fumaria-Chenopodium* were formed. Caryophyllaceae, Fumariaceae, Chenopodiaceae, Fabaceae, Poaceae and Primulaceae were the leading families on the basis of family importance values. The biological spectrum indicated that there were 82.5% therophytes and 12.5% hemicryptophytes. Geophytes and chamaephytes were characterized by one species each. Leaf spectra consisted of 42.5% microphylls, 35% nanophylls and 22.5% leptophylls. Biomass of the forbs was greater than the grasses. Species diversity was higher in Koz Mulk and Pani owing to crop rotation.

Robert *et al.* (2011) described that the rapid progress is being made in North American vegetation science through new progresses within the U.S. National Vegetation Classification (USNVC). Central to these developments are sharing, archiving, and distributing field plot data, the central data required for describing and accepting vegetation communities. Veg. Bank (GIVD ID NA-US-002) is the vegetation plot database of the Panel on Vegetation Classification of the Ecological Society of America. Veg. Bank is a stand-alone, Internet accessible, vegetation plot archive designed to permit users to simply submit, search, opinion, and note, cite, and download various types of vegetation data. The archive also contains inserted databases that comprise classifications of vegetation and individual organisms, designed and applied to pathway the many-to-many relationship between names and plant or community concepts, as well as other party perspectives on conventional taxa. The Veg. Bank data model is also applied in Veg. Branch, a desktop tool for data organization and for uploading to and downloading from Veg. Bank.

Rao *et al.* (2013) reported that total number of plant species observed was 105 plant species of 41 families. The maximum number of plant species observed belongs to Fabacea family. According to the IVI values observed *Tephrosea purpurea* in herbs, *Lantana camara* in shrubs & climbers, and *Anacardium occidentale* in trees showing the maximum IVI value and these are considered as important dominants and

Acalypha alnifolia in herbs, *Atylosia scaraboides*, *Waltheria indica* in shrubs and climbers and *Sapindus emarginatus* in tree species are measured as rare species to the study area, because these species having the least IVI values. The results in the chief nutrients N, P, K levels are discouraging though the presences of these nutrients are relatively very low in the corresponding coastal area. *Aristida adscensionis* and *Cynodon doctylon* are the effective, indigenous and suggested grasses to check the erosion in the study area.

Scheiter *et al.* (2013) reported the dynamic global vegetation models (DGVMs) are dominant tools to project past, current and future vegetation designs and linked biogeochemical cycles. However, most models are incomplete by how they define vegetation and by their simplistic representation of race. We discuss how ideas from community assembly theory and coexistence theory can help to advance vegetation models. We further present a trait- and individual-based vegetation model (aDGVM2) that permits individual plants to assume a unique combination of trait values. These traits define how individual plants grow and compete. A genetic optimization algorithm is used to simulate trait inheritance and reproductive isolation between individuals. These model properties allow the assembly of plant communities that are modified to a site's biotic and abiotic conditions. The aDGVM2 simulates how environmental settings influence the trait spectra of plant communities; that fire selects for traits that improve fire defense and reduces trait diversity; and the emergence of life-history policies that are allusive of colonization–competition trade-offs. The aDGVM2 deals with functional diversity and struggle fundamentally differently from current DGVMs. This approach may yield novel visions as to how vegetation may respond to climate variation and we believe it could foster collaborations between functional plant biologists and vegetation modelers

Coskun Saglam (2013) reported the phytosociological properties of the forest, shrub, and steppe vegetation of Kizildag (Isparta province) were explored in 2010 and 2011. The vegetation of the area was analyzed using a 3-dimensional ordination technique based on the Braun-Blanquet method. As a result, 5 new plant associations were determined as belonging to forest, shrub, and steppe vegetation and categorized syntaxonomically. The associations and their higher units are as follows. Quercetea-Pubescentis Doing-Kraft ex Scamoni & Passarage 1959. Querco-Cedretalia libani Barbéro, Loisel & Quézel 1974. Meliloto bicoloris-Quercetum cocciferae ass. nova.

Hyperico heterophylli-Cistetum laurifolii ass. nova. *Atraphaxo billardieri-Amygdaletum orientalii* ass. nova. *Abieto-Cedrion* Akman, Barbéro & Quézel 1977. *Veronico isauricae-Cedretum libani* ass. nova. *Astragalo-Brometea* Quézel 1973 em. Parolly. *Onobrychido armenaeThymetalia leucostomi* Akman, Ketenoğlu, Quézel & Demirörs 1984. *Phlomido armeniaca-Astragalion microcephali* Ketenoğlu, Akman, Quézel & Demirörs 1984. *Centauro detonsae-Thymetum sipylei* ass. nova

Gul *et al.* (2014) reported that this present research work was conducted out in September and October 2013 to examine the vegetation of Latamber and its outskirts of District Karak by quadrat method. The research area was distributed mainly into 3-stands on the basis morphology and edaphic factors of the research area. i.e Plain area, Floody sandy area and Mountain area. The plain area was examined by quadrat method and taken 40-quadrates and the leading community was *Cynodon-Nerium*-Community on the basis of IVI. In the floody sandy area total 30-quadrates were thrown randomly and the dominant community was *Eucalyptus-Saccharum*-Community on the basis of IVI. The vegetation of mountain area was studied also by using total 30-quadrates which show the dominant community of *Cymbopogon-Nerium*-Community on the basis of IVI. After completing the whole vegetation analysis of the area; it was concluded that the community *Cynodon-Nerium* found to be the most dominant in plain area with 28.83 % *Cynodon dactylon* and 25.55 % *Nerium indicum*, while in the foothill area the dominant community was *Cymbopogon nerium* with this percentage, *Cymbopogon distense* 30.63 % and *Nerium indicum* 27.37 %. Similarly, the floody sandy area was dominated by *Eucalyptus-Saccharum*community with 30.63 % *eucalyptus* species and 29 % *Saccharum spontaneum*.

Nutraceutical

Enujiugha (2003) described that the proximate chemical composition of freshly harvested mature conophor nut (*Tetratcarpidium conophorum*) had 29.09% protein, 6.34% fiber, 48.9% oil, 3.09% ash and 12.58% carbohydrates on a dry weight base. The elemental applications in the uncooked conophor nut had high phosphorus content (465.95 mg/100g) while cadmium and nickel were very low (0.01 and 0.38 mg/100g, respectively).

Coskun *et al.* (2004) expected the metabolized energy applications of the total plant, leaves and stems to be 12.2, 11.9 and 12.7 kg⁻¹ dry matter (DM), separately. This compared satisfactorily with high value forages commonly used in ruminant nurturing. The results displayed that *Prangos ferulacea* may be observed as high energy forage, but further research is required on its consumption characteristics and the levels of animal performance.

Starks *et al.* (2004) reported that possibility of estimating concentrations of nitrogen (N), neutral detergent fiber (NDF) and acid detergent fiber (ADF) of live, upright forages. It was exposed that estimates of N, NDF, and ADF from the radiometer clarified from 63 to 76 percent of the variability expressed in the laboratory data, and were equivalent to those assessments derived from the NIRS. Such a distant sensing attitude would allow real-time valuation of forage quality, would permit mapping of the nutritional landscape could be used as a tool to improved manage pastures and supplements, and would promotion in making harvesting assessments.

Cherney & Cherney (2005) stated that species selection, fertilization and yield management had a major impact on forage K concentration and low K was critical for non-lactating dairy cow feed. Yield of dry matter was 5.6% higher under split applications of K fertilizer associated with the K fertilizer treatments. Forage quality was not really impacted by K fertilization although the K concentration of forage improved by 12% due to K fertilization.

Smith *et al.* (2005) inspected that indehiscent fruits of 6-tree species, common in Matabeleland were in-vitro trials. *Acacia nilotica* ssp. *nilotica* limited more total phenolics than *D. cinerea*, but less nitrogen (N) and fiber (ADF and NDF). However, when nourished a supplement of *D. cinerea* untreated or pickled with PEG or NaOH, digestibility and N-retention were highest and similar to a commercial goat meal, with the natural fruit.

Starks *et al.* (2006) reported that seasonal deviation in herbage mass, neutral-detergent fiber (NDF), acid-detergent fiber (ADF) and simple protein (CP) concentrations of herbage and canopy reflectance of grasslands of genotypes *Cynodon dactylon* and to examine the associations between these descriptors of nutritive value of herbage.

Choudhury and Garg (2007) worked on mineral composition of 15-wild herbs. Some herbs were supplemented in Ca, Co, Cu, Mg, P, Fe, Mn and Zn. often used as antibacterial, antipyretic and heart tonic. These were also used as feedstuff fodder. An effort was made to relate elemental fillings with the therapeutic importance of many herbs.

Phillips *et al.* (2007) described that performance of calves grazing warm-season grass pastures was typically reduced during the previous half of the summer as associated to the first half, because as the plant established the concentration of protein in the plants decreases under the dietary nutrient requisite needed to keep animal growth. If supplemental protein to calves during the last half of the summer grazing season can increase animal performance, but knowing when to begin supplementation is difficult.

Kiyani *et al.* (2007) reported that alkaloids, saponins, tannins and quantification of total phenolic insides in plants of Hazarganji Chiltan National Park Quetta. *Caragana ambigua*, *Clematis graveolens*, *Juniperus excelsa* and *Pistacia khinjak* confined all 3-secondary metabolites while these 3-secondary metabolites in *Chrysopogon aucheri*, *Ferula oopoda*, *Fraxinus xanthoxyloides*, *Pennisetum orientale*, *Saccharum griffithii* and *Verbascum erianthum* were absent

Sultan *et al.* (2007) recognized that the mean in-vitro dry matter digestibility (IVDMD) and metabolizable energy (ME) of marginal land grasses at early blossom stage were $58.4 \pm 2.05\%$ and 7.74 ± 0.29 MJ/kg DM, correspondingly, whereas, mean IVDMD and ME at advanced stage were $43.3 \pm 1.89\%$ and 5.64 ± 0.25 MJ/kg DM, separately. The chemical and structural composition, IVDMD, RP and PIR values designate that marginal land grasses be nourished to livestock with some supplementation for different levels of production and forms of livestock.

Khan *et al.* (2007) studied the levels of Ca, Na, Cu, and Zn in forage plants Punjab, Pakistan. They initiate that minerals were considerably improved, generally with plant development from summer to winter. Grazing ruminants in the grasses might possibly be lacking in most minerals and these grazing pastures are not providing satisfactory levels of the minerals to the livestock grazing therein. Supplementation was commonly higher in the foliage of naturally growing.

Chiesa *et al.* (2008) stated that organic matter, neutral detergent fiber and nitrogen consumption, as well as rumen ammonia-N concentration, reduced linearly with age of regrowth. Acid-detergent fiber and indigestible consumptions were similar for all treatments. Apparent digestibility of organic matter NDF and N, as well as true digestibility of OM, microbial protein production in the rumen, N retention, pH of rumen fluid and sugars, amino acids and peptide concentrations in rumen fluid were alike for all treatments.

Zhao *et al.* (2008) described that fodder nitrogen (N) and non-structural carbohydrate (NSC) concentrations were important indicators of feed quality, and knowledge of N and NSC difference among grass germplasm is one element to consider in increasing effective fodder and livestock management program. The applications of N, neutral detergent fiber (NDF), acid detergent fiber (ADF), glucose, fructose, sucrose, fructans, and starch in 13 perennial cool-season grass.

Rahim *et al.* (2008) examined the nutritive value of 12 marginal land grasses of Himalayan Pakistan. The mean *in vitro* dry substance digestibility (IVDMD) and metabolizable energy (ME) of marginal land grasses at early blossom stage were $58.4 \pm 2.05\%$ and 7.74 ± 0.29 MJ/kg DM, respectively, whereas, at developed stage were $43.3 \pm 1.89\%$ and 5.64 ± 0.25 MJ/kg DM, respectively. It was recommended that the macro and micro mineral arrangement, IVDMD, RP and PIR values of marginal land grasses are suitable for nursing to livestock with some supplementation for dissimilar levels of production and classes of livestock.

Cheema *et al.* (2010) stated that dry matter (TDM), crop growing rate (CGR), leaf area duration (LAD), seed yield; oil yield and protein content were meaningfully affected by dissimilar nitrogen tariffs. The highest N level (120 kg ha^{-1}) shaped maximum values for all these traits as equated to minimum in control during both years of study. Time of nitrogen application did not meaningfully affect TDM, CGR, protein and oil contents however, split presentation of nitrogen ($\frac{1}{2}$ at sowing + $\frac{1}{2}$ at branching or flowering) fashioned suggestively higher seed and oil yield than full nitrogen at sowing or its split application as $\frac{1}{2}$ at branching + $\frac{1}{2}$ at flowering.

Pandey *et al.* (2011) reported that nutritional therapy and phyto-therapy have appeared as new concepts of health relief in recent years. Strong references for ingesting of nutraceuticals from plant origin have become increasingly popular to

recover health, and to check and treat diseases. Nutraceuticals are "naturally derived bioactive complexes that originate in foods, dietary supplements and herbal products, and have health encouraging, disease avoiding and medicinal properties." Plant consequent Nutraceuticals/functional foods have established considerable attention because of their supposed safety and potential nutritional and therapeutic properties. Some popular phyto-nutraceuticals contain glucosamine from ginseng, Omega-3 fatty acids from linseed, Epigallocatechin gallate from green tea, lycopene from tomato etc. Majority of the nutraceuticals are requested to own multiple therapeutic benefits though substantial suggestion is lacking for the benefits as well as undesirable effects. With these trends, development of the dietary nourishing values of fruits, vegetables and other crops or improvement of the bioactive components in folk herbals have become the targets of flourishing plant biotechnology industry. The present analysis has been devoted towards better understanding of the phyto-nutraceuticals from different medicinal plants based on their disease specific suggestions.

Ranfa *et al.* (2013) reported the importance of wild plants for their worth in human nutrition. Data on the practice of 50 species were collected through informed consent semi-structured interviews with local informants. They were consumed raw in salads (43%), boiled (35%), as ravioli filling (10%), cooked without or with eggs (8%) and in vegetable soup (4%). Moreover, the nutraceutical analysis centered on four of the generally used wild edible plants determined how these species contain many of the so-called slight nutrients, such as antioxidising vitamins and polyphenols, which were maximum in *Sanguisorba minor* L.

Kaur *et al.* (2015) reported that metabolic syndrome has developed a worldwide health problem and it touches a wide variety of population. It is a situation that includes a cluster of complaints such as obesity, diabetes, hypertension, hyperlipidemia etc. mainly due to deprived nutrition. In order to agreement with this syndrome, researchers have made various interferences in the treatment methods as well in terms of nutrition. The term nutraceutical comprised nutritional and pharmaceutical aspects that worked for the prevention and treatment of diseases and afford health and medicinal benefits. Researchers have acknowledged presence of a wide range of phytoconstituents present in several traditional plants and spices.

Certain plants such as *Lagenaria siceraria*, *Trigonella foenum graecum*, *Curcuma longa*, *Vigna mungo* etc. shows admirable properties in curing hypertension, obesity, diabetes and hypercholestromia. The current article reviews the rank of various nutraceuticals that we devour in our daily food and their involvement in treating the metabolic syndrome.

CHAPTER – 3

MATERIALS AND METHODS

3.1 Ethnobotanical Study

i. Field Equipment

Before starting the ethno botanical research work common data about the area was collected. All the essential equipment like Altitude meter, compass, note book, maps pencils, markers plant presser, scale blotting papers, tags polythene bags, knife, cutter, digger, rope, digital camera, questionnaires, measuring tape, leather gloves, water bottle, food and iron bar were carried to the site.

ii. Ethnobotanical Data Collection

Prior to undertaking laboratory study of wild edible fruits and vegetables samples, ethno botanical information was obtained through semi structured interviews, questionnaires, market survey and motivation group conversation with key respondents having complete customary knowledge of useful remote edible plants (Menendez- Baceta *et al.*, 2014; Anely Nedelcheva, 2013; Stevens 2013; Kalle and Soukand 2012; Luczaj *et al.*, 2012; Martin, 1995; Cotton, 1996). Unceremonious dialogue and village walks with key information (190) containing farmers, herdsman, shepherds, housewives, school boys and children were held to improve understanding and collected information about diverse species of wild food plants available around the village. Adult female members from the household responsible for food preparation, were considered as the respondents with additional information from children and adults which, contribution in collection and handling of wild leafy vegetables and fruits (Misra *et al.*, 2008). The age of accused ranged from 10 to 70 years. The answers were noted precisely (Mengistu and Hager, 2008). Data were also collected on informant's features such as age, gender, educational status and number of children. This was done to narrate their social status with their species competencies. Reflections on species inclinations of people were measured both through separate interviews of informants and in groups, of which the latter trained pair-wise ranking (Maundu, 1995). Complete information about the local name of a plant, part used, flowering/ fruiting periods, season/ quantity of collection, cooking recipe (for culinary vegetables), medicinal uses (method of preparation, mode of application, diseases cured), other ethno botanical uses as (food, fuel, decorative

purposes, fencing, construction etc.) were continuously recorded. In most of the cases, the data collected was also cross checked at different villages from native names or showing field photographs to the informants to confirm the reality of the claims.

vi. Plant Sampling and Photography

A total 193 plant species of 54 families were recorded (Table 2). The wild medicinal plants were composed during the survey in different seasons and temporarily stored and categorized polythene bags to prevent the loss of moisture and prior to being brought to the laboratory (Plates C and D). About 5 to 10 samples of each plant were collected during the study. The photography of the plant was completed by using a Sony Digital Camera (W-50).

v. Plants Preservation

The plant specimen were properly pressed, dried and attached on herbarium sheets (41 × 29 cm). Name of genus, species, authority citation, family, area, name of collector and identifier were documented on label. The voucher specimens were placed in the Herbarium (PUP), Department of Botany, and University of Peshawar.

vi. Taxonomic Identification

Taxonomic identification of the collected plant samples was carried out with the help of Flora of Pakistan (Ali & Qaiser, 1995-2009; Kukkonen, 2001; Chen *et al.*, 2006; Barkworth *et al.*, 2003, 2007). Identified voucher specimens were deposited in Herbarium of department of Botany, university of Peshawar.

vii. Morphological Description

For morphological account with both vegetative and reproductive structures, 3 to 5 specimens per species were studied under the binocular microscope (Kyowa SZE, 0.75x - 3.4X). The morphological characters comprised of both vegetative and reproductive parts that were confirmed by using Flora of Pakistan (Ali and Qaiser, 1995-2009).

3.2 Floristic Structure and Ecological Characteristics

Floristic survey was carried out throughout district Bannu during 2013 - 2015 in different seasons. Plants from different localities were collected, preserved and identified with the help of Flora of Pakistan (Nasir & Ali, 1971-2007; Ali & Qaisar,

1995-2009; Kukkonen, 2001; Chen *et al.*, 2006; Barkworth *et al.*, 2003, 2007). The documentation was later on confirmed at Herbarium (PUP), Department of Botany, University of Peshawar, Herbarium, National Agriculture Research Council, Islamabad, and Herbarium, Pakistan Museum of Natural History, Islamabad and Herbarium, Department of Botany, University of Karachi.

A whole floristic list was alphabetically compiled. The voucher specimens were numbered and placed in Herbarium (PUP), Department of Botany, and University of Peshawar.

3.2.1 Biological Spectra

Plants were classified into several Life-form classes following Raunkiaer (1936) and Hussain (1989) as follows:

- a. **Therophytes** (Th.) these are the annual Plants, bearing seeds and complete their life cycle in one season and over winter the disapproving seasons by means of seeds and spores.
- b. **Geophytes** (G.) These are plants, in which the perennating buds are located underneath the surface of soil and contain plants with deep rhizomes, bulbs, corms and tubers. These may also include hydrophytes which may be submerged, partly submerged and free-floating.
- c. **Hemicryptophytes** (H.) Herbaceous perennials plants are categorized under hemicryptophytes. The aerial portions of the plants die at the end of budding seasons leaving a parenting bud at or just beneath the ground surface may be covered by litter
- d. **Chamaephytes** (Ch) In which, perennating buds are situated near to the ground surface under the height of 25cm.
- e. **Phanerophytes**
 - i. **Nanophanerophytes** (NP) Their perennating sprouts are borne, on aerial shoots from 0.25 m (25 cm) up to 2 m (0.8 ft. to 6 ft.) above the ground surface.
 - ii. **Microphanerophytes** (MicP.) The shrubby plant species with perennating shoots situated above 2 to 7.5 m (6 to 25 ft.) height.

iii. **Mesophanerophytes** (MesP.) These are small trees with their perennating buds are found from 7.5 to 30 m (25 to 100 ft.) height.

iv. **Megaphanerophytes** (MgP.) these are tree species whose perennating buds are located above the height of 30 m (100 ft).

3.2.2 Raunkiaerian and quantitative spectra were calculated as follows.

$$= \frac{\text{No. of sp. falling in a particular life form class}}{\text{Total number of all the species}} \times 100$$

Raunkiaerian Life form spectrum, Quantitative life form spectra were calculated on the basis of importance values of each species encountered in sampling through quadrats by following Cain and Castro (1956) and Qadir and Shetvy (1986).

Leaf size spectra of plants were classified into various Raunkiaerian groups (Raunkiaer, 1934) and quantitative leaf sizes as follows:

Leaf size class	Leaf area up to mm²
Leptophyll (L.)	25 mm ²
Nanophyll (N.)	9 × 25 mm ²
Microphyll (Mic.)	9 ² × 25 mm ²
Mesophyll (Mes.)	9 ³ × 25 mm ²
Macrophyll (Mac.)	9 ⁴ × 25 mm ²
Megaphyll (Meg.)	Larger than macrophyll.

Raunkiaerian spectrum was calculated as follows

$$\text{Leaf size spectrum} = \frac{\text{Number of species falling in a particular leaf-size class}}{\text{Total number of all species for that community}} \times 100$$

Quantitative leaf size spectra were calculated using importance value indices of plant species following Cain & Castro, (1956).

3.2.3 Phytosociology/Vegetation structure

Phytosociological studies were carried out in three representative designated sites. These sites were selected on the basis of soil mineral and elemental composition, species composition, habitats, and physiognomic contrast. Vegetation was studied by using 10 x 10 m quadrates for trees, 5 x 5 m quadrats for shrubs and 1x1 m quadrats for herbs in respectively each sites. Density, cover and frequency of each species were measured and values were changed to relative values. The plant communities were established on the basis of highest importance values.

i. Density

Density is the average number of individuals of a species in unit / area

$$\text{Density} = \frac{\text{No. of individuals of a species}}{\text{Area sampled (Total no. of Quadrats sample)}}$$

$$\text{Relative density} = \frac{\text{Density of a particular species}}{\text{Total densities for all species}} \times 100$$

Table 2. Ten density classes were established as follows; and the mid points were used for calculations:

Class	Range (No. of individual)	Mid-point Value
1	Up to 10	5
2	11-20	15
3	21-30	25
4	31-40	35
5	41-50	45
6	51-60	55
7	61-70	65
8	71-80	75
9	81-90	85
10	91-100	95

ii. Herbage cover

Cover is the vertical projection of foliage shoots/crown of a species to the ground surface expressed as fraction or percentage of a surface area. For low shrubs and herbaceous vegetation the cover may be determined visually by estimating how much percent of an area of the quadrat is covered or shaded by all the individuals or a particular species as viewed from above.

$$\text{Coverage} = \frac{\text{Total coverage of a species}}{\text{Sampled area}}$$

$$\text{Relative coverage} = \frac{\text{Coverage of a particular species}}{\text{Total coverage for all species}} \times 100$$

Table 3. ten cover classes were established for estimating plant cover. Mid-point values were used for calculation.

Class	Range (No. of individual)	Mid-point Value
1	Up to 10	5
2	11-20	15
3	21-30	25
4	31-40	35
5	41-50	45
6	51-60	55
7	61-70	65
8	71-80	75
9	81-90	85
10	91-100	95

iii. Frequency

It is the percentage of quadrats in which species are recorded. It shows how a species is distributed within the stand. It is determined by just recording the existence of a species within the sampling unit regardless of its density and coverage.

$$\text{Frequency} = \frac{\text{No. of quadrats in which a species occur}}{\text{Total number of quadrats sampled}} \times 100$$

$$\text{Relative frequency} = \frac{\text{Frequency value of a particular species}}{\text{Total frequency value for all species in a stand}} \times 100$$

iv. Importance value

The relative values of each parameter for species were added to become the importance values. The community was named after the three foremost species having the highest importance values as follows.

$$IV = RD + RC + RF$$

v. Family importance value

Importance value of each species in a particular families was added together to give rise family importance value for all the quantitatively documented families.

vi. Determination of similarity index

Similarity index was determined by using Sorensen's index (Sorensen, 1948). Which are used quantitative value relatively than simply computing presence or absence of species. The similarities among the stands were compared.

$$IS_{MO} = \frac{2W}{A+B} \times 100$$

Where

W = Sum of lowermost quantitative value of spp. common to both the communities/stand

A = Sum of quantitative value of all spp. in stand/community A,

B = Sum of quantitative value of all spp.in stand/community B

Index of dissimilarity was calculated as, ID = 100 - Index of Similarity

vii. Species diversity

Species diversity was calculated by Simpson's index of diversity (Simpson, 1949).

$$D = \frac{N(N-1)}{\sum n(n-1)}$$

Where

D = Diversity index,

N = Total number of individuals of all species,

n = Number of individuals of a species.

vii. Species richness

Species richness was determined by using following Menhinick (1964).

$$D = S/\sqrt{N}$$

Where

S = Total number of species in the stand

N = Total number of individuals in the stand and

d = species richness.

3.3 Multiple correlations

Correlation is a bivariate study that measures the strengths of relationship between 2-variables. In statistics, the value of the correlation coefficient varies among +1 and -1. When the value of correlation coefficient lies about ± 1 , then it said to be perfect degree of association between the two variables. As the correlation coefficient value goes to 0, the association between the two variables will be weaker. Frequently in statistics, we measure three types of correlation: Person correlation, Kendall rank correlation and Sperarman correlation.

Multiple correlation of different soil variables in relation to the total Density, Frequency, Cover and importance values in different season were studied. For this purpose, SAM v 4.0 software was used.

SAM (Spatial Analysis in Macro-ecology) is a program designed as a package of tackles for spatial statistical analysis; generally for applications in surface pattern spatial Analysis. SAM is frequently used in the fields of Macro-ecology and Bio-geography, but also in Conservation-iology, Community and Ecology, Geography, Geology, Demography, Econometrics, and Epidemiology.

SAM is used worldwide by thousands of scientists, in more than 50 countries, as their primary instrument for statistical analysis. In detail, a paper published in *Global Ecology and Biogeography* to announce SAM for the scientific community has a citation rate of ~50 new citations per year. It shows how much SAM is accepted and used as a valuable investigative tool in science.

3.4 Edaphology

Soil samples were collected in March and August, 2012-2014, from 0-6 cm depth at 3 multiple of 3 different sites and analyzed for elemental composition and physico-chemical characteristics (Bao, 1999; Anon, 1978 and Collison, 1977).

i. Soil texture

A soil texture was determined by Hydrometer method (Bouyoucos, 1936) and textural classes were determined with the help of textural triangle (Brady, 1990).

ii. Organic matter

Soil organic matter was determined by oxidation with potassium dichromate in sulphuric acid medium under standard wet burning method followed by (Rayan *et al.*, 1997).

iii. Nitrogen

Total Nitrogen was determined by the Kjeldahl method of (Bremner & Mulvaney, 1982).

iv. Phosphorus

Phosphorus was determined after Olsen & Sommers (1982).

v. Potassium

Potassium was determined by flame emission spectroscopy (Rhoades, 1982).

vi. pH

Soil pH was measured in 1:5 soil water suspensions with a pH meter (Jackson, 1962).

vii. Electrical conductivity

Electrical conductivity of the soil was determined in 1: 5 soil water interruptions with EC meter.

3.5 Palatability of vegetation

The degree of palatability of plant species was documented by observing the grazing livestock in the field. Cattle, goats and sheep were usually observed to determine their preferences. Information was collected through survey in different season and also from local people of the area. Plants were categorized into palatable and non-palatable plants species in the area following Hussain & Durani (2009); Hardison *et al.* (1954); Heady, (1964) and Jonstone-W & Kennedy, (1944).

Palatable plants were classified by animal preference; parts used and season of availability. Palatable plant species were classified as follows following Hussain & Durani (2009).

- a. Non palatable.
- b. Highly Palatable
- c. Mostly Palatable.
- d. Less Palatable.
- e. Rarely Palatable.

3.6 Elemental analysis

Elemental analysis of powder form the selected plants were carried out with atomic absorption spectrophotometry for the following elements.

Nitrogen (N), Phosphorus (Ph), Potassium (K), Magnesium (Mg), Calcium (Ca), Sulphur (S), Manganese (Mn), Silicon (Si), Iron (Fe), Copper (Cu), Zinc (Zn), Cobalt (Co), Lead (Pb), Nickel (Ni), Chromium (Cr) and Cadmium (Cd).

i. Reagents and equipment

Double distilled water, Nitric acid (HNO_3), Sulphuric acid (H_2SO_4), Hydrogen peroxide (H_2O_2), Hydrogen Fluoride (HF), per chloric Acid (HClO_4) and Hydrochloric acid (HCl). The total reagents used were from Merk (Darmstadt, Germany). Pb, Cd, Co and Mn sigma prepared and Cu, Zn and Fe Aldrich made. Glassware's and plastic apparatus were thoroughly washed away with water, followed by cleaning with distilled water prior to use.

ii. Sample preparation

Samples were prepared by wet digestion process (Hseu, 2004). For this purpose 01g of the particular powder drug was occupied in a conical flask and then added 10 ml of concentrated HNO_3 (67%) and preserved overnight (24 h) at room temperature, monitored by the adding of 4 ml of HClO_4 (67%). After 30 minutes, the substances of each flask were heated on hot plate to vaporize, until a clear solution of about 1 ml was left. After cooling that, solution was prepared to a final volume of 100 ml by adding of double distilled water and sifted through what-man # 42 filter-papers. The filtrate worked as stock solution for all sample. The samples were stored in airtight bottles for elemental analysis through atomic absorption spectrophotometer (Eslami *et al.*, 2007). All samples were then examined by flame atomic absorption spectrophotometer (Polarized Zeeman Hitachi 2000) and flame photometer (Jenway PFP7, UK) in triplicate. Calibration standard of each metal was arranged by suitable of stock solutions (Saeed *et al.*, 2010).

iii. Procedure

The corresponding cathode lamp for each element was rotated on and permitted to warm up for 10 minutes after regulating the instrument according to the situations given in the table below. After heating, cathode lamp the air acetylene flame was ignited. The instrument was calibrated and standardized with working standards values of 2.5, 5, and 10 ppm for particular element. The element standard solution used for calibration were set by diluting a stock solution of Pb, Co, Mn, Cr, K (sigma), Fe, Na, Cu (Aldrich), Zn and Ni (Parkin Elmer) working standard was sought into the flame and the concentration in ppm of each element was intended by comparing with the standard curve of individual metal (Tuzen, 2003; Isildak *et al.*, 2004; Soylak *et al.*, 2005; Svoboda *et al.*, 2006 and Elekes *et al.*, 2010).

Table 4. Optimal analytical conditions for the elemental analysis using air-acetylene flame on atomic absorption spectrophotometer.

Elements	Wavelength (nm)	HC Lamp Current (mA)	Slit width (nm)	Fuel-gas flow rate (L/min)	Detection limit (µg/L)
Ca	422.7	6.0	0.5	2.0	4
Cd	228.8	4.0	0.3	1.8	4
Co	240.7	6.0	0.2	2.2	5
Cr	357.9	5.0	0.5	2.6	6
Cu	324.8	3.0	0.5	1.6	4
Fe	248.3	8.0	0.2	2.0	6
K	766.5	5.0	0.5	1.9	4
Mg	285.2	4.0	0.5	1.6	1
Mn	279.5	5.0	0.4	1.9	3
Pb	217.0	7.0	0.3	1.8	10
Zn	213.9	4.0	0.5	2.0	2

3.7 Nutritional investigation

Plants offer nutritional requirements as they comprise protein, carbohydrates, fats and other nutrients, mandatory for growth and development of human (Aruoma, 2003). The subsequent parameters were estimated in the proposed plants.

Proximate analysis

The plant samples were examined in tri-plicate for their moisture, ash, dry matters, crude proteins, crude fats, crude fibers, carbohydrates and gross energy value using standard methods as outlined by Association of Official Analytical Chemists (A. O. A. C, 1990, 1999 and 2000) and Association of American Oil Chemists (A. O.C. S, 2005).

i. Determination of the moisture

Equipment and glassware

Electric Oven, Petri dishes, desiccators and electric balance.

Procedure

About 2 gram of respective plant material was taken in a known weight Petri-dish (W_1). The petri-dishes were moderately enclosed with lid, kept in oven at temperature of 105°C for 4-6 hours, till constant weight was achieved and was then transferred and down for 30 minutes; after that the Petri-dishes were weighted again (W_2). Percentage moisture content were calculated by the following formula (A.O.A.C, 2000)

$$\% \text{ Moisture} = \frac{X}{\text{Wt of Sample}} \times 100$$

Where

$$X = \text{Weight of the sample (after heating)} = W_2 - W_1$$

$$W_2 = \text{Weight of the empty Petri dish + sample (after heating)}$$

$$W_1 = \text{Weight of the empty Petri dish.}$$

ii. Determination of ash

Equipment's and glassware

Muffle furnace, silica-dish, electric-balance, desiccators, and benzene burner. Ash was determined by heating at 550°C in muffle furnace. The method is given below.

Procedure

Kept flat bottomed silica dish in a burner lame just for 1 minute, transfer it to a desiccators then cool down, and weight it (W). Weight out suitable quantity of the plants materials into a silica dish (W) and heat it gradually on the Bunsen burner and charred mass is in an appropriate condition for transfer to a muffle furnace at 550°C (A. O. A. C, 2000).

Continue the heating until the carbon has been burnt away. Transfer the dishes plus ash to desiccators, cool down, and weight it (W_2).

Weight of the empty dish = W

Weight of the empty dish + sample = W₁

Weight of the empty dish + ash = W₂

Formula:

$$\% \text{ Ash} = \frac{W_1 - W_2}{W_t \text{ of the sample}} \times 100$$

iii. Determination of Protein by “Macarojeldahl distillation method”

Reagents

Concentrated H₂SO₄, 32% NaOH, 4% Boric Acid K₂SO₄, CuSO₄ and 0.1 N standard HCL solution.

Mixed indicators

Prepared by mixing 0.01g of methyl red and 0.03g of bromo-cresol green in 100 ml of alcohol.

Apparatus

Kjeladhl flask, digestion and distillation apparatus and burette etc.

Procedure

Protein (% N ×6.25) was determined by Macro Kjeldahl distillation method. The method is given below.

Put 0.5 gram of dry ground sample in digestion flask. Digestion mixture (Copper sulphate (5 gram), Potassium sulphate (94 gram) and ferrous sulphate (1 gram) and 25 ml con. Sulphuric acid were added to the flask and digested in digestion flask for 6 hours. The flask was then detached, cool down and the contents were then shifted to 250 ml flask. Small quantities of distilled water were added to make the volume to the level 50 ml of the above solution. 10 ml of strong alkali was added to make it basic.

About 50 ml of 4% Boric acid solution was putted to the distillation flask along with 3-5 drops of mixed indicator. 50 ml of water and 60 ml of 32% NaOH solutions were then added to it. Afterward distillation, it was then collected in flask for titration.

Titration was completed by noted and the percentage of protein was determined using the following formulae (A. O. A. C., 2000).

$$(N \%) = \frac{(V_1 - V_2) \times 14.01 \times 0.5 \times 100}{(\text{Sample in mg})}$$

V_1 = titration reading of sample

V_2 = titration reading of blank

14.01 = Atomic weight of Nitrogen (N)

Crude percent protein contents were calculated for all samples by multiplying the nitrogen (N) content of the sample by 6.25.

Protein (%) = % Nitrogen $\times$ 6.25.

iv. Determination of Fats (ether extract)

Equipments, chemicals and glassware

Petroleum ether B.P (40-60°C) H.T (Tecator).

Procedure

Soxhlet apparatus was used for the extraction of crude fats (Zarnowski & Suzuki, 2004). 2 gram of respective samples was packed in cellulose extraction thimble prepared of filter-paper which was kept in extraction chamber of the apparatus. A clean and dried pre-weight 250 ml round bottom flask was filled with petroleum ether and connected to the extraction tube containing thimble. The Soxhlet apparatus was run for 6-hours. The solvent from the extract in the round bottom flask was evaporated using water bath and weighted (W_2). Fats percentage was then calculated by the following standard method (A.O.A.C., 2000).

$$\% \text{ Fats (Ether extract)} = \frac{X}{\text{Wt of Sample}} \times 100$$

Where

X = Weight of the fats = $W_2 - W_1$

W_1 = Weight of the empty flask

W_2 = Weight of the empty flask + sample after evaporation of solvent.

v. Determination of crude fiber

Equipment's and glassware

Crude fiber extraction apparatus (Fiber Tec System M. Tecator), Suction pump, Muffle furnace, oven.

Reagents

Sulphuric acid – 0.255N

Sodium hydroxide – 0.313

Asbestose, petroleum ether, ethyl alcohol

Procedure

Three gram of the respective sample was dried out in the oven to constant weight. Two gram of this material was extracted with Petroleum ether to remove crude fats. The residue material was shifted to digestion flask along with asbestos (0.5 g). To this, about 200 ml boiling 0.255 N, H₂ SO₄ was added. The flask was attached to the condenser and boiled for 30 minutes. The contents were then filtered through lien cloth in fluted funnel. The residue was wash to remove the acids and transferred again to the digestion flask with boiling 0.313 N NaOH. Adding of NaOH was continued till the volume to accurately 200 ml. the flask was then connected to the reflux condenser and boil for 30 minutes. This hot material was then filtered through Gooch crucible prepared with asbestose-mat. It was carefully washed with boiling water monitored by 15 ml of ethyl alcohol. The substances were then taken to a crucible and dried at 110⁰C in hot air oven till constant (W₁). The crucible was then shifted to the muffle furnace, ignited till white and weighted (W₂) crude fiber were then calculated (A.O. A. C., 2000).

$$\% \text{ Crude Fiber} = \frac{W_2 - W_1}{\text{Weight of Sample}} \times 100$$

Where

$$W_2 - W_1 = \text{Crude fiber}$$

vi. Carbohydrates contents

Carbohydrates contents were calculated by subtracting the sum of the weight of proteins, fats, crude fibers, ash, and moisture contents from 100 (Merril and Watt, 1973).

$$\% \text{ Carbohydrates} = 100 - (\text{Proteins} + \text{Fats} + \text{Crude Fibers} + \text{Ash} + \text{Moisture contents})$$

vii. Gross energy

The gross energy of proteins, fats, fibers and carbohydrates were find out through (A.O. A. C., 2000) method. Following formula is used to study the total gross energy of proteins, fats, fibers and carbohydrates in a particular plant parts. We can the gross energy individual plants species as well for each of the nutrients independently.

Formula:

Energy value (K cal/100g = $(2.62 \times \% \text{ Proteins}) + (8.37 \times \% \text{ fats}) + (4.2 \times \% \text{ Carbohydrates}) + (4.6 \times \text{fibers})$ (Umerie *et al.* 2010).

CHAPTER – 4

RESULTS AND DISCUSSION

4.1 Floristic Study

Floristic diversity of a region is the total numbers of the species within its specific boundaries, whether wild or cultivated, which is an image of vegetation and plant resources. Plant resources are affected by agriculture, over grazing, deforestation, anthropogenic interaction and natural disasters. The research area was frequently visited and plants were collected during 2012-2014. In the present research study, the flora of District Bannu consists of 193 plant species of 155 genera belonging to 54 families (Table 5). Out of them 145 species belong to Dicotyledons and 48 species to Monocotyledons. Poaceae was the dominant family with 37 species followed by Asteraceae with 17 species, Papilionaceae with 15 species, Solanaceae 9 species, Brassicaceae 8 species, Cucurbitaceae 7 species, Amaranthaceae 6 species, Boraginaceae 6 species, Chenopodiaceae 5 species, Euphorbiaceae 5 species, Mimosaceae 5 species, Polygonaceae 5 species, Malvaceae 4 species, Moraceae 4 species, Zygophyllaceae 3 species, Alliaceae, Apocynaceae, Aslepiadaceae, Caryophyllaceae, Convolvulaceae, Cyperaceae, Myrtaceae, Ranunculaceae, Rutaceae, Typhaceae, Tamaricaceae and Verbenaceae having (2 spp.) each. While the rest of all Anacardiaceae, Arecaceae, Aizoaceae, Cappariaceae, Cuscutaceae, Fumariaceae, Gentianaceae, Iridaceae, Juncaceae, Linaceae, Meliaceae, Nyctaginaceae, Orobanchaceae, Oxalidaceae, Papaveraceae, Primulaceae, Resedaceae, Rhamnaceae, Rubiaceae, Scrophulariaceae, Tiliaceae, Violaceae and Vitaceae families are monospecific. Our results are in accordance with the work of Badshah *et al.* (2013; Ihsan *et al.* (2011) and Malik & Malik, (2004). Flora of Pakistan (Ali & Qaisar, 1995-2009) and abroad (Antje *et al.*, 2003; Eilu *et al.*, 2004) also indicated similar result.

The highest species percentage was recorded in family Poaceae (19.17%) while lowest is 0.52% is found in monospecific families (Table 6). Poaceae was dominant family and having large numbers of species which are consistently supported by Parveen *et al.* (2008); Qureshi & Bhatti, (2008) and Hussain *et al.* (2009).

The habitat conditions of (Figure 2) showed that dry habitat condition was dominant (45.07%) followed by wet (34.71%), cultivated (18.13%) and both wet and dry

(2.07%). Dry area have greater diversity as compared to wet moist and cultivated habitat in the study area. Wild xerophyte were dominant in the research area. Similar results were obtained by Musila *et al.* (2003) and Gimenez *et al.* (2004).

Seasonal variation (Figure 3) showed that spring had 156 species (41.37%), followed by summer with 94 species (24.93%), winter 74 species (19.62%) and autumn 53 species (14.05%). The research area was clearly classified in four aspects i.e. spring, summer, winter and autumn. Durrani *et al.* (2010) and Ahmad *et al.* (2009) have reported that vernal and aestival aspects have higher numbers of species than any other aspect.

The biological spectrum of the research area (Figure 4) showed that Therophytes were dominant (60.62%) followed by Hemi-cryptophytes (9.84%), Chamaephytes (7.25%), Geophytes (9.84%), Microphenerophytes (6.73%), Nanophenerophytes (5.69%) and Parasites (0.52%). Life form of Raunkiaer, (1934) classification is more reliable, which is based upon the principal of position and degree of protection to perennating bud during the unfavorable or adverse condition. Raunkiaer, (1934) distinguished three main phytoclimates on the basis of life form. It includes phanerophytic climate in the tropics, therophytic in deserts and hemicryptophytic in the greater part of cold temperate zone. Therophytic flora was dominant in research area. Biological spectra are important in comparing geographically and habitually widely separated plant communities and are also considered as an indicator of prevailing environmental condition. Biological spectra changes due to biotic influences like agricultural practices, grazing, deforestation, trampling and climatic changes Hussain, (1989).

The leaf size spectra (Figure 5) expressed that the plants with Nanophyll leaves were dominant (48.18%) followed by Leptophyll (21.24%), Microphyll (19.17%), Mesophyll (9.84%), and Aphyllous (1.55%). Nanophyll species and leptophyll species are characteristic of hot desert while microphyll is the characteristic of steppes (Khan *et al.*, 2013; Tareen & Qadir, 1993.). Similarly, Sher & Khan (2007) reported high percentage of leptophylls and nanophylls from Chagarzai area. Species with small leaves are generally characteristics of dry and adverse habitats adapted to arid region (Nasir & Sultan, 2002). Hussain & Chudhary, (2009) reported higher percentage of microphyllous in contrast to our findings owing to moist environmental condition in Azad Kashmir. In dry habitats soil generally have poor nutrient contents

due to which roots feel difficulty in absorbing soil moisture as in the present study, encouraging leptophyllous and nanophyllous vegetation.

Plants with simple leaves (Figure 6) were dominant (76.16%) followed by compound leaves (11.39%), dissected leaves (11.39%) and leafless type (1.03%).

During present investigation, 18 species (9.32%) were spiny and 175 species (90.67%) were non- spiny in nature. Spinescence is also indicator of dry soil and environment. The leaf lamina was simple in 147 species (76.16%), 2 species (1.03%) were leafless; while in the remaining 44 species (23.79%) leaves were compound or divided leaves. Same species have been described from other parts of Pakistan by Badshah *et al.* (2013) and Durrani *et al.* (2010).

Although 193 species were listed from the district Bannu, however, quantitatively they had limited distribution in the study area. A rich flora is that one which has high species diversity and species richness. Floristic composition of flora is a qualitative feature that alone cannot reflect the true picture of this area. Thus there is a need of quantitative consideration of the vegetation resources. It helps in the recognition of ecological elucidation of vegetation.

Table 5. Floristic list of plant Species of District Bannu.

S/No.	Plant species Name	Family	Habitat	Seasonality				Life Form	Leaf Size	Lamina	Spinescence
				A	W	S	Sm				
01	<i>Abelmoschus esculentus</i> (Linn.) Moench.	Malvaceae	C	-	-	-	+	Th	Mic	S	-
02	<i>Achyranthes aspera</i> L.	Amaranthaceae	W	+	-	-	-	Th	N	S	Sp
03	<i>Acacia modesta</i> Wall.	Mimosaceae	D	+	+	+	+	Mp	L	Com	Sp
04	<i>Acacia nilotica</i> (L.) Wild.ex Delile	Mimosaceae	D	+	+	+	+	Mp	L	Com	Sp
05	<i>Aerva javanica</i> (Burm. F.) Juss.	Amaranthaceae	W	+	+	+	+	Ch	L	S	-
06	<i>Albiza lebbeck</i> (L.) Benth	Mimosaceae	W	+	+	+	+	Mp	L	Com	-
07	<i>Alhagi maurorum</i> Medic.	Papilionaceae	W	-	-	-	+	H	L	Dis	Sp
08	<i>Allium sativum</i> L.	Alliaceae	C	-	+	+	-	G	N	S	-
09	<i>Allium cepa</i> L.	Alliaceae	C	-	+	+	-	G	N	S	-
10	<i>Alopecurus nepalensis</i> Trin.Ex Steud.	Poaceae	W	-	-	+	-	Th	Mic	S	-
11	<i>Aloe vera</i> (L.) Brum	Asphodelaceae	D	+	+	+	+	Th	Mic	S	-
12	<i>Anagallis arvensis</i> L.	Primulaceae	W	-	-	+	-	Th	N	S	-
13	<i>Amaranthus blitoides</i> S. Watson	Amaranthaceae	W	-	-	+	-	Th	N	S	-
14	<i>Amaranthus viridis</i> L.	Amaranthaceae	W	+	-	-	-	Th	N	S	-
15	<i>Aristida adscensionis</i> L.	Poaceae	D	+	-	-	-	H	Mic	S	-
16	<i>Aristida cyanantha</i> Nees ex Steud.	Poaceae	D	-	-	-	+	H	Mic	S	-
17	<i>Arnebia hispidissima</i> (Lehm.) A. DC.	Boraginaceae	W	-	-	+	-	Th	L	S	-

18	<i>Asphadelus tunifolius</i> Caven.	Asphodelaceae	W	-	+	+	-	G	L	S	-
19	<i>Astragalus scorpiurus</i> Bunge.	Papilionaceae	D	-	-	+	+	Ch	L	Com	-
20	<i>Atriplex stocksii</i> Boiss	Chenopodiaceae	W	-	+	+	+	Np	N	S	-
21	<i>Avena fatua</i> L.	Poaceae	W	-	+	-	-	Th	N	S	-
22	<i>Boerhavia procumbens</i> Banks ex Roxb	Nyctaginaceae	D	+	-	-	-	H	N	S	-
23	<i>Brassica campestris</i> L.	Brassicaceae	C	-	+	+	-	Th	N	Dis	-
24	<i>Brassica tournefortii</i> Gouan	Brassicaceae	W	-	+	+	-	Th	N	Dis	-
25	<i>Bromus pectinatus</i> Thunb.	Poaceae	W	-	-	+	-	Th	N	S	-
26	<i>Calendula officinalis</i> L.	Asteraceae	W	-	-	+	-	Th	N	S	-
27	<i>Calligonum polygonoides</i> L.	Polygonaceae	W	+	+	+	+	Np	L	S	-
28	<i>Calotropis procera</i> (Willd.) R. Br.	Asclepiadaceae	D	+	+	+	+	Ch	Mes	S	-
29	<i>Capsicum annuum</i> L.	Solanaceae	C	-	-	+	+	Th	N	S	-
30	<i>Capparis decidua</i> (Frossk.) Edgew.	Capparidaceae	D	+	+	+	+	Np	Ap	Abs	Sp
31	<i>Carduus argentatus</i> L.	Asteraceae	D	-	-	+	-	Th	Mic	S	-
32	<i>Carthamus persicus</i> Willd.	Asteraceae	D	-	-	+	+	Th	Mic	S	-
33	<i>Carthamus tinctorius</i> L.	Asteraceae	D	-	-	+	+	Th	Mic	S	Sp
34	<i>Celosia argentea</i> L.	Amaranthaceae	W	-	-	+	-	Th	N	S	-
35	<i>Cenchrus biflorus</i> Roxb.	Poaceae	D	-	-	-	+	H	L	S	-
36	<i>Cenchrus ciliaris</i> L.	Poaceae	D	-	+	-	+	H	L	S	-
37	<i>Centaurea iberica</i> Spreng.	Asteraceae	D	-	-	+	-	Th	N	Dis	Sp

38	<i>Centaurium pulchellum</i> (Sw.) Druce	Gentianaceae	W	-	-	+	-	Th	N	Dis	-
38	<i>Chenopodium album</i> L.	Chenopodiaceae	D	-	+	+	-	Th	N	S	-
40	<i>Chenopodium murale</i> L.	Chenopodiaceae	D	+	-	-	-	Th	L	S	-
41	<i>Chrozophora tinctoria</i> (L.) Raf.	Euphorbiaceae	D	-	-	-	+	Th	N	S	-
42	<i>Cicer arietinum</i> L.	Papilionaceae	C	-	-	+	-	Th	L	Com	-
43	<i>Cirsium arvense</i> (L.) Scop.	Asteraceae	W	-	-	+	-	Th	Mic	S	-
44	<i>Cistanche tubulosa</i> (Schrenk.) Hook. f.	Orobanchaceae	D	-	-	+	-	G	L	S	-
45	<i>Citrullus colocynthis</i> (L.) Shred.	Cucurbitaceae	D	+	-	-	-	Th	Mic	Dis	-
46	<i>Citrus limon</i> (L.)Burm.f	Rutaceae	C	+	+	+	+	Th	N	S	Sp
47	<i>Citrus reticulata</i> Blanco	Rutaceae	C	+	+	+	+	Th	N	S	-
48	<i>Convolvulus arvensis</i> L.	Convolvulaceae	D	-	+	+	-	Th	N	S	-
49	<i>Convolvulus spicatus</i> Hallier f.	Convolvulaceae	D	-	-	+	+	Th	N	S	-
50	<i>Conyza bonariensis</i> (L.) Cronquist	Asteraceae	D	-	-	+	+	Th	Mic	S	-
51	<i>Corchorus depressus</i> (L.)	Tiliaceae	W	+	-	-	-	Th	L	S	-
52	<i>Croton bonplandianus</i> Bat.	Euphorbiaceae	D	-	-	+	-	Th	N	S	-
53	<i>Cucumis sativus</i> L.	Cucurbitaceae	C	-	-	-	+	Th	Mic	S	-
54	<i>Cucurbita maxima</i> Duch Ex. Lam.	Cucurbitaceae	C	-	-	-	+	Th	Mes	S	-
55	<i>Cucurbita pepo</i> L.	Cucurbitaceae	C	-	-	-	+	Th	Mes	S	-
56	<i>Cuscuta reflexa</i> Roxb.	Cuscutaceae	D	+	+	+	+	P	Ap	Dis	-
57	<i>Cymbopogon distans</i> Schutt.	Poaceae	D	-	-	+	-	H	N	S	-
58	<i>Cyamopsis tetragonoloba</i> (L.) Taubert	Papilionaceae	C	-	-	-	+	Th	N	Com	-

59	<i>Cynodon dactylon</i> (L.) Pers.	Poaceae	D & W	+	+	+	+	H	L	S	-
60	<i>Cyperus difformis</i> L.	Cyperaceae	W	-	+	+	-	G	N	S	-
61	<i>Cyperus rotundus</i> L.	Cyperaceae	W	+	+	-	+	G	N	S	-
62	<i>Dalbergia sissoo</i> Roxb.	Papilionaceae	W&D	+	+	+	+	Mp	N	Com	-
63	<i>Datura alba</i> Nees.	Solanaceae	D	-	-	+	-	Th	Mic	S	Sp
64	<i>Desmostachya bipinnata</i> (L.) Stapf.	Poaceae	D & W	+	-	+	-	H	N	S	-
65	<i>Dichanthium annulatum</i> Forssk.	Poaceae	D	-	+	-	-	H	N	S	-
66	<i>Digera muricata</i> (L.) Mart	Amaranthaceae	D	-	-	+	-	Th	N	S	-
67	<i>Dinebra retroflexa</i> (Vahl) Panzer.	Poaceae	D	-	-	+	-	Th	N	S	-
68	<i>Daucus carota</i> Linn.	Apiaceae	C	-	+	+	-	Th	L	Dis	-
69	<i>Echinochloa crus-galli</i> (L.) P. Beauv.	Poaceae	D	-	-	-	+	Th	N	S	-
70	<i>Echinops echinatus</i> L.	Asteraceae	D	-	-	+	+	Th	N	Dis	Sp
71	<i>Eleusine indica</i> (L.) Gaertn.	Poaceae	D	-	-	-	+	Th	N	S	-
72	<i>Eragrostis pilosa</i> (L.) P. Beauv.	Poaceae	D	-	-	+	+	H	N	S	-
73	<i>Eragrostis minor</i> Host.	Poaceae	D	-	-	+	+	H	N	S	-
74	<i>Eruca sativa</i> Mill.	Brassicaceae	C	-	+	+	-	Th	N	Dis	-
75	<i>Eucalyptus camaldulaensis</i> Dehnh.	Myrtaceae	C	+	+	+	+	Mp	N	S	-
76	<i>Euphorbia dracunculoides</i> Lam.	Euphorbiaceae	D	-	+	+	-	Th	N	S	-
77	<i>Euphorbia helioscopia</i> L.	Euphorbiaceae	D	-	-	+	-	Th	N	S	-
78	<i>Euphorbia prostrata</i> Ait.	Euphorbiaceae	D	-	-	+	+	Th	L	S	-
79	<i>Fagonia indica</i> L.	Zygophyllaceae	D	-	-	+	+	Th	L	S	Sp

80	<i>Farsetia jacquemontii</i> (Hook. F. & thoms.) Jafri	Brassicaceae	D	-	-	+	+	Th	N	S	-
81	<i>Ficus carica</i> L.	Moraceae	D	+	+	+	+	Np	Mes	S	-
82	<i>Ficus religiosa</i> L.	Moraceae	C	+	+	+	+	Np	Mes	S	-
83	<i>Filago pyramidata</i> L.	Asteraceae	D	-	-	+	-	Th	L	S	-
84	<i>Fumaria indica</i> Hausskn.	Fumariaceae	D	-	+	+	-	Th	N	Dis	-
85	<i>Galium tricornis</i> Stokes	Rubiaceae	W	-	-	+	-	Th	N	S	
86	<i>Heliotropium crispum</i> Desf.	Boraginaceae	D	-	-	+	-	Th	Mic	S	-
87	<i>Heliotropium europaeum</i> (F. & M.) Kazmi	Boraginaceae	D	-	-	+	-	Th	Mic	S	-
88	<i>Heliotropium strigosum</i> Wild	Boraginaceae	D	-	-	+	-	Th	Mic	S	-
89	<i>Hibiscus rosa-sinensis</i> Linn.	Malvaceae	C	+	+	+	+	Th	Mic	S	-
90	<i>Hordeum vulgare</i> L.	Poaceae	C	-	-	+	-	Th	Mic	S	-
91	<i>Hypecoum pendulum</i> L.	Papaveraceae	D	-	-	+	+	Th	L	Dis	-
92	<i>Hyoscyamus niger</i> L.	Solanaceae	D	-	-	+	—	Th	Mic	S	Sp
93	<i>Juncus inflexus</i> L.	Juncaceae	W	-	-	+	+	G	L	S	-
94	<i>Ifloga spicata</i> Forssk.	Asteraceae	D	-	-	+	-	Th	L	S	-
95	<i>Iris lactea</i> Pallas	Iridaceae	W	-	—	+	—	G	N	S	-
96	<i>Lactuca serriola</i> L.	Asteraceae	D	-	-	+	-	Th	Mic	S	-
97	<i>Lathyrus aphaca</i> L.	Papilionaceae	W	-	-	+	-	Th	N	Com	-
98	<i>Lathyrus sativus</i> L.	Papilionaceae	W	-	-	+	+	Th	N	Com	-
99	<i>Launaea angustifolia</i> (Desf.) Kuntze	Asteraceae	D	-	-	+	-	Th	Mes	S	-

100	<i>Launaea procumbens</i> Pravin Kawale	Asteraceae	D	-	-	+	-	Th	Mes	S	-
101	<i>Leptochloa panicea</i> Retz	Poaceae	D	-	+	+	-	Th	N	S	-
102	<i>Linum corymbulosum</i> Reichenb.	Linaceae	D	-	-	+	-	Th	N	S	-
103	<i>Luffa aegyptica</i> Mill.	Cucurbitaceae	C	-	-	-	+	Th	N	S	-
104	<i>Lycopersicon esculentum</i> Miller	Solanaceae	C	-	-	+	+	Th	Mic	Com	-
105	<i>Magifera indica</i> L.	Anacardiaceae	C	+	+	+	+	Mp	Mic	S	-
106	<i>Malcolmia africana</i> (L.) R.Br.	Brassicaceae	D	-	-	+	-	Th	N	S	-
107	<i>Malva neglecta</i> Wallr.	Malvaceae	D	-	+	+	+	Th	Mic	S	-
108	<i>Malvastrum coromendelianum</i> (L.) Gracke	Malvaceae	D	-	-	+	-	H	N	S	-
109	<i>Mentha longifolia</i> L.	Lamiaceae	W	-	+	+	-	G	N	S	-
110	<i>Mentha spicata</i> (L.) L.	Lamiaceae	W	-	+	+	-	G	N	S	-
111	<i>Momordica charantia</i> L.	Cucurbitaceae	C	-	-	-	+	Th	N	S	-
112	<i>Medicago polymorpha</i> L.	Papilionaceae	D	-	-	+	-	Th	N	Com	-
113	<i>Melia azedarach</i> L.	Meliaceae	C	+	+	+	+	Ph	N	Com	-
114	<i>Melilotus alba</i> Desr.	Papilionaceae	D	-	-	+	+	Th	L	S	-
115	<i>Melilotus indica</i> (L.) All.	Papilionaceae	D	-	+	+	-	Th	N	S	-
116	<i>Morus alba</i> L.	Moraceae	D	+	+	+	+	Mp	Mes	S	-
117	<i>Morus nigra</i> L.	Moraceae	D	+	+	+	+	Mp	Mes	S	-
118	<i>Nerium indicum</i> Mill.	Apocynaceae	D	+	+	+	+	Np	Mic	S	-
119	<i>Neslia apiculata</i> Fisch.	Brassicaceae	W	-	-	+	-	Th	N	S	-
120	<i>Nicotiana plumbaginifolia</i> Viv.	Solanaceae	W	-	-	+	-	Th	N	S	-

121	<i>Nonea edgeworthii</i> A. DC.	Boraginaceae	W	-	-	+	-	Th	L	S	-
122	<i>Nonea pulla</i> (L.) DC.	Boraginaceae	W	-	-	+	-	Th	L	S	-
123	<i>Oligomeris linifolia</i> (Vahl.) Macbride	Resedaceae	D	-	-	+	-	Th	N	S	-
124	<i>Hordeum murinum</i> Sub. <i>Glacum</i> (Steud) Tzveleve	Poaceae	W	-	-	+	-	Th	L	S	-
125	<i>Oryza sativa</i> L.	Poaceae	C	-	-	-	+	Th	Mic	S	-
126	<i>Ocimum basilicum</i> L.	Lamiaceae	D	+	+	+	+	Ch	N	S	-
127	<i>Oxalis corniculata</i> L.	Oxalidaceae	W	-	-	+	+	Th	N	Com	-
128	<i>Oxyria digyna</i> (L.) Hill.	Polygonaceae	D	-	-	+	-	Th	N	S	-
129	<i>Pennisetum glaucum</i> Linn.	Poaceae	C	-	-	-	+	Th	Mic	S	-
130	<i>Parthenium hysterophorus</i> L.	Asteraceae	D	-	-	+	+	Th	Mic	Dis	-
131	<i>Pegnum harmala</i> L.	Zygophyllaceae	D	-	-	+	+	H	L	S	-
132	<i>Periploca aphylla</i> Decne.	Asclepiadaceae	D	+	+	+	+	Np	Ap	Abs	-
133	<i>Phalaris minor</i> Retz.	Poaceae	D	-	-	+	-	G	N	S	-
134	<i>Phoenix dactylifera</i> L.	Arecaceae	W & D	+	+	+	+	Mp	Mes	Com	-
135	<i>Phragmites karka</i> (Retz.) Trimn.ex Steud.	Poaceae	W	+	-	+	+	Ch	Mes	S	-
136	<i>Plantago lanceolata</i> L.	Plantaginaceae	W	-	-	+	+	Th	N	S	-
137	<i>Plantago ovata</i> Frossk.	Plantaginaceae	W	-	-	+	+	Th	N	S	-
138	<i>Poa annua</i> L.	Poaceae	W	-	+	+	-	Th	L	S	-
139	<i>Poa botryoides</i> (Trin. Ex Griseb.) Kom.	Poaceae	W	-	+	+	-	Th	L	S	-
140	<i>Poa bulbosa</i> L.	Poaceae	W	-	+	+	-	Th	L	S	-

141	<i>Polygonum biaristatum</i> Aitch. & Hemsl.	Polygonaceae	D	-	+	+	-	Th	N	S	-
142	<i>Polygonum plebejum</i> R.Br	Polygonaceae	W	-	+	+	-	H	N	S	
143	<i>Polypogon monspeliensis</i> (L.) Desf.	Poaceae	W	-	-	+	-	Th	N	S	-
144	<i>Portulaca oleracea</i> Linn.	Azioaceae	D	-	-	+	+	Th	N	S	-
145	<i>Psammogeton biternatum</i> Edgew.	Apiaceae	W	-	-	+	+	Th	L	Dis	-
146	<i>Psidium guajava</i> Linn.	Myrtaceae	C	+	+	+	+	Th	Mes	S	-
147	<i>Prosopis cineraria</i> L.	Mimosaceae	D	+	+	+	+	Np	L	Com	Sp
148	<i>Prosopis juliflora</i> Swartz.	Mimosaceae	D	+	+	+	+	Np	L	Com	Sp
149	<i>Raphanus sativus</i> Linn.	Brassicaceae	C	-	+	-	-	Th	N	Dis	-
150	<i>Ranunculus muricatus</i> L.	Ranunculaceae	W	-	-	+	+	G	Mic	Dis	-
151	<i>Ranunculus sceleratus</i> L.	Ranunculaceae	W	-	-	+	-	G	Mic	Dis	-
152	<i>Rostraria cristata</i> Linn.	Poaceae	W	-	-	+	-	H	N	S	-
153	<i>Rostraria pumila</i> (Desf.) Tzvelev.	Poaceae	W	-	-	+	-	H	N	S	-
154	<i>Rhazya stricta</i> Decne.	Apocynaceae	D	-	-	+	+	Ch	N	S	-
155	<i>Rumex dentatus</i> (Meisn.) Rech.f.	Polygonaceae	W	-	-	+	+	G	Mes	S	-
156	<i>Saccharum bengalense</i> Retz.	Poaceae	D	+	-	+	+	Ch	N	S	-
157	<i>Saccharum officinarum</i> Linn.	Poaceae	C	+	+	+	+	Ch	Mic	S	-
158	<i>Saccharum spontaneum</i> Linn.	Poaceae	D	-	+	-	-	Ch	N	S	-
159	<i>Salsola foetida</i> Del.ex Spreng.	Chenopodiaceae	D	+	+	+	+	Ch	L	S	-
160	<i>Setaria pumila</i> (Poir.) Roem.	Poaceae	D	-	-	+	-	Th	L	S	-
161	<i>Silene vulgaris</i> (Moench) Garcke.	Caryophyllaceae	W	-	-	+	-	Th	N	S	-

162	<i>Sesbenia sesban</i> (L.)Merrill.	Papilionaceae	C	-	-	-	+	Th	Mes	Com	-
163	<i>Sisymbrium irio</i> L	Brassicaceae	W	-	-	+	+	Th	N	Dis	-
164	<i>Sonchus asper</i> (L.) Hill.	Asteraceae	W	-	+	+	-	Th	Mic	Dis	-
165	<i>Solanum nigrum</i> L.	Solanaceae	W	-	-	+	-	Th	Mic	S	-
166	<i>Solanum surattense</i> Burm.f.	Solanaceae	D	+	-	-	-	H	N	S	Sp
167	<i>Sorghum halepense</i> (L.) Pers.	Poaceae	W	-	-	+	+	Ch	N	S	-
168	<i>Sorghum bicolor</i> (Linn.)Moench.	Poaceae	C	-	-	-	+	Th	Mes	S	-
169	<i>Spergula fallax</i> (Lowe) E.H.L. Krause	Caryophyllaceae	W	-	-	+	-	Th	N	S	-
170	<i>Suaeda fruticosa</i> Forssk.ex J.F. Gmelin.	Chenopodiaceae	D	+	+	+	+	Ch	L	S	-
171	<i>Taraxacum officinale</i> F.H. Wiggers	Asteraceae	W	-	-	+	+	Th	Mic	S	-
172	<i>Tamarix aphylla</i> (L.) Karst	Tamaricaceae	D	+	+	+	+	Mp	L	S	-
173	<i>Tamarix dioica</i> Roxb. Ex Roth.	Tamaricaceae	W	+	+	+	+	Mp	L	S	-
174	<i>Torilis nodosa</i> (L.) Gaertn.	Apiaceae	W	-	-	+	-	Th	N	Dis	-
175	<i>Tribulus terrestris</i> L.	Zygophyllaceae	D	+	-	-	-	H	L	Com	Sp
176	<i>Trichosanthes dioica</i> Rxb.	Cucurbitaceae	W	-	-	+	-	Th	N	Dis	-
177	<i>Trifolium alexandrianum</i> L.	Papilionaceae	C	-	+	+	-	Th	N	Com	-
178	<i>Trifolium repens</i> L.	Papilionaceae	C	-	+	+	-	Th	N	Com	-
179	<i>Trigonella crassipes</i> Boiss.	Papilionaceae	W	-	-	+	-	Th	N	S	-
180	<i>Triticum aestivum</i> L	Poaceae	C	-	+	+	+	Th	Mic	S	-
181	<i>Typha latifolia</i> L.	Typhaceae	W	+	+	+	+	G	Mes	S	-
182	<i>Typha minima</i> Frunck ex Hoppe	Typhaceae	W	+	-	-	+	G	Mes	S	-

183	<i>Verbena officinalis</i> L.	Verbenaceae	W	-	-	+	-	Th	N	S	-
184	<i>Veronica aquatica</i> Bern.	Scrophulariaceae	W	-	-	+	-	G	N	Dis	-
185	<i>Vicia hirsuta</i> (L.) S.F. Gray, Nat.	Papilionaceae	W	-	-	+	-	Th	N	Com	-
186	<i>Vitex negundo</i> L.	Verbenaceae	W	+	+	+	+	Np	N	Com	-
187	<i>Vitis vinifera</i> L.	Vitaceae	C	+	+	+	+	Np	Mes	S	-
188	<i>Viola stockii</i> Boiss.	Violaceae	W	+	-	-	-	G	Mic	S	-
189	<i>Withania coagulans</i> Dunal.	Solanaceae	D	+	+	+	+	Ch	Mic	S	-
190	<i>Withania somnifera</i> L.	Solanaceae	D	-	-	+	+	Ch	Mic	S	-
191	<i>Xanthium strumarium</i> L.	Asteraceae	D	-	-	+	-	Th	N	S	Sp
192	<i>Zea mays</i> L.	Poaceae	C	-	-	-	+	Th	Mes	S	-
193	<i>Ziziphus jujuba</i> Mill.	Rhamnaceae	D	+	+	+	+	Mp	N	S	Sp

Key: D = Dry, W = Wet, C = Cultivated, A = Autumn, S = Spring, W = Winter, Sm = Summer, Th = Therophytes, H = Hemicryptophytes, Ch = Chamaephytes, G = Geophytes, Np = Nanophanerophytes, Mp = Microphanerophytes, P = Parasites, L = Leptophyll, N = Nanophyll, Mic = Microphyll, Mes = Mesophyll, Ap = Aphyllous, S = Simple, Dis = Dissected, Com = Compound, Abs = Absent and Sp = Spiny.

Table 6. Percentage of family, genera, and species in the study area.

S.No.	Family	No. of Genera	No. of Species	Species Percentage
1	Alliaceae	1	2	1.04%
2	Amaranthaceae	5	6	3.11%
3	Anacardiaceae	1	1	0.52%
4	Apocynaceae	2	2	1.04%
5	Asclepiadaceae	2	2	1.04%
6	Apiaceae	3	3	1.55%
7	Asphodelaceae	2	2	1.04%
8	Asteraceae	15	17	8.81%
9	Arecaceae	1	1	0.52%
10	Aizoaceae	1	1	0.52%
11	Boraginaceae	4	6	3.11%
12	Brassicaceae	7	8	4.15%
13	Capparidaceae	1	1	0.52%
14	Caryophyllaceae	2	2	1.04%
15	Chenopodiaceae	4	5	2.6%
16	Convolvulaceae	1	2	1.04%
17	Cucurbitaceae	6	7	3.62%
18	Cuscutaceae	1	1	0.52%
19	Cyperaceae	1	2	1.04%
20	Euphorbiaceae	3	5	2.6%
21	Fumariaceae	1	1	0.52%
22	Gentianaceae	1	1	0.52%
23	Iridaceae	1	1	0.52%
24	Juncaceae	1	1	0.52%
25	Lamiaceae	2	3	1.55%
26	Linaceae	1	1	0.52%

27	Malvaceae	4	4	2.07%
28	Meliaceae	1	1	0.52%
29	Mimosaceae	3	5	2.6%
30	Moraceae	2	4	2.1%
31	Myrtaceae	2	2	1.04%
32	Nyctaginaceae	1	1	0.52%
33	Orobanchaceae	1	1	0.52%
34	Oxalidaceae	1	1	0.52%
35	Papilionaceae	13	15	7.8%
36	Papaveraceae	1	1	0.52%
37	Plantaginaceae	1	2	1.04%
38	Poaceae	27	37	19.17%
39	Polygonaceae	4	5	2.6%
40	Primulaceae	1	1	0.52%
41	Ranunculaceae	1	2	1.04%
42	Resedaceae	1	1	0.52%
43	Rhamnaceae	1	1	0.52%
44	Rubiaceae	1	1	0.52%
45	Rutaceae	1	2	1.04%
46	Scrophulariaceae	1	1	0.52%
47	Solanaceae	7	9	4.7%
48	Tiliaceae	1	1	0.52%
49	Typhaceae	1	2	1.04%
50	Tamaricaceae	1	2	1.04%
51	Verbenaceae	2	2	1.04%
52	Violaceae	1	1	0.52%
53	Vitaceae	1	1	0.52%
54	Zygophyllaceae	3	3	1.55%
Total		155	193	

Table 7. Distribution of plant species in the various habitats

S. No.	Habitat	No. of plant species	Percentage
1	Wet	67	34.715%
2	Dry	87	45.077%
3	Both	4	2.072%
4	Cultivated	35	18.134%

Table 8. Distribution of plant species in the various aspects

S. No.	Aspect	No. of plant species	Percentage
1	Autumn	53	14.058%
2	Hibernal	74	19.628%
3	Vernal	156	41.379%
4	Astival	95	24.933%

Table 9. Distribution of plant species in the various life form spectra

S. No.	Life form	No. of plant species	Percentage
1	Therophytes	117	60.621%
2	Hemi-cryptophytes	19	9.844%
3	Chamaephytes	14	7.253%
4	Geophytes	18	9.844%
5	Microphanerophytes	13	6.735%
6	Nanophanerophytes	11	5.699%
7	Parasite	1	0.518%

Table 10. Comparison of Biological spectrum of the area with Raunkiaer's standard Biological Spectrum (SBS).

Spectrum	PP	ChP	TP	HP	CrP	Total
RSBS	46	26	13	9	6	100
Current study	12.434	7.253	60.621	9.844	9.844	100
Deviation	33.369	18.632	-47.526	-0.473	-3.473	0

PP = Phanerophytes, ChP = Chamaephytes, TP = Therophytes, HP = Hemiphytes. CrP = Cryptophytes

Table 11. Distribution of plant species according to leaf size spectra

S.No.	Leaf size	No. of plant species	Percentage
1	Leptophyll	41	21.243%
2	Nanophyll	93	48.186%
3	Microphyll	37	19.170%
4	Mesophyll	19	9.844%
5	Aphyllous	3	1.554%

Table 12. Distribution of plant species according to lamina shape

S.No.	Lamina shape	No. of plant species	Percentage
1	Simple	147	76.165%
2	Compound	22	11.398%
3	Dissected	22	11.398%
4	Absent	2	1.036%

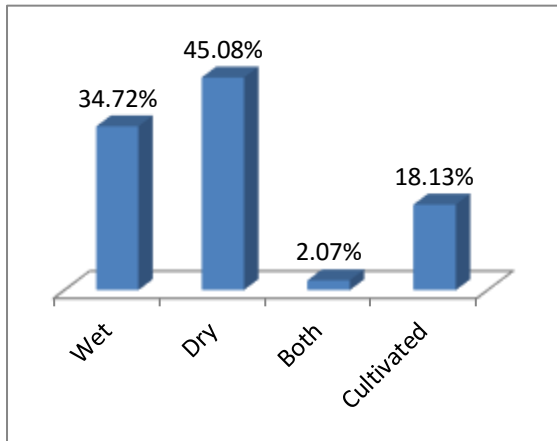


Fig 2. Habitat

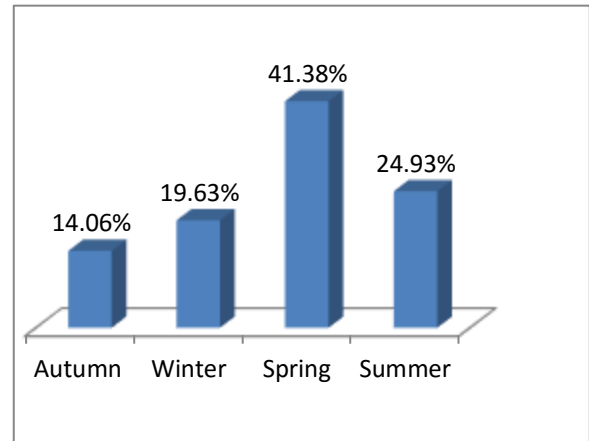


Fig 3. Aspect

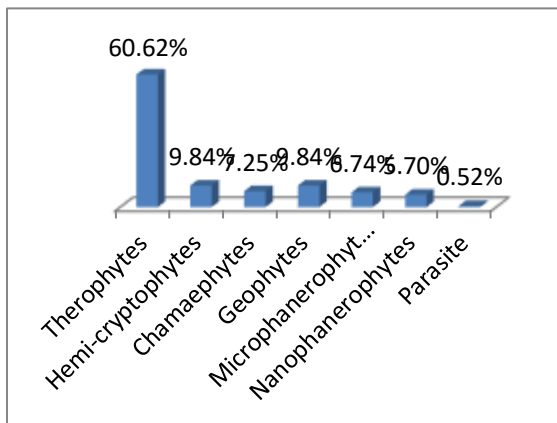


Fig 4. Life form spectra

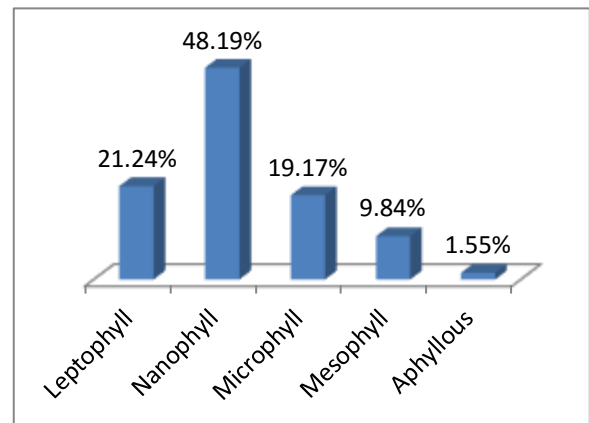


Fig 5. Leaf size spectra

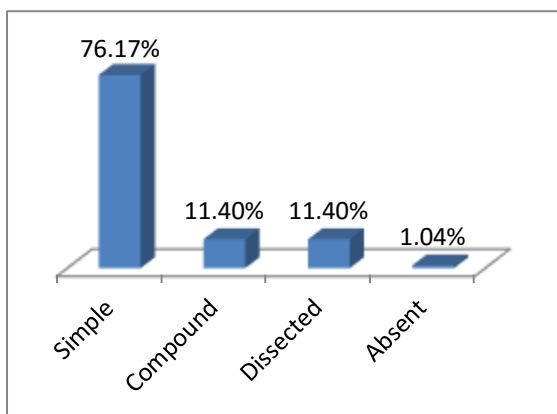


Fig 6. Lamina shape

4.2 Ethnobotany

During these study a total of 58 plant species of 34 families were recognized for medicinal properties in the distict Bannu (Table.13) which were being used conventionally for several daily life needs. These species belonged to the following families, Asteraceae was the leading family (7 spp.) followed by Solonaceae and Poaceae (4 spp. each), Mimosaceae, Zygophyllaceae, Amaranthaceae and Euphorbiaceae (3 spp. each), Chenopodiaceae, Moraceae, Rhamnaceae and Papilionaceae (2 spp. each), while the rest of all Convolvulaceae, Boraginaceae, Apocyanaceae, Rosaceae, Asclepidiaceae, Papilionaceae, Cucurbitaceae, Lamiaceae, Asphodelaceae, Primulaceae, Nyctaginaceae, Plantaginaceae, Malvaceae, Capparidaceae, Cyperaceae, Sapindaceae, Brassicaceae, Oxalidaceae, Tamaricaceae, Myrtaceae, Portulaceae, Meliaceae and Rannunculaceae families have only one species each (Table 14). It was found that the native communities had diffident skill about the uses of medicinal plant and their suitable time of collection. The maximum number of species were used for remedial purpose. They were used for various diseases, food, fodder & fuel and ornamental. Simillar results were shown by Ankli *et al.* (1999); Bennett & Prance, (2000); Shuaib *et al.* (2014) and Qureshi *et al.* (2007).The plant parts like stem, roots, leaves, flowers, fruits and seeds were used for remedial purposes according to Sardar & khan, (2009). To promote the significance of medicinal plants used in the area, locale consume values were considered for the process described by Phillip *et al.* (1994).

Out of 58 plants 14(12.73%) are used as fodder, 8(7.3%) as astringent, 6(5.45%) as diuretic, 6(5.45%) as urinary problems, 5(4.45%) as purgative, 5(4.45%) as cooling agents, 4(3.63%) as diarrhea, dysentery, inflammation, stomach problems, Astama, and tonic. While 3(2.73%) pants were being used for vomiting, furniture, laxative, kidney problems, rheumatism, skin diseases, expectorant, pain of joints and ornamental purposes. Two species (1.81%) used for antiseptic, epilepsy, carminative, vegetables, constipation and heart diseases and 1(0.90%) are used for hair loss, diabetes, night blindness and arache (Table.15). These plants are used to treat different diseases. Amongst assorted classes of home-grown uses, all crossways the earth, dissimilar types of gastrointestinal disorders are largest, for the removal of such problems different plants are used by tribal communities (Ankli *et al.*, 1999; Bennett & Prance, 2000). Current study recognized that these plants are used in the fashion of conventional healers otherwise they may affect harsh. For example the extract of *Cyperus*

rotundus if dropped in the eyes then it can cause serious problems (Qureshi *et al.*, 2007). In these study, herbs dominated (56.896%) followed by trees (22.415%) and shrubs (20.689%) (Table. 16). These plants were used for different purposes in the area. These results were according to Khan *et al.* (2013).

Among plant parts used for indigenous medicines, whole plants are used as (52.63%), followed by stem and leaves (10.53%), fruits (9.21%), roots (7.9%), seeds (5.26%), latex, flowers and gums are used (1.31%) each (Table 17). some plant species such as *Acyranthes aspera* and *Albizia lebeck* are used in resistance to nausea. Similarly, for maintenance of medicinal valuable plant species has become vital for upcoming generations (Dhar *et al.*, 2000). Owing to developing care in herbal drugs for bodily state care all across all over the earth (Franz, 1993).

Table 13. Ethno botanical important plant list used in District Bannu.

S.N	Plant Name	Family	Local name	Habit	Parts used	Uses
1	<i>Achranthes aspera</i> L.	Amaranthaceae	Aghzikai	Herb	Whole plant	Vomiting, Heart diseases and Ulcers
2	<i>Acacia modesta</i> Wall.	Mimosaceae	Palosa	Tree	Whole plant	Gum is restorative
3	<i>Acacia nilotica</i> (Linn) Delite	Mimosaceae	Kikar	Tree	Stem, Gum, roots	Diarrhea and Dysentery
4	<i>Aerva javanica</i> (Burm.) Juss	Amaranthaceae	Kharvorrh	Herb	Whole plant	Diuretic, Emetic and Purgative
5	<i>Albizia lebbek</i> (L.) Bth	Mimosaceae	Sreen	Tree	Roots, Stem, Leaves, Flowers	Diarrhea, Fodder and Night blindness
6	<i>Amaranthus viridis</i> L.	Amaranthaceae	Ranzaka	Herb	Whole plant	Laxative, Diuretic, Blood diseases, Antipyretic, Stomachic and Leprosy
7	<i>Asphodelus tenuifolius</i> Cavan	Asphodelaceae	Lewanai Piaz	Herb	Whole plant	Diuretic, Ulcers and Inflammation
8	<i>Avena sativa</i> L.	Poaceae	Javdar	Herb	Whole plant	Tonic and Stimulant
9	<i>Anagalis arvensis</i>	Primulaceae	Khoso beta	Herb	Whole plant	Inflammation, Kidney pains, Improves eye sight, Epilepsy and Dropsy
10	<i>Alhagi mauroram</i> Meddic.	Papilionaceae	Tandah	Shrub	Whole plant	Rheumatism and Piles
11	<i>Boerhavia procumbens</i> Banks ex Roxb	Nyctaginaceae	Pandrawash	Herb	Whole plant	Ophthalmia, Pains of joints, Toxic, Expectorant and Carminative
12	<i>Calatropis procera</i> (willd) R.Br (AC)	Asclepiadaceae	Spalmaka	Shrub	Latex	Dog bites, Asthma, Cough and Skin diseases

13	<i>Convolvulus arvensis</i> L.	Convolvulaceae	Parwatye	Herb	Whole plant	Skin disorders and purgative
14	<i>Carthamus oxycantha</i> M.B	Asteraceae	Conzali	Herb	Whole plant	Hair loss and Painful joints
15	<i>Capparis decidua</i> Edgew.	Capparidaceae	Taph	Tree	Fruits, Stem, roots	Vegetables and Boats planks
16	<i>Chenopodium murale</i> L.	Chenopodiaceae	Surma	Herb	Whole plant	Fodder and vegetable
17	<i>Citrullus colocynthis</i> (L) Schrad.	Cucurbitaceae	maragenye	Herb	Whole plant	Intestinal disorders, Dropsy, Urinary diseases and Snake bites
18	<i>Cynodon dactylon</i> (L.) Pers.	Poaceae	Barawa	Herb	Whole plant	Fodder, Jaundice and Dysentery
19	<i>Cyperus rotundus</i> L.	Cyperaceae	Delai	Herb	Whole plant	Fodder
20	<i>Chenopodium album</i> L	Chenopodiaceae	Spen surma	Herb	Whole plant	Fodder
21	<i>Cymbopogon distans</i> Schutt.	Poaceae	Sargaraya	Herb	Whole plant	Fodder, Mats
22	<i>Datura metal</i> Nees	Solonaceae	Barbaka	Shrub	Whole plant	Rheumatism, Emollients and Mydriatic
23	<i>Dalbergia sissoo</i> Roxb.	Papilionaceae	Shawa	Tree	Stem, roots, leaves	Gonorrhea, Leprosy, Vomiting and Furniture
24	<i>Dodonaea viscosa</i> (L.) Jacq	Sapindaceae	Sanata	Shrub	Whole plant	Ornamental, Rheumatism and Astringent
25	<i>Echinops echinatus</i> L.	Asteraceae	Azghai	Shrub	Whole plant	Reduce pain and Kidney pain
26	<i>Eruca sativa</i> Mill.	Brassicaceae	Shersham	Herb	Whole plant	Fodder, Pickles, Purgative, Epilepsy, Ulcers and Vomiting
27	<i>Euphorbia helioscopia</i> L.	Euphorbiaceae	Purparie	Herb	Whole plant	Anthelmintic and Eruptions

28	<i>Euphorbia prostrata</i> Ait.	Euphorbiaceae	Speni wana	Herb	Whole plant	Cholera
29	<i>Eucalyptus camaldulaensis</i> Dehnh.	Myrtaceae	Lochai	Tree	Whole plant	Furniture, Burning purposes and Antiseptic
30	<i>Fagonia indica</i> L.	Zygophyllaceae	Spelagzai	Herb	Whole plant	Fever, Dysentery, Urinary discharges, Reduces tumors, Cooling agent and Blood purifier
31	<i>Heliotropium europaeum</i> (F. & M.) Kazmi	Boraginaceae	Harponai	Herb	Whole plant	Fodder for camels
32	<i>Helianthus annuus</i> L.	Asteraceae	Mer Gul	Herb	Seeds	Rheumatic pains, Edible seeds and Constipation
33	<i>Launaea procumbens</i> Pravin Kawale.	Asteraceae	Piawarie	Herb	Whole plant	Fodder
34	<i>Malva neglecta</i> L.	Malvaceae	Peskie	Herb	Whole plant	Chronic bronchitis, Inflammation and Urinary discharges
35	<i>Morus alba</i> L.	Moraceae	Speen teet	Tree	Fruits, leaves, stem	Throat infection, Astringent, Anthelmintic, Laxative, Purgative and Fodder
36	<i>Morus nigra</i> L.	Moraceae	Tor Teet	Tree	Fruits, leaves, stem	Throat infection, Astringent, Anthelmintic, Laxative, Purgative and Fodder
37	<i>Melia azedrach</i> L.	Meliaceae	Bakana	Tree	Stem, leaves	Emetic, Poultice, Hysteria, Diabetes, Furniture and Fodder
38	<i>Nerium odorum</i> Soland	Apocynaceae	Gandarie	Shrub	Whole plant	Hair loss, Ornamental and Poisonous
39	<i>Oxalis corriculata</i> L.	Oxalidaceae		Herb	Whole plant	Dysentery, Astringent, Diarrhea, Scabies and Diuretic

40	<i>Ocimum basilicum</i> L.	Lamiaceae	Bobrai	Shrub	Whole plant	Ornamental, Fragrant and Ear ache
41	<i>Parthenium hysterophorus</i> L.	Asteraceae	Kherbotta	Herb	Whole plant	Leucoderma, Tonic and Anticancer
42	<i>Peganum harmala</i> L.	Zygophyllaceae	Sponda	Herb	Seeds	Parkinsonism, Narcotic, Antiseptic and Hypnotic
43	<i>Portulaca oleracea</i> L.	Portulacaceae	Warhorai	Herb	Leaves	Refrigerant, Kidney Problems, Urinary Problems and Lungs Problems
44	<i>Plantago lanceolata</i> L.	Plantaginaceae	Speghol	Herb	Seeds	Constipation, Stomached and Digestive
45	<i>Phoenix dactylifera</i> L.	Arecaceae	Hajeera	Tree	Fruits	Edible, Hand fans and mats, Urinary diseases and Expectorants
46	<i>Rosa indica</i> (Willd) Koehne	Rosaceae	Ghulab	Shrub	Whole plant	Wounds, Tonic, Astringent and Ornamental
47	<i>Ricinus communis</i> L.	Euphorbiaceae	Arandah	Shrub	Seeds	Asthma and skin diseases
48	<i>Ranunculus muricatus</i> L.	Ranunculaceae	Zerri gul	Herb	Whole plant	Tonic and Astringent
49	<i>Solanum nigrum</i> L.	Solanaceae		Herb	Whole plant	Diuretic, Heart & eye diseases and Laxative
50	<i>Solanum surrattense</i> Burn F.	Solanaceae	Warekye Marraghenye	Herb	Whole plant	Cough, Asthma, Demulcents and Expectorants
51	<i>Saccharum arundinaceum</i> H. K. F	Poaceae	Kana	Shrub	Whole plant	Fodder, Baskets and Binders
52	<i>Tribulus terrestris</i> L.	Zygophyllaceae	Malkendye	Herb	Whole plant	Cooling, Tonic, Astringent and Urinary
53	<i>Tamarix aphylla</i> (L.) Karst	Tamariaceae	Ghaz	Tree	Whole plant	Astringent, Flue and Aphrodisic

54	<i>Trigonella crassipes</i> L.	Fabaceae	Spistherlia	Herb	Whole plant	Fodder
55	<i>Withania coagulans</i> Dunal.	Solanaceae	Shapyanga	Shrub	Fruits	Asthma and Digestive problems
56	<i>Xanthium strumarium</i> L.	Asteraceae	Babar azgai	Shrub	Whole plant	Cooling and Small pox
57	<i>Ziziphus jujuba</i> Mill.	Rhamnaceae	Bera	Tree	Fruits, Stem, Leaves, Roots	Blood Purifier, Improves digestion, Bronchitis and Cough & cold
58	<i>Ziziphus nummularia</i> (Burm.f.) Wt. & Arn.	Rhamnaceae	Karkana bera	Tree	Fruits, Stem, Leaves, Roots	Cough & cold, Blood Purifier, Improves digestion and Bronchitis

Table 14. Genera and species distribution in different families.

S.No	Name of Family	Species/Genera
1.	Asteraceae	07
2.	Solanaceae	04
3.	Poaceae	04
4.	Mimosaceae	03
5.	Zygophyllaceae	03
6.	Amaranthaceae	03
7.	Euphorbiaceae	03
8.	Chenopodiaceae	02
9.	Moraceae	02
10.	Rhamnaceae	02
11.	Papilionaceae	02
12.	Convolvulaceae	01
13.	Boraginaceae	01
14.	Apocyanaceae	01
15.	Rosaceae	01
16.	Asclepidiaceae	01
17.	Papilionaceae	01
18.	Cucurbitaceae	01
19.	Lamiaceae	01
20.	Asphodelaceae	01
21.	Primulaceae	01
22.	Nyctaginaceae	01

23.	Plantaginaceae	01
24.	Malvaceae	01
25.	Capparidaceae	01
26.	Cyperaceae	01
27.	Sapindaceae	01
28.	Brassicaceae	01
29.	Oxalidaceae	01
30.	Tamaricaceae	01
31.	Myrtaceae	01
32.	Portulacaceae	01
33.	Meliaceae	01
34.	Ranunculaceae	01
Total	34 Families	58 species

Table 15. Classification of plants on the basis of their uses

S.No	Diseases	No. of plants used	Percentage (%)
1	Fodder	14	12.73%
2	Astringent	8	7.27%
3	Diuretic	6	5.45%
4	Urinary problems	6	5.45%
5	Purgative	5	4.54%
6	Cooling agent	5	4.54%
7	Diarrhea	4	3.63%
8	Dysentery	4	3.63%

9	Inflammation	4	3.63%
10	Stomach problems	4	3.63%
11	Asthma	4	3.63%
12	Tonic	4	3.63%
13	Vomiting	3	2.73%
14	Furniture	3	2.73%
15	Laxative	3	2.73%
16	Kidney problems	3	2.73%
17	Rheumatism	3	2.73%
18	Skin diseases	3	2.73%
19	Expectorant	3	2.73%
20	Pains of joints	3	2.73%
21	Ornmental	3	2.73%
22	Antiseptic	2	1.82%
23	Epilepsy	2	1.82%
24	Carminative	2	1.82%
25	Vegetables	2	1.82%
26	Constipation	2	1.82%
27	Heart diseases	1	0.91%
28	Hair loss	1	0.91%
29	Diabetes	1	0.91%
30	Night blindness	1	0.91%
31	Earache	1	0.91%

Table 16. Classification of plants on the basis of their habit

Habit	No. of plants	Percentage (%)
Herbs	33	56.896%
Shrubs	12	20.689%
Trees	13	22.413%

Table 17. Classification of plants on the basis of their parts used

Part used	No. of genera	Percentage (%)
Whole plant	40	52.63%
Stem	8	10.53%
Leaves	8	10.53%
Roots	6	7.9%
Fruits	7	9.21%
Seeds	4	5.26%
Latex	1	1.31%
Flowers	1	1.31%
Gums	1	1.31%

4.3 Phytosociology

On the basis of soil variable and their macro and micro-elemental composition the area was divided into three sites. These study concludes that there could possibly 18 different plants communities during four seasons in the area. In each sites, six different plant communities were established on the basis of their highest importance values.

Community structure

The vegetation, climate and soil are complexly interrelated to each other. The deviation in anyone of these components might cause a variation in the other related components. By knowing two of the factors, forecast about the third might be possible within certain boundaries. The survival and establishing of community mirrors the plant type and habitat form under which they grow. Biotic factors, particularly human interface shape the course of sequence of a community or vegetation type (Grubb, 1987; Badshah *et al.*, 2010). A community is distinct as a collective of living plants having mutual relationships among themselves and to the environment, or a collection of plant population found in one habitat type in one area and joined to a degree by a competition complementarities and reliance (Hussain & Badshah, 1998; Ahmad *et al.*, 2006). Some of the chief environmental factors that affect the vegetation and parts there are deforestation, overgrazing, crushing, erosion and other ecological factors. The investigated area is nearly flat plains with a semiarid climate. The present study distinguishes different plant communities based on quantitative values which as whole link up the major vegetation type. Usually the cultivated land possesses low wild plants due to anthropogenic interference (Devineau & Fournier, 2007; Frances & Shahroukh, 2006). The present study recognizes different plant communities were established on basis of soil micro and macro elemental status. The plant communities arranged on quantitative values which as whole link up the major vegetation type/unit. The present study concludes that there could possibly be 18 different plant communities during four seasons in 3-sites of the area. In each sites, 6 different plants communities separately established i.e. trees, shrubs and herbs in different seasons of the area.

Site I

These is dry area of district Bannu and consist of many villages such as Landi Jhalander, Bandaar killa, Azim killa, Barmi khel, Topen killa, Umer zai, Sirki khel, Marghalie Peerba khel and Oligie Mosa khel. In these areas only the natural flora occurred on Umer zai, Sirki khel, and Nalla Kashoo and Oligie Mosa Khel sites. At site I, dry habitats had sandy soil with pH (8.03), EC (0.018 Sdm^{-1}) nitrogen contents (0.32%), low phosphorus ($1.23 \mu\text{g/gm}$) and potassium contents were 8%. The organic matter was less (1.55%) but sulphur ($913 \mu\text{g/gm}$), silicon ($45 \mu\text{g/gm}$), ferrous ($1.06 \mu\text{g/gm}$), Cu ($0.092 \mu\text{g/gm}$), Zn ($1.98 \mu\text{g/gm}$) and Ca ($95.14 \mu\text{g/gm}$) were high. Mg ($113.98 \mu\text{g/gm}$), Pb ($0.014 \mu\text{g/gm}$), Cd ($0.44 \mu\text{g/gm}$), Ni ($1.22 \mu\text{g/gm}$), Cr ($4.4 \mu\text{g/gm}$) and Mn were ($1.568 \mu\text{g/gm}$) reported at the site I (Table. 26). During quantitative analysis of vegetation in these areas, 60 plant species of 29 families were listed at site I (Table. 18). On the basis of total family importance values at the site I, Poaceae was dominant family with family importance values (483.4) followed by Chenopodiaceae (136.2), Mimosaceae (133.76), Tamaricaceae (107.29), Cyperaceae (101.14), Polygonaceae (97.25), Papilionaceae (66.66), Rhamnaceae (61.20) (Table 21). On the basis of micro and macro elements in the soil of these site, six different plants communities have been recognized in different seasons. These plant communities established each categories separately i.e. trees, shrubs and herbs at the site. These plants communities were as follows.

1. *Prosopis-tamarix-Zizyphus* community (PTZ)

This community was confined to trees at site I in spring season. At this site, *Prosopis cineraria*, *Tamarix aphylla* and *Zizyphus jujuba* were dominant from trees side. On the basis of importance values, *Prosopis cineraria* had maximum value (77.55) followed by *Tamarix aphylla* (62.44), *Zizyphus jujuba* (61.20), *Acacia nilotica* (56.19), and *Capparis decidua* (42.62) (Table.18). Most of the plants of this community were palatable. These findings agree with Hadi *et al.* (2009) who reported *Tamarix* and *Capparis* community from Peshawar. Similarly, Ahmad *et al.* (2009) reported ten *Olea* communities from Dir Khyber Pakhtunkhwa, which are in agreement with the present results.

2. *Calligonum-Periploca-Tamarix* community (CPT)

This community was confined to shrubs at site I in spring season. At this site, *Calligonum polygonoides*, *Periploca aphylla* and *Tamarix dioica* were dominant (Table.18). On the basis of importance values, *Calligonum polygonoides* had maximum value with (87.4) importance values followed by *Periploca aphylla* (52.03), *Tamarix dioica* (44.85), *Rhazya stricta* (44.18), *Cistanche tubulosa* (37.89) and *Echinops echinatus* (33.63). The plant species of these community were slightly palatable. Similar report was also made by Malik & Malik (2004), Ahmad *et al.* (2006), Perveen & Hussain (2007) and Badshah *et al.* (2010).

3. *Cymbopogon-Chenrus-Cynodon* community (CCC)

This community was confined to herbs at site I in spring season. At this site, *Cymbopogon distense*, *Chenrus cilairus* and *Cynodon dactylon* were dominant. On the basis of importance values of herbs in spring season, *Cymbopogon distense* with importance value (32.96) followed by *Chenrus cilairus* (19.72), *Cynodon dactylon* (18.5), *Astragalus scorpiurus* (16.58) and etc. the detail have been given in (Table.18). Most of the plant species of these community were palatable. Similar trend was reported by Arshad (2003) and Malik & Hussain (2006) from other areas of Pakistan. Similarly, Shukla & Mishra (2006) stated that highest therophytes occurrence followed by chamaephytes. This finding favours the present results.

4. *Cynodon-Aristida-Eragrostis* community (CAE)

This community was confined to herbs at site I in summer season. At this site, *Cynodon dactylon*, *Aristida cynantha* and *Eragrostis pilosa* were dominant plant community respectively. On the basis of importance values of herbs in summer season, *Cynodon dactylon* with importance value (35.09) followed by *Aristida cynantha* with (28.57), *Eragrostis pilosa* with (26.72), *Alhagi maurorum* with (24.94) and etc. the detail have been given in (Table.18). *Cynodon* is palatable species while the two species are slightly palatable. Malik & Husain (2006 and 2008), Peer *et al.* (2007), Ahmad *et al.* (2008) also reported the dominance of Poaceae and Asteraceae from other areas of Pakistan which are similar to our findings.

5. *Chenopodium-Cynodon-Cenchrus* community (CCC)

This community was confined to herbs at site I in autumn season. At this site, *Chenopodium murale*, *Cynodon dactylon*, and *Chenchrus biflorus* were dominant plant community. On the basis of importance values of herbs in autumn season, *Chenopodium murale* is leading plant community with (85.88), *Cynodon dactylon* with (84.77), *Chenchrus biflorus* with (73.4) and *Cyperus rotundus* with (55.90). The detail is given in (Table.18). These findings agree with Hadi *et al.* (2009) who reported *Tamarix* and *Capparis* community from Peshawar. Similarly, Ahmad *et al.* (2009) reported ten *Olea* communities from Dir Khyber Pakhtunkhwa, which are in agreement with the present results.

6. *Cynodon-Asphadelus-Diachanthium* community (CAD)

This community was confined to herbs in site I in winter season. At these site *Cynodon dactylon*, *Asphadelus tunifolius*, *Diachanthium annulatum* were dominant plant community. The basis of importance values of herbs in winter season, *Cynodon dactylon* with importance value (51.49) was leading community followed by *Asphadelus tunifolius* with (43.94), *Diachanthium annulatum* with (38.91) were dominated. The detail is present in (Table. 18). In these community *Asphadelus tunifolius* is harmful weed and having no forage value. Similar dynamics of the community was also reported by Tabanez & Viana (2000), Malik & Malik (2004) and Ahmad *et al.* (2007).

Site II

This site consists of Painsa khel, Sada khel, Spark waziran, Amal khel, Nadar Bodin khel, Domel area, Tazeree Benzen khel, Saed khel and Jhando khel etc. The natural flora are found along Sada khel, Painsa khel and Jhando khel area. In site II, dry habitats had sandy soil with pH (8.13), EC (0.002 Sdm^{-1}) nitrogen contents (0.42%), low phosphorus ($1.99 \mu\text{g/gm}$) and potassium contents were 5%. The organic matter was 1.04% but sulphur ($177 \mu\text{g/gm}$), silicon ($38 \mu\text{g/gm}$), ferrous ($0.58 \mu\text{g/gm}$), Cu ($0.042 \mu\text{g/gm}$), Zn ($1.77 \mu\text{g/gm}$) and Ca ($91.42 \mu\text{g/gm}$) were high. Mg ($117.98 \mu\text{g/gm}$), Pb ($0.06 \mu\text{g/gm}$), Cd ($0.053 \mu\text{g/gm}$), Ni ($1.78 \mu\text{g/gm}$), Cr ($10.4 \mu\text{g/gm}$) and Mn were ($1.488 \mu\text{g/gm}$) reported (Table. 26). During quantitative analysis of vegetation in this area, 65 plant species of 26 families were listed (Table.19). On the basis of total family importance value at this, Poaceae was dominant family with total

family importance values (472.42) followed by Mimosaceae (206), Asteraceae (128.82), Chenopodiaceae (99.13) and Amranthaceae (94.56) (Table. 22). On the basis of micro and macro elements of soil at these site, six different plants communities were recognized in different season. These plant communities established separately each categories i.e. trees, shrubs and herbs in the site. These plants communities were as follows.

1. *Tamarix-Prosopis-Phoenix* community (TPP)

This community was confined to trees at site II in spring season. At this site II, *Tamarix aphylla*, *Prosopis cineraria* and *Phoenix dactylifera* were dominant community (Table. 19). On the basis of importance values, *Tamarix aphylla* had maximum value with (66.96) followed by *Prosopis cineraria* with (57.26), *Phoenix dactylifera* with (52.55), *Ziziphus jujuba* with (43.64), *Acacia nilotica* with (41.72) and *Acacia modesta* with (37.87). Plant species of these community are slightly palatable and most of them used in furniture. These results are in agree with Manhas *et al.* (2010) and Bocuk *et al.* (2009) recorded therophytes and leptophylls from Kandi region India.

2. *Prosopis-Tamarix-Rhazya* community (PTA)

This community was confined to shrubs at site II in spring season. At this site, *Prosopis juliflora*, *Tamarix dioica* and *Rhazya stricta* were dominant community (Table. 19). On the basis of importance values, *Prosopis juliflora* with importance value (69.22) followed by *Tamarix dioica* with (44.81), *Rhazya stricta* with (34.81) and *Aerva javanica* with (32.05). This community had fewer numbers of species due to dry soil. Only few shrubby species occurred. Our results were agree with workers like Badshah *et al.* (2010) from nearby Waziristan and Qureshi *et al.* (2008) form Nara desert (Sindh) which valued our present results.

3. *Cymbopogon-Cynodon-Cenchrus* community (CCC)

This community was confined to herbs at site II in spring season. At this site, *Cymbopogon distance* maximum values with (31.66) followed by *Cynodon dactylon* (24.57), *Cenchrus ciliaris* (20.66) were dominant plant community (Table. 19). *Cymbopogon-Cynodon-Cenchrus* community confine only on grasses and palatable.

These results were according with Malik & Hussain (2006), Sher & Khan (2007) and Bocuk *et al.* (2009).

4. *Eleusine-Bromus-Cynodon* community (EBC)

This community was confined to herbs at site II in summer season. At this site, *Eleusine indica*, *Bromus pectinatus* and *Cynodon dactylon* were dominant plant community in summer season. On the basis of importance values of herbs in summer season, *Eleusine indica* (31.32), *Bromus pectinatus* (29.4), *Cynodon dactylon* (28.06), *Pegnum harmala* (25.42) and the detail is present in (Table. 19). *Eleusine-Bromus-Cynodon* community is also consisted on grasses. *Eleusine* and *Cynodon* species are palatable and having forage value for domesticate animals in the area. These results were agree with earlier co-worker like Bocuk *et al.* (2009); Ture & Tokur, (2000) and Wahab *et al.* (2008).

5. *Cynodon- Bromus-Citrullus* community (CBC)

This community was confined to herbs at site II in autumn season. At this site, *Cynodon dactylon*, *Bromus pectinatus* and *Citrullus colocynthis* were dominated due to their importance values in autumn season. On the basis of highest importance values *Cynodon dactylon* with (46.42) followed by *Bromus pectinatus* with (40.61) and *Citrullus colocynthis* with (34.53) the detail is given in (Table.19). Poaceae member having forage while *Citrullus* is medicinal plant occurred in this site and used as anthelmintic to Cow and Buffalo. These result compared with earlier Kareston *et al.* (2005); Costa *et al.* (2006); Parveen & Hussain, (2007).

6. *Chenopodium-Cynodon-Sonchus* community (CCS)

This community was confined to herbs at site II in winter season. At this site, *Chenopodium album*, *Cynodon dactylon* and *Sonchus asper* were dominated in winter season due to importance value. On the basis of highest importance value *Chenopodium album* with (51.52) followed by *Cynodon dactylon* with (42.27), and *Sonchus asper* with (39.9) and the detail is given in the (Table. 19). *Cynodon* is one the grass which is usually occurred in the area and used as food for livestock in daily life. These results agree with Hadi *et al.* (2009), Ahmad *et al.* (2009) described ten Olea communities from Dir Khyber Pakhtunkhwa, which are in agreement with the

current results. Dasti *et al.* (2010) while functioning on the vegetation of Suleiman ranges.

Site III

This sites includes Baka khel, Sardi khel and Jani khel. During quantitative analysis of vegetation in these areas, 85 plant species of 28 families were listed (Table. 20). In site III, dry habitats had sandy soil with pH (8.04), EC (0.005 Sdm⁻¹) nitrogen contents (0.35%), low phosphorus (1.34 µg/gm) and potassium contents were studied (4%). The organic matter was 1.35% but sulphur (295 µg/gm), silicon (34 µg/gm), ferrous (4.28 µg/gm), Cu (0.318 µg/gm), Zn (0.206 µg/gm) and Ca (102.66 µg/gm) were higher as compared with sites I and II. Mg (120.94 µg/gm), Pb (0.006 µg/gm), Cd (0.08 µg/gm), Ni (0.68 µg/gm), Cr (52 µg/gm) and Mn were (1.998 µg/gm) reported at the site III (Table. 26). On the basis of family importance value in the site III, Poaceae was dominant family with total family importance values (472.47) followed by Mimosaceae (267.13), Amranthaceae (128.42) Papilionaceae (121.19), Solanaceae (90.17) and Asteraceae (88.79) (Table 23). On the basis of soil six different plants communities have been recognized in different season. These plants communities were as follows.

1. *Tamarix-Acacia-Acacia* community (TAA)

This community was confined to trees at site III in spring season. At this site, *Tamarix aphylla*, *Acacia nilotica* and *Acacia modesta* community was dominant. On the basis of maximum values *Tamarix aphylla* with (81.17) followed by *Acacia nilotica* with (76.60), *Acacia modesta* with (61.42), *Ziziphus jujuba* with (55.29) and *Prosopis cineraria* with (25.50) in the site (Table. 20). These results agree with Salvatori *et al.* (2003) while studying the vegetation observed that 46% of the area was converted from wood land to scrub and grassland. These result are in line to the extent that have similar results (Patrick *et al.*, 2004; Walepole *et al.*, 2004; Jorge *et al.*, 2005) in the area of investigation.

2. *Prosopis-Withania-Aerva* community (PWA)

This community was confined to shrubs at site III in spring season. At this site, *Prosopis juliflora*, *Withania coagulans* and *Aerva javanica* community was dominant. On the basis of importance values *Prosopis juliflora* had maximum values with (103.61) followed by *Withania coagulans* with (55.65), *Aerva javanica* with (51.14),

Calotropis procera with (47.96) and *Rhazya stricta* (41.65) in the site (Table. 20). These results are according to Kennedy *et al.* (2003); Malik & Malik, (2004); and Hussain *et al.* (2005) also reported similar changes in dominance with the season and temperature. Shah and Hussain, (2008) reported similar vegetation for wet lands of Akbar pura Peshawar.

3. *Cynodon-Euphorbia-Poa* community (CEP)

This community was confined to herbs at site III in spring. At this site, *Cynodon dactylon*, *Euphorbia helioscopia* and *Poa annua* were dominant. On the basis of importance values *Cynodon dactylon* (17.21) followed by *Euphorbia helioscopia* with (15.24), *Poa annua* with (12.95) (Table. 20). This community have forage value in the area. Generally spring is the most favourable growing season for most plants in Pakistan by Wazir *et al.* (2008); Ahmad *et al.* (2008) and Arshad *et al.* (2008).

4. *Alhagi-Cynodon-Polypogon* community (ACP)

This community was confined to herbs at site III in summer season. At this site, *Alhagi maurorum*, *Cynodon dactylon* and *Polypogon pectinatus* were dominant due to their importance values. On the basis of highest importance values *Alhagi maurorum* with (52.15) followed by *Cynodon dactylon* with (50.7) and *Polypogon pectinatus* with (41.31) in the site (Table. 20). *Cynodon* is one of the grass which is constantly found in the area and usually used as food for cow while *Alhagi* is used as a food for Camel. These results were according to Malik & Hussain (2006 and 2008), Peer *et al.* (2007). Ahmad *et al.* (2008) also reported the dominance of Poaceae and Asteraceae from other areas of Pakistan which are similar to our findings.

5. *Chenopodium-Amaranthus-Achyranthes* community (CAA)

This community was also confined to herbs at site III in autumn season. At this site, *Chenopodium murale*, *Amaranthus viridis* and *Achyranthes aspera* were dominant plant species due to importance values. On the basis of highest importance values *Chenopodium murale* (43.22) followed by *Amaranthus viridis* (39.14) and *Achyranthes aspera* (38.07) in the site (Table. 20). These results agree with earlier co-worker like Malik & Hussain (2008) and Perveen *et al.* (2008) who reported plants communities of annual herbs in their respective study sites.

6. *Euphorbia-Cynodon-Dichanthium* community (ECD)

This community confined to herbs at site III in winter seasons. At this site, *Euphorbia helioscopia*, *Cynodon dactylon* and *Dichanthium annulatum* were dominant due to importance value respectively. On the basis of highest importance values *Euphorbia helioscopiai* with (52.64) followed by *Cynodon dactylon* (45.37) and *Dichanthium annulatumi* (39.19) in the site (Table. 20). These results agree with earlier workers in their studies (Enright *et al.*, 2005; Badshah *et al.*, 2010; Claros, 2003) who studied a related situation has been described.

Table 18. Phytosociological attributes of plant community at site I

SNo	Name of plant	Family	R/Density	R/Frequency	R/Cover	Importance value
During spring, trees						
1	<i>Acacia nilotica</i> (L.) Wild.ex Delile	Mimosaceae	13.16	19.51	23.52	56.19
2	<i>Capparis decidua</i> (Frossk.) Edgew.	Cappridaceae	15.79	12.19	14.63	42.62
3	<i>Prosopis cineraria</i> L.	Mimosaceae	28.94	26.83	21.78	77.55
4	<i>Tamarix aphylla</i> (L.) Karst	Tamaricaceae	22.37	21.95	18.12	62.44
5	<i>Ziziphus jujuba</i> Mill	Rhamnaceae	19.74	19.51	21.95	61.20
During spring, shrubs						
6	<i>Calligonum polygonoides</i> L.	Polygonaceae	26.79	23.08	37.53	87.4
7	<i>Periploca aphylla</i> Decne.	Asclepiadaceae	13.39	19.23	19.41	52.03
8	<i>Tamarix dioica</i> Roxb. Ex Roth.	Tamaricaceae	19.64	13.46	11.75	44.85
9	<i>Rhazya stricta</i> Decne.	Apocynaceae	12.5	15.38	1.30	44.18
10	<i>Echinops echinatus</i> L.	Asteraceae	8.92	15.38	9.32	33.63
11	<i>Cistanche tubulosa</i> (Shehenk.)	Orobancheaceae	18.75	13.46	5.68	37.89

During spring, herbs

12	<i>Arnebia hispidissima</i> (Lehm.) A. DC.	Boraginaceae	4.21	4.66	4.25	13.12
13	<i>Astragalus scorpiurus</i> Bunge.	Papilionaceae	5.68	6	4.90	16.58
14	<i>Boerhavia procumbens</i> Banks ex Roxb	Nyctaginaceae	2.94	5.33	5.96	14.23
15	<i>Cenchrus ciliaris</i> L.	Poaceae	6.73	5.33	7.66	19.72
16	<i>Chenopodium album</i> L.	Chenopodiaceae	4.42	4.66	6.30	15.38
17	<i>Convolvulus arvensis</i> L.	Convolvulaceae	3.36	4.66	3.780	11.8
18	<i>Cymbopogon distans</i> Schutt.	Poaceae	9.47	8	15.49	32.96
19	<i>Cynodon dactylon</i> (L.) Pers.	Poaceae	6.52	4.66	7.32	18.5
20	<i>Euphobia dracunculoides</i> Lam.	Euphorbiaceae	5.05	3.33	2.99	11.37
21	<i>Farsetia jacquemontii</i> (Hook. F. & thoms.) Jafri	Brassicaceae	2.73	3.33	2.55	8.61
22	<i>Heliotropium europaeum</i> (F. & M.) Kazmi	Boraginaceae	2.31	3.33	3.23	8.87
23	<i>Hypocoum pendulum</i> L.	Papaveraceae	3.36	4	1.90	9.26
24	<i>Launaea procumbens</i> Pravin Kawale.	Asteraceae	4	4.66	3.95	12.61
25	<i>Melilotus indica</i> (L.) All.	Papilionaceae	3.78	4	1.90	9.68
26	<i>Oligomeris linifolia</i> (Vahl.) Macbride	Resedaceae	2.10	2.66	1.53	6.29

27	<i>Plantago lanceolata</i> L.	Plantaginaceae	4	4	1.19	9.19
28	<i>Plantago ovata</i> Frossk.	Plantaginaceae	2.94	3.33	1.87	7.98
29	<i>Psammogeton biternatum</i> Edgew.	Apiaceae	3.78	3.33	2.21	9.32
30	<i>Rostraria cristata</i> Linn.	Poaceae	6.94	6	1.19	14.13
31	<i>Rumex dentatus</i> (Meisn.) Rech.f.	Polygonaceae	2.94	2.66	4.25	9.85
32	<i>Silene vulgaris</i> (Moench) Garcke.	Caryophyllaceae	3.57	4.66	4.25	12.48
33	<i>Sisymbrium irio</i> L	Brassicaceae	4.21	2.66	5.27	12.14
34	<i>Trigonella crassipes</i> Boiss.	Papilionaceae	4.84	4.66	5.96	15.46

During summer, herbs

35	<i>Alhagi maurorum</i> Medic.	Papilionaceae	5.88	10.84	8.21	24.94
36	<i>Amaranthus viridis</i> L.	Amaranthaceae	8.14	8.43	5.35	21.92
37	<i>Aristida cynantha</i> L.	Poaceae	8.59	9.63	10.35	28.57
38	<i>Carthamus persicus</i> Willd.	Asteraceae	7.69	7.22	5.35	20.26
39	<i>Chrozophora tinctoria</i> (L.) Raf.	Euphorbiaceae	6.78	6.02	5.71	18.51
40	<i>Citrullus colocynthis</i> (L.) Shred.	Cucurbitaceae	4.52	6.02	7.07	17.61
41	<i>Cynodon dactylon</i> (L.) Pers.	Poaceae	12.66	7.22	13.21	35.09
42	<i>Cyperus rotundus</i> L.	Cyperaceae	6.78	6.02	6.07	18.87
43	<i>Eragrostis pilosa</i> (L.)P. Beauv.	Poaceae	9.50	7.22	10	26.72

44	<i>Eragrostis minor</i> Host.	Poaceae	7.69	7.22	6.07	20.98
45	<i>Euphorbia prostrata</i> Ait.	Euphorbiaceae	5.42	6.02	6.78	18.22
46	<i>Fagonia indica</i> L.	Zygophyllaceae	6.78	7.22	7.92	21.92
47	<i>Plantago ovata</i> Frossk.	Plantaginaceae	4.97	6.02	3.21	14.2
48	<i>Portulaca oleraceae</i> Linn.	Aizoaceae	4.52	4.81	4.64	13.97

During autumn, herbs

49	<i>Cenchrus bifolrus</i> Roxb.	Poaceae	22.05	21.73	29.62	73.4
50	<i>Chenopodium murale</i> L.	Chenopodiaceae	26.47	26.08	33.33	85.88
51	<i>Cynodon dactylon</i> (L.) Pers.	Poaceae	30.88	30.43	23.45	84.77
52	<i>Cyperus rotundus</i> L.	Cyperaceae	20.58	21.73	13.58	55.90

During winter, herbs

53	<i>Asphadelus tunifolius</i> Caven.	Asphodelaceae	20.19	14.28	9.44	43.91
54	<i>Aristida adscensionis</i> L.	Poaceae	20.19	8.92	9.05	38.16
55	<i>Chenopodium album</i> L.	Chenopodiaceae	15.38	8.92	10.62	34.94
56	<i>Cynodon dactylon</i> (L.) Pers.	Poaceae	7.28	14.28	29.52	51.49
57	<i>Cyperus rotundus</i> L.	Cyperaceae	10.57	7.14	8.66	26.37
58	<i>Dichanthium annulatum</i> Frossk	Poaceae	5.76	10.71	22.44	38.91
59	<i>Launaea angustifolia</i> (Desf.) Kuntze	Asteraceae	11.53	10.71	5.11	27.35
60	<i>Malva neglecta</i> Wallr.	Malvaceae	8.65	25	5.11	38.76

Table 19. Phytosociological attributes of plant community at site II

S.No	Name of plants	Family	R/Density	R/Frequency	R/Cover	Importance value
During spring, trees						
1	<i>Acacia modesta</i> Wall.	Mimosaceae	10.68	14.28	12.89	37.87
2	<i>Acacia nilotica</i> (L.) Wild.ex Delile	Mimosaceae	8.39	15.87	17.45	41.72
3	<i>Phoenix dactylifera</i> L.	Araceae	19.08	19.04	14.41	52.55
4	<i>Prosopis cineraria</i> L.	Mimosaceae	20.61	19.05	17.60	57.26
5	<i>Tamarix aphylla</i> (L.) Karst	Tamaricaceae	30.53	17.46	18.97	66.96
6	<i>Ziziphus jujuba</i> Mill.	Rhamnaceae	10.68	14.28	68.66	43.64
During spring, shrubs						
7	<i>Aerva javanica</i> (Burm. F.) Juss.	Amaranthaceae	11.18	16.67	4.21	32.05
8	<i>Calotropis procera</i> (Willd.) R. Br.	Asclepiadaceae	7.65	12.12	11.97	31.74
9	<i>Cistanche tubulosa</i> (Shehenk.)	Orobanchaceae	13.53	9.09	6.15	28.77
10	<i>Prosopis juliflora</i> Swartz.	Mimosaceae	17.05	18.18	33.98	69.22
11	<i>Rhazya stricta</i> Decne.	Apocynaceae	10	10.60	14.24	34.84
12	<i>Tamarix dioica</i> Roxb. Ex Roth.	Tamaricaceae	23.53	10.60	10.68	44.81
13	<i>Vitex negundo</i> L.	Vitaceae	7.06	9.09	8.09	24.24
14	<i>Withania coagulans</i> Dunal.	Solanaceae	10	13.63	10.67	34.31

During spring, herbs

15	<i>Anagallis arvensis</i> L.	Primulaceae	5.34	6.09	2.65	14.08
16	<i>Avena fatua</i> L.	Poaceae	2.56	6.09	1.59	10.24
17	<i>Calendula officinalis</i> L.	Asteraceae	2.77	4.87	3.00	10.64
18	<i>Carthamus persicus</i> Willd.	Asteraceae	4.27	3.65	4.06	11.98
19	<i>Cenchrus ciliaris</i> L.	Poaceae	9.61	4.87	6.18	20.66
20	<i>Chenopodium album</i> L.	Chenopodiaceae	4.91	5.48	7.59	17.98
21	<i>Convolvulus arvensis</i> L.	Convolvulaceae	3.20	3.65	3.35	10.22
22	<i>Cymbopogon distanse</i> Schutt.	Poaceae	5.55	7.92	18.19	31.66
23	<i>Cynodon dactylon</i> (L.) Pers.	Poaceae	7.90	7.31	9.36	24.57
24	<i>Datura alba</i> Nees.	Solanaceae	4.059	4.87	4.41	13.33
25	<i>Euphorbia helioscopia</i> L.	Euphorbiaceae	2.35	3.65	3.35	9.35
26	<i>Heliotropium europaeum</i> (F. & M.) Kazmi	Boraginaceae	2.77	3.65	4.41	10.83
27	<i>Malcolmia Africana</i> (L.) R.Br.	Malvaceae	9.61	6.70	4.06	20.37
28	<i>Oligomeris linifolia</i> (Vahl.) Macbride	Resedaceae	2.56	4.26	2.29	9.12
29	<i>Pegnum harmala</i> L.	Zygophyllaceae	4.27	5.48	6.53	16.26
30	<i>Polygonum plebejum</i> R.Br	Polygonaceae	3.20	3.04	2.29	8.83

31	<i>Rumex dentatus</i> (Meisn.) Rech.f.	Polygonaceae	4.48	4.26	4.41	13.15
32	<i>Sisymbrium irio</i> L	Brassicaceae	6.19	3.65	4.59	14.43
33	<i>Sonchus asper</i> (L.) Hill.	Asteraceae	6.19	4.26	2.29	12.74
34	<i>Spergula fallax</i> (Lowe) E.H.L. Krause	Caryophyllaceae	1.49	2.43	1.23	5.15
35	<i>Taraxacum officinale</i> F.H. Wiggers	Asteraceae	6.62	3.65	4.06	14.33

During summer, herbs

36	<i>Alhagi maurorum</i> Medic.	Papilionaceae	7.6	9.90	7.83	25.33
37	<i>Avena fatua</i> L.	Poaceae	4.8	6.93	2.43	14.16
38	<i>Bromus pectinatus</i> Thunb.	Poaceae	9.6	10.89	8.91	29.4
39	<i>Carthamus persicus</i> Willd.	Asteraceae	7.6	5.94	5.13	18.67
40	<i>Cenchrus biflorus</i> Roxb.	Poaceae	9.2	7.92	6.21	23.33
41	<i>Cynodon dactylon</i> (L.) Pers.	Poaceae	12.4	8.91	6.75	28.06
42	<i>Cyperus rotundus</i> L.	Cyperaceae	4.4	4.95	3.51	12.86
43	<i>Eleusine indica</i> (L.) Gaertn.	Poaceae	4.4	9.90	17.02	31.32
44	<i>Fagonia cretica</i> L.	Zygophyllaceae	4.8	3.96	2.97	11.73
45	<i>Pegnum harmala</i> L.	Zygophyllaceae	7.6	8.91	8.91	25.42
46	<i>Poa annua</i> L.	Poaceae	11.6	8.91	2.97	23.48
47	<i>Rumex dentatus</i> (Meisn.) Rech.f.	Polygonaceae	7.6	6.93	6.48	21.01
48	<i>Taraxacum officinale</i> F.H. Wiggers	Asteraceae	8.4	5.94	6.21	20.55

During autumn, herbs

49	<i>Achyranthes aspera</i> L.	Amaranthaceae	12.68	14.51	7.28	34.47
50	<i>Amaranthus viridis</i> L.	Amaranthaceae	10.44	11.29	6.31	28.04
51	<i>Boerhavia procumbens</i> Banks ex Roxb	Nyctaginaceae	11.19	8.06	9.22	28.47
52	<i>Bromus pectinatus</i> thumb.	Poaceae	5.22	9.67	25.72	40.61
53	<i>Chenopodium murale</i> L.	Chenopodiaceae	12.68	9.67	7.28	29.63
54	<i>Citrullus colocynthis</i> (L.) Shred.	Cucurbitaceae	8.20	11.29	15.04	34.53
55	<i>Cynodon dactylon</i> (L.) Pers.	Poaceae	18.65	16.12	11.65	46.42
56	<i>Cyperus rotundus</i> L.	Cyperaceae	12.68	11.29	6.31	30.28
57	<i>Solanum surattense</i> Burm.f.	Solanaceae	8.20	8.06	11.16	27.42

During winter, herbs

58	<i>Aristida adscensionis</i> L.	Poaceae	8.94	13.46	11.45	33.85
59	<i>Chenopodium album</i> L.	Chenopodiaceae	12.19	15.38	23.95	51.52
60	<i>Convolvulus arvensis</i> L.	Convolvulaceae	8.94	9.61	15.62	34.17
61	<i>Cynodon dactylon</i> (L.) Pers.	Poaceae	15.44	15.38	11.45	42.27
62	<i>Dichanthium annulatum</i> Forssk.	Poaceae	10.56	11.53	10.41	32.5
63	<i>Poa annua</i> L.	Poaceae	17.07	13.46	9.375	39.8
64	<i>Polygonum plebejum</i> R.Br	Polygonaceae	9.75	7.69	8.33	25.77
65	<i>Sonchus asper</i> (L.) Hill.	Asteraceae	17.07	13.46	9.37	39.9

Table 20. Phytosociological attributes of plant community at site III

S.No	Name of Plants	Family	R/Density	R/Frequency	R/Cover	Importance value
During spring, trees						
1	<i>Acacia modesta</i> Wall.	Mimosaceae	20.98	22	18.44	61.42
2	<i>Acacia nilotica</i> (L.) Wild.ex Delile	Mimosaceae	25.92	24	26.68	76.60
3	<i>Tamarix aphylla</i> (L.) Karst	Tamariaceae	34.57	26	20.60	81.17
4	<i>Ziziphus jujuba</i> Mill.	Rhamnaceae	12.34	18	24.94	55.29
5	<i>Prosopis cineraria</i> L.	Mimosaceae	6.17	10	9.33	25.50
During spring, shrubs						
6	<i>Aerva javanica</i> (Burm. F.) Juss.	Amaranthaceae	21.24	21.05	8.84	51.14
7	<i>Calotropis procera</i> (willd.) R. Br.	Capparidaceae	13.27	19.29	15.38	47.96
8	<i>Prosopis juliflora</i> Swartz.	Mimosaceae	30.97	26.56	48.08	103.61
9	<i>Rhazya stricta</i> Decne.	Apocynaceae	14.16	14.03	13.46	41.65
10	<i>Withania coagulans</i> Dunal.	Solanaceae	20.35	21.05	14.23	55.65
During spring, herbs						
11	<i>Alopecurus nepalensis</i> Trin.Ex Steud.	Poaceae	2.10	1.84	1.51	5.45
12	<i>Anagallis arvensis</i> L.	Primulaceae	3.00	3.69	2.34	9.03
13	<i>Atriplex stocksii</i> Boiss	Chenopodiaceae	1.70	2.46	2.34	6.5
14	<i>Calendula officinalis</i> L.	Asteraceae	2.90	3.69	3.45	10.04

15	<i>Carduus argentatus</i> L.	Asteraceae	1.50	1.84	2.07	5.41
16	<i>Cirsium arvense</i> (L.) Scop.	Asteraceae	2.30	2.46	1.79	6.55
17	<i>Convolvulus arvensis</i> L.	Convolvulaceae	3.51	3.07	3.17	9.75
18	<i>Conyza bonariensis</i> (L.) Cronquist	Asteraceae	1.90	1.84	1.51	5.25
19	<i>Cymbopogon distans</i> Schutt.	Poaceae	1.30	2.76	4.00	8.06
20	<i>Cynodon dactylon</i> (L.) Pers.	Poaceae	4.51	4	8.70	17.21
21	<i>Datura alba</i> Nees.	Solanaceae	2.10	1.84	2.07	6.01
22	<i>Dinebra retroflexa</i> (Vahl) Panzer.	Poaceae	0.90	1.84	0.69	3.43
23	<i>Echinochloa crus-galli</i> (L.) P. Beauv.	Poaceae	1.40	2.15	0.82	4.37
24	<i>Euphorbia helioscopia</i> L.	Euphorbiaceae	5.61	3.69	5.94	15.24
25	<i>Euphorbia prostrata</i> Ait.	Euphorbiaceae	3.10	1.84	3.15	8.09
26	<i>Fagonia indica</i> L.	Zygophyllaceae	2.70	2.15	3.17	8.02
27	<i>Filago pyramidata</i> L.	Asteraceae	0.90	1.53	0.96	3.39
28	<i>Fumeria indica</i> Hausskn.	Fumariaceae	2.90	2.46	3.73	9.09
29	<i>Heliotropium crispum</i> Desf.	Boraginaceae	1.30	1.84	0.69	3.83
30	<i>Lactuca serriola</i> L.	Asteraceae	1.90	2.15	1.24	5.29
31	<i>Lathyrus aphaca</i> L.	Papilionaceae	1.40	1.53	0.55	3.89
32	<i>Launaea procumbens</i> Pravin Kawale	Asteraceae	1.10	1.53	0.96	3.18

33	<i>Leptochloa panacea</i> Retz	Poaceae	1.70	2.15	0.55	4.4
34	<i>Malva neglecta</i> Wallr.	Malvaceae	1.50	1.53	0.82	3.85
35	<i>Medicago polymorpha</i> L.	Papilionaceae	2.40	2.46	2.07	6.93
36	<i>Melilotus alba</i> Desr.	Papilionaceae	1.30	1.53	0.69	3.52
37	<i>Melilotus indica</i> (L.) All.	Papilionaceae	2.30	2.15	0.96	5.41
38	<i>Neslia apiculata</i> Fisch.	Brassicaceae	1.10	1.23	1.10	3.43
39	<i>Nicotiana plumbaginifolia</i> Viv.	Solanaceae	1.50	1.53	0.96	4.01
40	<i>Oxalis corniculata</i> L.	Oxalidaceae	2.30	1.84	0.55	4.69
41	<i>Phalaris minor</i> Retz.	Poaceae	1.80	1.84	0.96	4.6
42	<i>Plantago lanceolata</i> L.	Plantaginaceae	3.00	2.76	1.51	7.27
43	<i>Poa annua</i> L.	Poaceae	4.71	3.69	4.55	12.95
44	<i>Poa botryoides</i> (Trin. Ex Griseb.) Kom.	Poaceae	2.10	1.84	1.24	5.18
45	<i>Polygonum plebejum</i> R.Br	Polygonaceae	1.10	1.53	2.07	4.7
46	<i>Ranunculus sceleratus</i> L.	Ranunculaceae	1.30	1.53	0.96	3.79
47	<i>Rumex dentatus</i> (Meisn.) Rech.f.	Polygonaceae	1.10	1.23	1.79	4.12
48	<i>Polypogon monspeliensis</i> (L.) Desf.	Poaceae	1.00	2.46	5.94	9.4
49	<i>Sisymbrium irio</i> L	Brassicaceae	3.10	2.15	3.17	8.42
50	<i>Sonchus asper</i> (L.) Hill.	Asteraceae	2.90	3.07	1.93	7.9

51	<i>Solanum nigrum</i> L.	Solanaceae	1.00	1.84	0.96	3.8
52	<i>Taraxacum officinale</i> F.H. Wiggers	Asteraceae	3.51	2.15	3.31	8.97
53	<i>Torilis nodosa</i> (L.) Gaertn.	Apiaceae	2.30	1.53	2.07	5.9
54	<i>Trigonella crassipes</i> Boiss.	Papilionaceae	3.10	2.15	2.07	7.32
55	<i>Verbena officinalis</i> L.	Verbenaceae	1.70	1.84	1.51	5.05
56	<i>Xanthium strumarium</i> L.	Asteraceae	1.90	1.53	3.17	6.6

During summer, herbs

57	<i>Alhagi maurorum</i> Medic.	Papilionaceae	17.1	15.94	19.02	52.15
58	<i>Aristida cyanantha</i> Nees ex Steud.	Poaceae	7.00	8.69	7.06	22.75
59	<i>Cenchrus ciliaris</i> L.	Poaceae	10.82	13.04	5.97	29.83
60	<i>Conyza bonariensis</i> (L.) Cronquist	Asteraceae	9.55	10.14	6.52	26.21
61	<i>Cynodon dactylon</i> (L.) Pers.	Poaceae	17.19	14.49	19.02	50.7
62	<i>Cyperus rotundus</i> L.	Cyperaceae	12.10	10.14	8.15	30.39
63	<i>Fagonia cretica</i> L.	Zygophyllaceae	12.10	8.69	7.06	27.85
64	<i>Heliotropium strigosum</i> Wild	Boraginaceae	7.64	7.24	3.80	18.68
65	<i>Polypogon monspeliensis</i> (L.) Desf.	Poaceae	6.36	11.59	23.36	41.31

During autumn, herbs

66	<i>Achyranthes aspera</i> L.	Amaranthaceae	13.60	12.65	11.82	38.07
67	<i>Amaranthus viridis</i> L.	Amaranthaceae	14.20	12.65	12.36	39.21
68	<i>Boerhavia procumbens</i> Banks ex Roxb	Nyctaginaceae	7.69	7.59	5.91	21.19
69	<i>Chenopodium murale</i> L.	Chenopodiaceae	14.79	13.92	14.51	43.22
70	<i>Corchorus depressus</i> (L.)	Tiliaceae	5.91	6.32	4.83	17.06
71	<i>Cynodon dactylon</i> (L.) Pers.	Poaceae	12.42	11.39	13.97	37.78
72	<i>Cyperus rotundus</i> L.	Cyperaceae	9.46	8.86	4.83	23.15
73	<i>Polypogon monspeliensis</i> (L.) Desf.	Poaceae	5.91	10.12	23.11	39.14
74	<i>Solanum surattense</i> Burm.f.	Solanaceae	8.28	7.59	4.83	20.7
75	<i>Tribulus terrestris</i> L.	Zygophyllaceae	7.69	8.86	3.76	20.31

During winter, herbs

76	<i>Avena fatua</i> L.	Poaceae	7.98	10.81	5.18	23.97
77	<i>Convolvulus arvensis</i> L.	Convolvulaceae	11.73	9.45	8.14	29.32
78	<i>Cynodon dactylon</i> (L.) Pers.	Poaceae	11.73	12.16	21.48	45.37
79	<i>Dichanthium annulatum</i> Forssk.	Poaceae	9.85	10.81	18.51	39.17
80	<i>Euphorbia helioscopia</i> L.	Euphorbiaceae	16.43	16.21	20	52.64

81	<i>Leptochloa panacea</i> Retz	Poaceae	7.98	9.45	2.96	20.39
82	<i>Melilotus alba</i> Desr.	Papilionaceae	6.10	6.75	3.70	16.55
83	<i>Melilotus indica</i> (L.) All.	Papilionaceae	10.79	9.45	5.18	25.42
84	<i>Poa botryoides</i> (Trin. Ex Griseb.) Kom.	Poaceae	9.85	8.10	6.66	24.61
85	<i>Setaria pumila</i> (Poir.) Roem.	Poaceae	7.51	6.75	8.14	22.4

Table 21. Family importance values at site I

S.No.	Family	Total importance value of Family
1	Amaranthaceae	21.92
2	Apocynaceae	44.18
3	Asclepiadaceae	52.03
4	Apiaceae	9.32
5	Asphodelaceae	43.91
6	Asteraceae	93.85
7	Aizoaceae	13.97
8	Boraginaceae	21.99
9	Brassicaceae	20.73
10	Capparidaceae	42.62
11	Caryophyllaceae	12.48
12	Chenopodiaceae	136.2
13	Convolvulaceae	11.8
14	Cucurbitaceae	17.61
15	Cyperaceae	101.14
16	Euphorbiaceae	48.4
17	Malvaceae	38.76
18	Mimosaceae	133.74
19	Nyctaginaceae	14.23
20	Orobanchaceae	37.89
21	Papaveraceae	9.26
22	Papilionaceae	66.66
23	Plantaginaceae	31.37
24	Polygonaceae	97.25
25	Poaceae	483.4
26	Resedaceae	6.29
27	Rhamnaceae	61.20
28	Tamaricaceae	107.29
29	Zygophyllaceae	21.92

Table 22. Family importance values at site II.

S.No.	Family	Total importance value of family
1	Amaranthaceae	94.56
2	Apocynaceae	34.84
3	Asclepiadaceae	31.74
4	Asteraceae	128.82
5	Araceae	52.55
6	Boraginaceae	10.83
7	Brassicaceae	14.43
8	Caryophyllaceae	5.15
9	Chenopodiaceae	99.13
10	Convolvulaceae	44.39
11	Cucurbitaceae	34.53
12	Cyperaceae	43.14
13	Euphorbiaceae	9.35
14	Malvaceae	20.37
15	Mimosaceae	206
16	Nyctaginaceae	28.47
17	Orobanchaceae	28.77
18	Papilionaceae	25.53
19	Poaceae	472.43
20	Polygonaceae	55.61
21	Primulaceae	27.23
22	Resedaceae	9.12
23	Rhamnaceae	43.64
24	Solanaceae	56.76
25	Tamaricaceae	88.45
26	Vitaceae	24.24
27	Zygophyllaceae	53.41

Table 23. Family importance values at site III

S.No	Family	Total Family importance value
1	Amaranthaceae	128.42
2	Apocynaceae	41.65
3	Apiaceae	5.9
4	Asteraceae	88.79
5	Boraginaceae	22.51
6	Brassicaceae	11.85
7	Capparidaceae	47.96
8	Chenopodiaceae	49.72
9	Convolvulaceae	39.07
10	Cyperaceae	53.89
11	Euphorbiaceae	75.97
12	Fumariaceae	9.09
13	Malvaceae	3.85
14	Mimosaceae	267.13
15	Nyctaginaceae	21.19
16	Oxalidaceae	4.9
17	Papilionaceae	121.19
18	Plantaginaceae	7.27
19	Poaceae	472.47
20	Polygonaceae	8.19
21	Primulaceae	9.03
22	Ranunculaceae	3.79
23	Rhamnaceae	55.29
24	Solanaceae	90.17
25	Tiliaceae	17.06
26	Tamaricaceae	81.17
27	Verbenaceae	5.05
28	Zygophyllaceae	56.18

4.4 Shannon Diversity Index and Species richness.

Shannon diversity index of plant communities at three sites (I, II, III) is given (Table 24). Species diversity is one of the key characters of any vegetation that not only reflects the health of vegetation but also its productivity. Index of diversity is the degree of complexity of form and function in a community. Its specific measurement leads to understanding of process involved in the developing changes and group of communities (Shoukat *et al.*, 1978; Malik & Hussain, 2006). Species diversity reflects the influence of diverse factors such as over grazing, deforestation, and environmental stress as vulnerability of species to these factors, lowers the species diversity (Willoughby & Alexander, 2000, 2005). Shannon diversity index at site I was 3.814, at site II, 3.74 and at site III, 4.083 among plant communities in the area. These results are in line with those of Adhikari *et al.* (1991) and Badshah *et al.* (2013) who described high diversity near water courses similar to the present trends. Malik *et al.* (2001) documented high species diversity in the upper reaches of vegetation of Dao Khun while low diversity at lower altitude. Similarly, during the present study high species diversity was found at site III, based on habitat feature, water contents and climate.

Species richness was recorded at each sites of the area. At site-I, the species richness was 54 that gradually decreased to 51 at site-III while highest species richness was 72 species at site III (Table. 24). The high richness may be due to different habitats and appropriate edaphic and climatic factors supporting growth and survival of the species. This is also true in the present case where favorable temperature made the habitat suitable for plants (Samant *et al.* 2007). Central Himalayan area which are most arid cool have species richness from 11 - 106 (Rikhari *et al.*, 1997; Ram *et al.*, 2004). At site-I and site-II high deforestation, erosion and overgrazing have created aridity. The overall high species richness was observed at site-III. The high herbaceous richness value were stated in dry habitats by former workers varied from 34 - 414 (Kharkwal *et al.*, 2005 and Badsha *et al.*, 2010) and their values were greater than the present study.

Table 24. Shannon diversity index and species richness at three sites

	Site I	Site II	Site III
Shannon Diversity	3.814	3.742	4.083
Species Richness	54	51	72

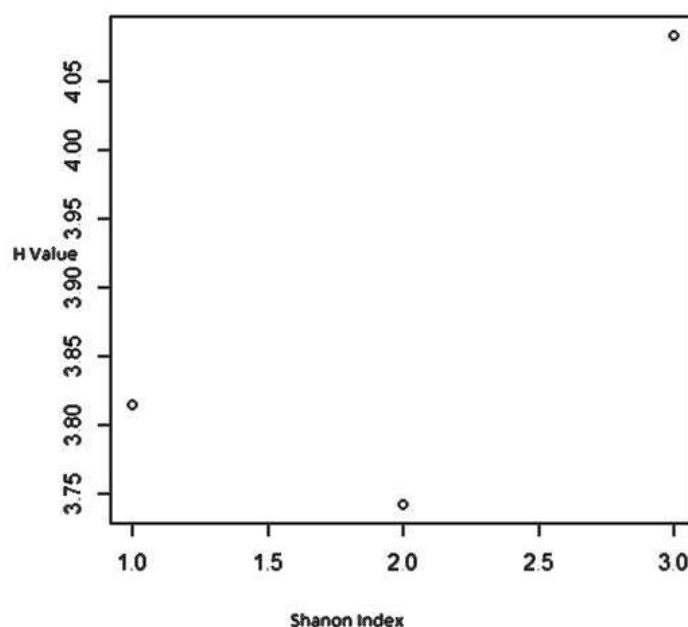


Figure 7. Species richness and diversity

4.5 Effect of rain on density, frequency, cover and Importance Values.

The effect of rain on density, frequency, cover and importance value of plant community at three sites is expressed in (Table 25). This study was conducted in dry and xeric habitat of district Bannu. The annual precipitation had direct effect on the total values of density, frequency, cover and importance values of plant community in dry area. There was linear correlation among the rain fall and density, frequency, cover and importance value of plant community in the area. It is quite evident from the (Fig. 8) values that the density, frequency, cover and importance values of plant communities increased with precipitation in the area. The xeric and dried habitat's biomes may responses positively to precipitation. Primary productivity of plant communities increased with precipitation in the area (Zeppel *et al.*, 2014). Moreover, seasonal variation in rain fall during warm or dry seasons may have larger effects than changes during cool or wet seasons. This shows similarity with the study of Volder *et al.* (2010, 2013); Reyer *et al.* (2012) and Misson *et al.* (2011).

Table 25. Effect of rain on total values of three sites.

	Estimate	Standard Error	T Value	P Value
Density	0.1975	0.3883	0.509	0.662
Frequency	7.073	13.922	0.508	0.662
Cover	0.1585	0.6923	0.229	0.849
IV	1.297	3.369	0.385	0.737

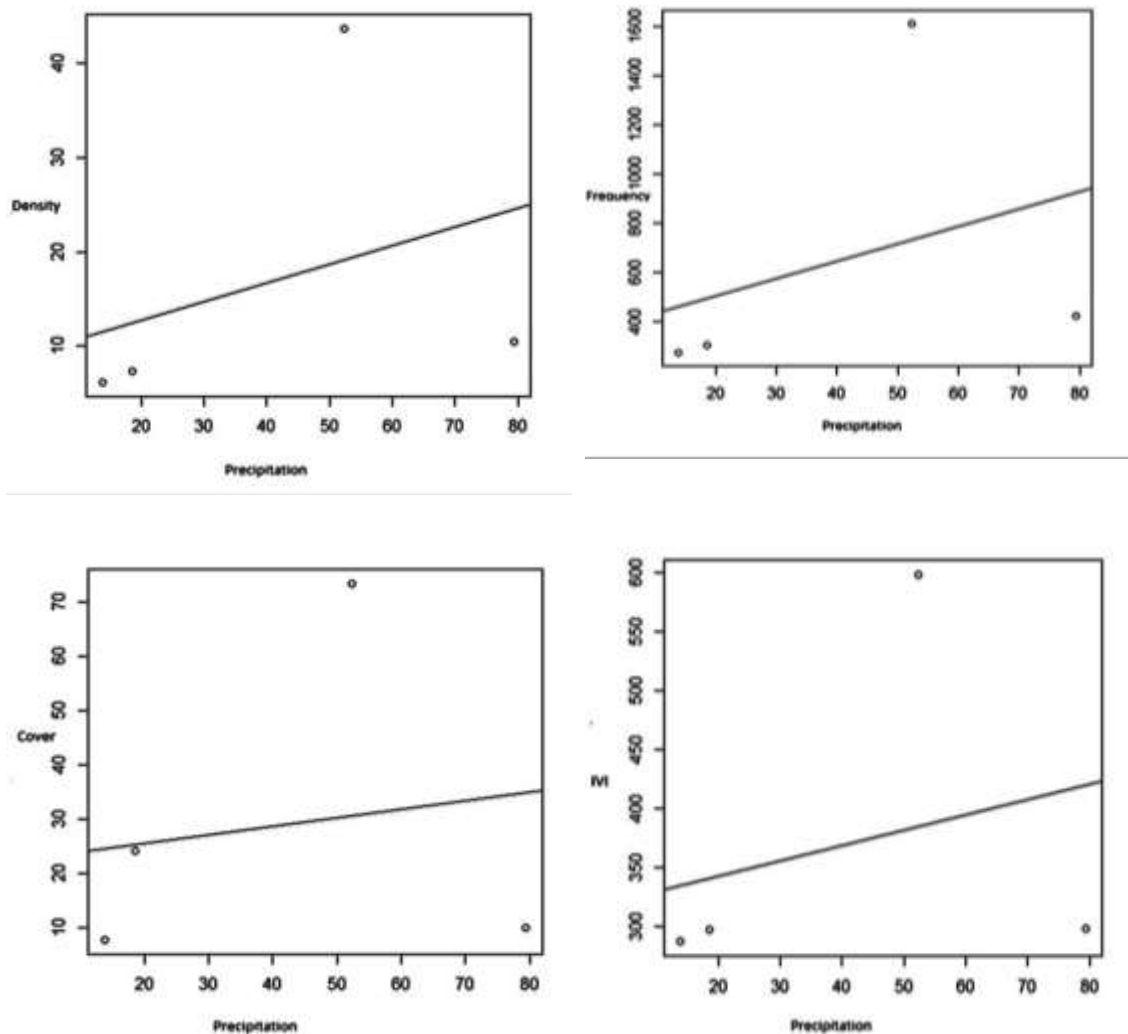


Figure 8. Effect of rain on total values of density, frequency, cover and importance value of plant community.

4.6 Edaphology

The study area was divided into three sites. At each site, the soil was carefully studied (Table 26). At site I, dry habitats had sandy soil with pH (8.03), EC (0.018 Sdm^{-1}) nitrogen contents (0.32%), low phosphorus ($1.23 \mu\text{g/gm}$) and potassium contents were 8ppm. The organic matter was (1.55%) but sulphur (913 ppm), silicon (45 ppm), ferrous ($1.06 \mu\text{g/gm}$), copper ($0.092 \mu\text{g/gm}$), zinc ($1.98 \mu\text{g/gm}$) and calcium ($95.14 \mu\text{g/gm}$) were high. magnesium ($113.98 \mu\text{g/gm}$), lead ($0.014 \mu\text{g/gm}$), cadmium ($0.44 \mu\text{g/gm}$), nickel ($1.22 \mu\text{g/gm}$), chromium ($4.4 \mu\text{g/gm}$) and manganese were ($1.568 \mu\text{g/gm}$) reported at the site I (Table 26). Similar study has been conducted in district Tank, various soil variables have studied in detail. There was slight variation in soil profile (Badshah *et al.*, 2010). Zinc concentration was considerably greater in leafy vegetables developed in non-calcareous soil. Fe-oxides are likely to root in calcareous soil and solubility and liability of Zn in soil both systematically drop as pH rises (Tye *et al.*, 2003). Some elements have low concentration in the study area that is compare with the similar study (Acosta *et al.*, 2012). The lower concentration of certain elements, like Ca, K in certain soils in soil could also be described by a recurrent break of primary minerals, particularly K-feldspars and plagioclase.

At site II, dry habitats had sandy soil with pH (8.13), EC (0.002 Sdm^{-1}) nitrogen contents (0.42%), low phosphorus ($1.99 \mu\text{g/gm}$) and potassium contents were (5 ppm). The organic matter was (1.04 %) but sulphur (177 ppm), silicon (38 ppm), ferrous ($0.58 \mu\text{g/gm}$), copper ($0.042 \mu\text{g/gm}$), zinc ($1.77 \mu\text{g/gm}$) and calcium ($91.42 \mu\text{g/gm}$) were high. magnesium ($117.98 \mu\text{g/gm}$), lead ($0.06 \mu\text{g/gm}$), cadmium ($0.053 \mu\text{g/gm}$), nickel ($1.78 \mu\text{g/gm}$), Cr ($10.4 \mu\text{g/gm}$) and manganese were ($1.488 \mu\text{g/gm}$) reported at the site II (Table 26). The association between clay mineralogy composition and K forms and physicochemical properties has also been confirmed by several studies (Suptaneni *et al.*, 2012; Raheb and Heidari, 2012). Similarly, the composition of elements like Ni, Cu and Zn in Riverbank their Phytoremediation using XRF and SEM/EDX technique was studied (Jamari *et al.* 2014).

Edward *et al.* (2015) studied six hundred and fifty-two plant samples, representing 97 edible food items sampled from >150 sites in Malawi between 2011-2013. Samples were studied by ICP-MS for up to 58-elements with the essential minerals like calcium, copper, Iron, magnesium and zinc. In maize grain calcium, copper, iron,

magnesium and zinc results showed that concentrations were greater from plants grown on calcareous soils than those from the more common low pH soils.

At site III, dry habitats had sandy soil with pH (8.04), EC (0.005 Sdm^{-1}) nitrogen contents (0.35%), low phosphorus ($1.34 \mu\text{g/gm}$) and potassium contents were studied (4 ppm). The organic matter was (1.35%) but sulphur (295 ppm), silicon (34 ppm), ferrous ($4.28 \mu\text{g/gm}$), copper ($0.318 \mu\text{g/gm}$), zinc ($0.206 \mu\text{g/gm}$) and calcium ($102.66 \mu\text{g/gm}$) were high. magnesium ($120.94 \mu\text{g/gm}$), lead ($0.006 \mu\text{g/gm}$), cadmium ($0.08 \mu\text{g/gm}$), nickel ($0.68 \mu\text{g/gm}$), chromium ($52 \mu\text{g/gm}$) and manganese were ($1.998 \mu\text{g/gm}$) reported in the site III (Table 26). This is due to statement that variation in the concentrations of soil chemical elements are determined from changes in the arrangement of the parent material and from fluxes of matter and energy into or from soils over time (Helmke, 2000; Rawlins *et al.*, 2012).

The nature of the key variables explanation ecological diversity of soils can be connected to the mineralogy of parent rock and though these relation-ships have indirect, mineralogy of parent rock is a chief factor regulates spatial patterns of land resources (Voortman, 2011). Generally the study area soils varied slightly in pH i.e. from 8.03-8.13 to 8.04, EC from $0.018\text{-}0.002 \text{ Sdm}^{-1}$ to 0.005 dSm^{-1} . Organic matter were adequate amount i.e. from 1.55-1.04 % to 1.35%. NPK and other macro and microelements which were essential for plant growth and development were also studied in (Table 26).

According to Towett *et al.* (2015) the variation in whole elements concentration is vital especially in the sub-saharan Africa soil setting for agricultural and environmental, management at big scale. With and between the sites forms of variation in total elements structure of 17-elements; Al, P, K, Ca, Ti, V, Cr, Mn, Fe, Ni, Cu, Zn, Ga, Sr, Y, Ta and Pb were explored. Total elements concentration standards were within the range reported globally for soil Cr, Mn, Zn, Ni, V, Sr, and Y and higher than reported range for Al, Cu, Ta, Pb and Ca. these were important variations (< 0.005) in total element composition within and between the sites for the elements examined with the highest proportion of total variation and member of significant variance constituents occurring at the site (55-88%) monitored by the cluster nested with site (10-40%) levels.

Table 26. Soil elements in three sites.

S/No	Elements	Site I	Site II	Site III
1	pH	8.03	8.13	8.04
2	EC in (dScm ⁻¹)	0.018(dScm ⁻¹)	0.002(dScm ⁻¹)	0.005(dScm ⁻¹)
3	OM in %	1.55%	1.04%	1.35%
4	Soil texture	Sandy Loam	Sandy Loam	Sandy Loam
5	Nitrogen as N	0.32%	0.42%	0.35%
6	Phosphorus as P	1.23 µg/gm	1.99 µg/gm	1.34 µg/gm
7	Potassium as K	8 ppm	5 ppm	4 ppm
8	Mg	113.98 µg/gm	117.52 µg/gm	120.94 µg/gm
9	Ca	95.14 µg/gm	91.42 µg/gm	102.94 µg/gm
10	Sulphur as S	913 ppm	177 ppm	295 ppm
11	Ferrous	1.06 µg/gm	0.58 µg/gm	4.28 µg/gm
12	Mn	1.568 µg/gm	1.488 µg/gm	1.998 µg/gm
13	Cu	0.092 µg/gm	0.042 µg/gm	0.318 µg/gm
14	Zn	1.98 µg/gm	1.77 µg/gm	0.206 µg/gm
15	Si	45 ppm	38 ppm	34 ppm
16	Pb	0.014 µg/gm	0.06 µg/gm	0.006 µg/gm
17	Ni	1.22 µg/gm	1.75 µg/gm	0.68 µg/gm
18	Cr	4.4 µg/gm	10.4 µg/gm	5.2 µg/gm
19	Cd	0.044 µg/gm	0.053 µg/gm	0.08 µg/gm

4.6.1 Principal component analysis among the soil variables

Soil is naturally composed of various degraded minerals and organic matter. It is deposited by numerous natural actions such as mechanical and chemical weathering on different types of rocks. The principal component among various soil variables are expressed in Table 27. There is strong correlation between N and Pb in the soil. Their probability value is 0.001. Similarly, there is negative correlation between Mg and S. Its probability value is -0.023 in the area. While, no correlation is found in rest of elements in the area (Fig. 9).

Soil pH and organic matter contents strongly affect soil function and plant nutrients availability. Specially, pH affects chemical solubility and accessibility of plant essential nutrient. To know plant nutrients availability and optimal growing conditions for specific plant, it is essential to understand soil chemistry and interrelating factors that affect soil pH (McCauley *et. al.*, 2009). Therefore, the soil pH is one of the influential factors in the plant nutrients availability in the soil. The essential range of soil pH is 5.5 to 7.0 for the suitable growth and progress of most of the plants (Singh, 1995). Most of the plant nutrients are accessible at somewhat acidic to slightly alkaline soil (PH 6.5 to 7.5). A number of plant nutrients are inaccessible at very acidic or extremely alkaline soils due to the altered reactions in the soil which fix the nutrient and convert them to the state that is unavailable for the plants (Brady, 1984). Soil organic matter is defined as the summation of plants and animals residue at various stages of decomposition, cell and tissue of soil organism, and well-decomposed materials (Brady and Weil, 1999). Soil organic matter helps multiple functions in the soil, counting nutrients storage and soil accretion. Soil organic matter levels have weakened over the last century in some soils as a result of extreme agricultural practices, overgrazing on grasslands, deforestation and change of forest to tilled farmland. Soil organic matter content is up to 5 percent in agricultural soils while it could be up to 30 percent in the organic soils (Brady and Weil, 2002).

Table 27. Soil variables obtained through Principal Component Analysis.

S.No	Paramter	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	p ^H	-0.778	0.629	0.895	0.802	-0.543	0.765	0.777	0.101	0.992	-0.993	-0.144	0.905	0.664	0.109	0.206	0.753	-0.67	-0.131
2	EC (dScm ⁻¹)	0.111	-0.994	-0.324	-0.99	-0.203	-0.092	-0.995	-0.771	-0.619	0.791	0.798	-0.943	0.052	0.62	0.541	-0.998	-0.045	0.79
3	OM %	0.55	-0.835	-0.718	-0.946	0.262	-0.533	-0.932	-0.398	-0.908	0.982	0.438	-0.991	-0.406	0.198	0.102	-0.917	0.412	0.426
4	Nitrogen	-0.633	0.774	0.785	0.907	-0.36	0.618	0.889	0.302	0.946	-0.996	-0.343	0.973	0.498	-0.096	0.001	0.871	-0.504	-0.331
5	P	-0.749	0.662	0.875	0.827	-0.506	0.737	0.804	0.144	0.986	-0.997	-0.186	0.922	0.631	0.066	0.163	0.781	-0.637	-0.174
6	K	-0.303	-0.953	0.09	-0.848	-0.585	0.322	-0.869	-0.964	-0.245	0.474	0.974	-0.726	0.455	0.886	0.837	-0.887	-0.449	0.971
7	Mg	0.547	0.837	-0.353	0.675	0.781	-0.563	0.704	1	-0.023	-0.22	-0.999	0.515	-0.677	-0.978	-0.953	0.731	0.672	-1
8	Ca	0.992	0.127	0.941	-0.123	0.982	-0.994	-0.083	0.649	-0.775	0.599	-0.616	-0.317	-0.999	-0.794	-0.849	-0.045	1	-0.625
9	S	0.084	-0.996	-0.298	-0.986	-0.23	-0.065	-0.992	-0.788	-0.598	0.774	0.814	-0.934	0.08	0.642	0.564	-0.996	-0.073	0.806
10	Fe	0.943	0.332	-0.849	0.088	1	-0.949	0.128	0.794	-0.626	0.418	-0.767	-0.112	-0.985	-0.904	-0.941	0.165	0.984	-0.775
11	Mn	0.952	0.307	-0.863	0.061	1	-0.958	0.101	0.778	-0.646	0.442	-0.75	-0.138	-0.989	-0.892	-0.932	0.139	0.988	-0.758
12	Cu	0.959	0.283	-0.875	0.037	1	-0.964	0.077	0.762	-0.665	0.464	-0.733	-0.162	-0.992	-0.881	-0.922	0.115	0.992	-0.742
13	Zn	-0.884	-0.537	0.707	-0.311	-0.969	0.854	-0.349	-0.911	0.433	-0.201	0.892	-0.116	0.92	0.977	0.993	-0.384	-0.917	0.898
14	Si	-0.42	-0.908	0.213	-0.775	-0.681	0.437	-0.8	-0.989	-0.123	0.36	0.995	-0.635	0.562	0.937	0.899	-0.822	-0.556	0.993
15	Pb	-0.9	0.436	0.973	0.646	-0.719	0.891	0.614	-0.127	0.995	-0.939	0.084	0.784	0.816	0.332	0.422	0.584	-0.82	0.097
16	Ni	-0.998	0.06	0.988	0.306	-0.93	0.997	0.267	-0.496	0.879	-0.738	0.458	0.489	0.975	0.667	0.736	0.23	-0.976	0.469
17	Cr	-0.757	0.654	0.881	0.821	-0.516	0.744	0.797	0.133	0.988	-0.996	-0.175	0.918	0.64	0.077	0.174	0.774	-0.645	-0.163
18	Cd	0.764	0.654	-0.607	0.435	0.927	-0.777	0.471	0.958	-0.309	0.069	-0.945	0.248	-0.86	-0.997	-1	0.504	0.856	-0.949

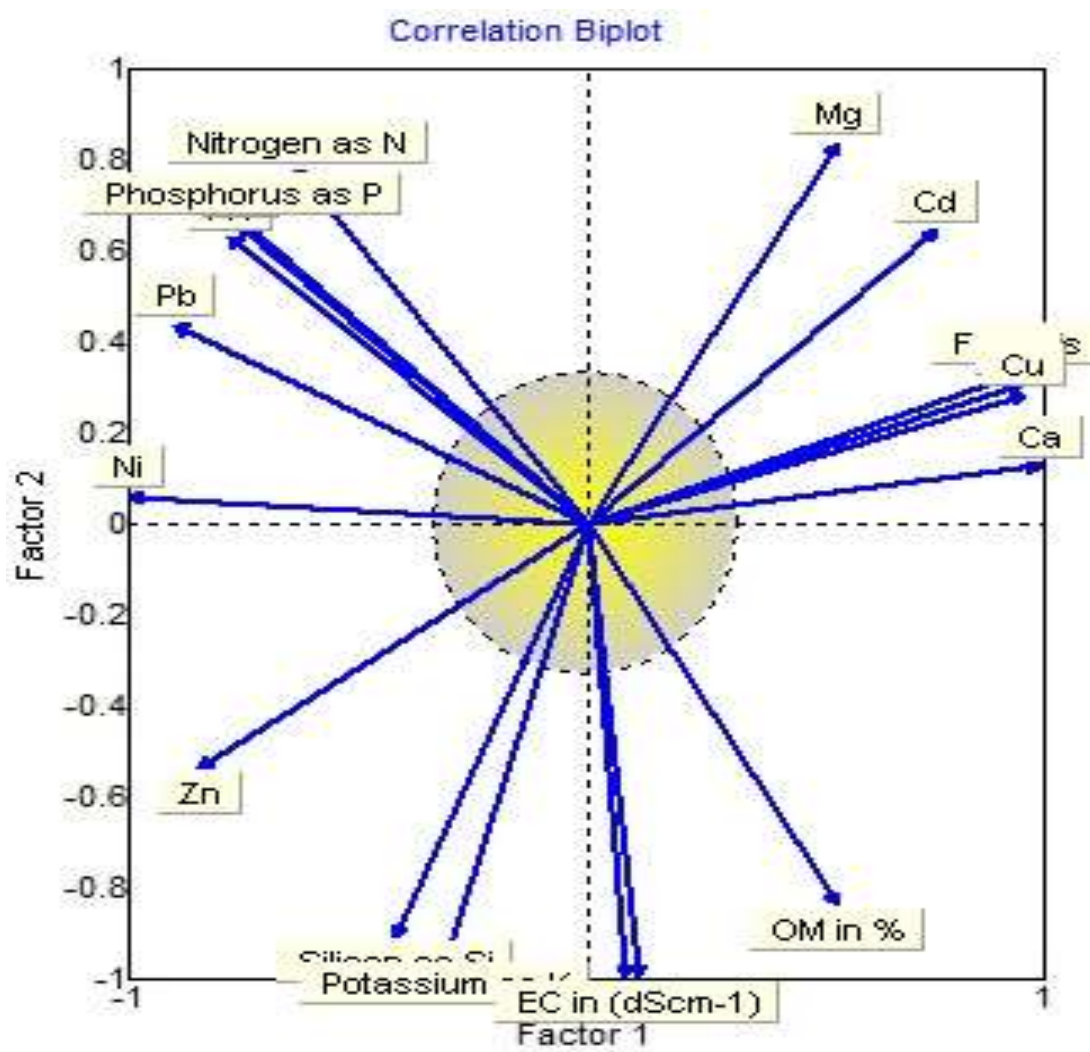


Figure 9. Principal component analysis

4.6.2 Correlation of different soil variables at three different sites with total values.

i. Correlation of different soil variables at three different sites with total density.

SAM software was used for determination of correlation among different soil variables with total values of density, frequency, cover and importance values. Total values of density, frequency, cover and importance values is expressed in (Appendix1)

The correlation of different soil variables with density is expressed in Table 28. Density is the numbers of individuals per unit area. The soil macro and microelements show marked effect on total density of the study area.

Dry habitats had sandy soil. The correlation of total plant density was positive and significant with Mg ($r = 0.97$, $p = 0.001$), Ca ($r = 0.72$, $p = 0.05$), Fe ($r = 0.902$, $r = 0.014$), Mn ($r = 0.89$, $p = 0.017$), Cu (0.87 , $p = 0.02$) and Cd ($r = 0.99$, $p = < .001$). The correlation of total plant density was negative and significant with K ($r = - 0.88$, $p = 0.018$), Zn ($r = - 0.99$, $p = 0.002$) and Si ($r = - 0.93$, $p = 0.007$). These results agree with earlier study Isaac & Guimaraes, 2008. Generally, the probability values of micronutrients are more significant with density as compared to macronutrients. Micronutrients have marked effect on total density of the study area. This is close agreement with the study of Kuva *et al.* (2008).

ii. Correlation of different soil variables at three different sites with total frequency

Frequency is the percentage occurrence of species in any area and also related with soil micro and macro elemental composition that were expressed in Table 29. The total frequency (Appendix 1) was positively significant and correlated with Mg ($r = 0.99$, $p = < .001$), Ca ($r = 0.72$, $p = 0.08$), Fe ($r = 0.85$, $r = 0.027$), Mn ($r = 0.84$, $p = 0.03$), Cu (0.82 , $p = 0.36$) and Cd ($r = 0.98$, $p = < .001$). These results agreed with study like Major *et al.* (2005) who have studied the weed distribution in relation to different soils with different fertility levels, could notice positive correlations between weed density and calcium, magnesium, potassium, phosphorus contents and soil pH. The correlation of total plant frequency was negatively significant with K ($r = - 0.92$, $p = 0.008$), Zn ($r = - 0.95$, $p = 0.005$) and Si ($r = - 0.96$, $p = 0.003$). These results were

also according to Moura *et al.* (2009) soil fertility affects the weed numbers and biomass and more demanding than others in certain nutrients.

iii. Correlation of different soil variables at three different sites with total cover.

Cover is the vertical projection of foliage shoots/crown of a species to the ground surface expressed as fraction or percentage of a surface area. Soils ingredients have mark effect on total cover of a study area were expressed in Table 30.

The total cover (Appendix 1) was positively significant and correlated with pH ($r = 0.85$, $p = 0.002$), P ($r = 0.82$, $p = 0.03$), Pb ($r = 0.94$, $p = 0.005$), Ni ($r = 0.99$, $p = < .001$) and Cr ($r = 0.83$, $p = 0.034$). The results were compare with an earlier study (Iwara *et al.*, 2011) they detected that P influenced in a higher weed density. The authors ascribed this result to the fact that P is a macroelement and, therefore, very essential for most species because it directly effects their growth and development. It also affects the plant cover of the area. Similarly, The correlation of total plant cover was negative and significant with Ca ($r = -0.96$, $p = 0.003$), Fe ($r = -0.89$, $p = 0.017$), Mn ($r = -0.9$, $p = 0.014$) and Cu ($r = -0.91$, $p = 0.011$). This was also compared with study like Shiratsuchi *et al.* (2005), pointing to study the correlation between soil properties negative correlation between the prevalence of *Cyperus rotundus*, *Brachiaria plantaginea* and *Commelina benghalensis* with K and a negative correlation with pH, Ca, Mg.

iv. Correlation of different soil variable at three different sites with total importance value.

The relative values of each parameter i.e. density, frequency and cover for species were added to become the importance values (IV). The soil ingredients had effect on the total importance values (Appendix 1) of the area expressed in Table 31.

OM ($r = 0.926$, $p = 0.009$) and Pb ($r = 0.989$, $p = < .001$) were the soil variable that have positively significant effect with total importance values (IV) of plant community in the area. The results were compare with the study like Otto *et al.* (2007) calculating the correlation of physio-chemical soil properties with emerged weed density. He observed that *Galinsoga parviflora* and *Chenopodium album* had a more number of individuals in low sand content, medium clay content and high silt content areas. According to the authors, the relation with soil properties can define and explain that why some species are spread through the area and others focus on precise points.

The correlation of of total importance values (Appendix 1) of plant communities was negative and significant with pH ($r = -0.997$, $p < .001$), N ($r = -0.96$, $p = 0.004$), P ($r = -0.993$, $p < .001$), Ni ($r = -0.857$, $p = 0.027$) and Cr ($r = -0.994$, $p < .001$). These results were also agreed with earlier study like Udoh *et al.* (2007) who studied the effect of physical and chemical soil properties in the weed spreading in five different soils in Nigeria. He observed that the distribution and existence of the dominant species, *Tridax procumbens* was strongly influenced by soil properties, counting C, K and high sand content.

Correlation of total density of plants community with different soil variables is expressed in Figure 10. From these it is evident that Mg, Ca, Fe, Mn, Cu and Cd have positive affects while K, Zn and Si have reciprocal affects on plants density in the area. Correlation of total frequency of plant community with soil variables is expressed in Figure 11. In these figure it is expressed that Mg, Ca, Fe, Mn, Cu and Cd have linear correlation with frequency of plants community while K, Zn and Si have negative significant affects on total plants frequency in the area. Correlation of the total cover with soil variables is showed in Figure 12. In these figure values, it is clear that pH, N, P, Pb, Ni and Cr have positive affects on the total cover values of plants community while Ca, Fe, Mn and Cu have negative significant affects on total plants cover in the area. Similarly, Correlation of total IV of plants community with different soil variables is expressed in Figure 13. From these it is evident that organic matter and Pb have positive affects on the total importance values of plants community while pH, N, P, Ni, and Cr have reciprocal affects on total importance values of plant community in the area. These results were also accordance to (Kuva *et al.*, 2008; Moura *et al.*, 2009 and Shiratsuchi *et al.*, 2005).

Table 28. Correlation of different soil variables at three different sites with total density. Macroelements are from S/No 1-9 and microelements are from 10-18. Significant P Value stands for probability and R for Pearson's Co-efficient are bold. DF stands for degree of freedom, R stands for Pearson's r, F stands for Pearson's F and T stands for Spearman's t.

S/N	Parameter	R	F	T	DF	P
1	pH	-0.107	0.02	1	1	0.81
2	EC in (dScm ⁻¹)	-0.62	1.26	-1	1	0.14
3	OM in %	-0.021	0.08	-1	1	0.65
4	N	0.09	0.02	1	1	0.82
5	P	-0.06	0.008	1	1	0.88
6	K	-0.88	7.42	-1	1	0.018
7	Mg	0.97	44.99	-1	1	0.001
8	Ca	0.72	3.36	1	1	0.05
9	S	-0.64	1.41	-1	1	0.13
10	Fe	0.902	8.77	1	1	0.014
11	Mn	0.89	7.67	1	1	0.017
12	Cu	0.87	6.81	1	1	0.02
13	Zn	-0.97	41.05	-1	1	0.002
14	Si	-0.93	14.64	-1	1	0.007
15	Pb	-0.32	0.24	-1	1	0.45
16	Ni	-0.66	1.58	-1	1	0.11
17	Cr	-0.075	0.011	1	1	0.86
18	Cd	0.99	287.51	-1	1	< .001

Table 29. Correlation of different soil variables at three different sites with total frequency. Macroelements are from S/No 1-9 and microelements are from 10-18. Significant P Value stands for probability and R for Pearson's Co-efficient are bold. DF stands for degree of freedom, R stands for Pearson's r, F stands for Pearson's F and T stands for Spearman's t.

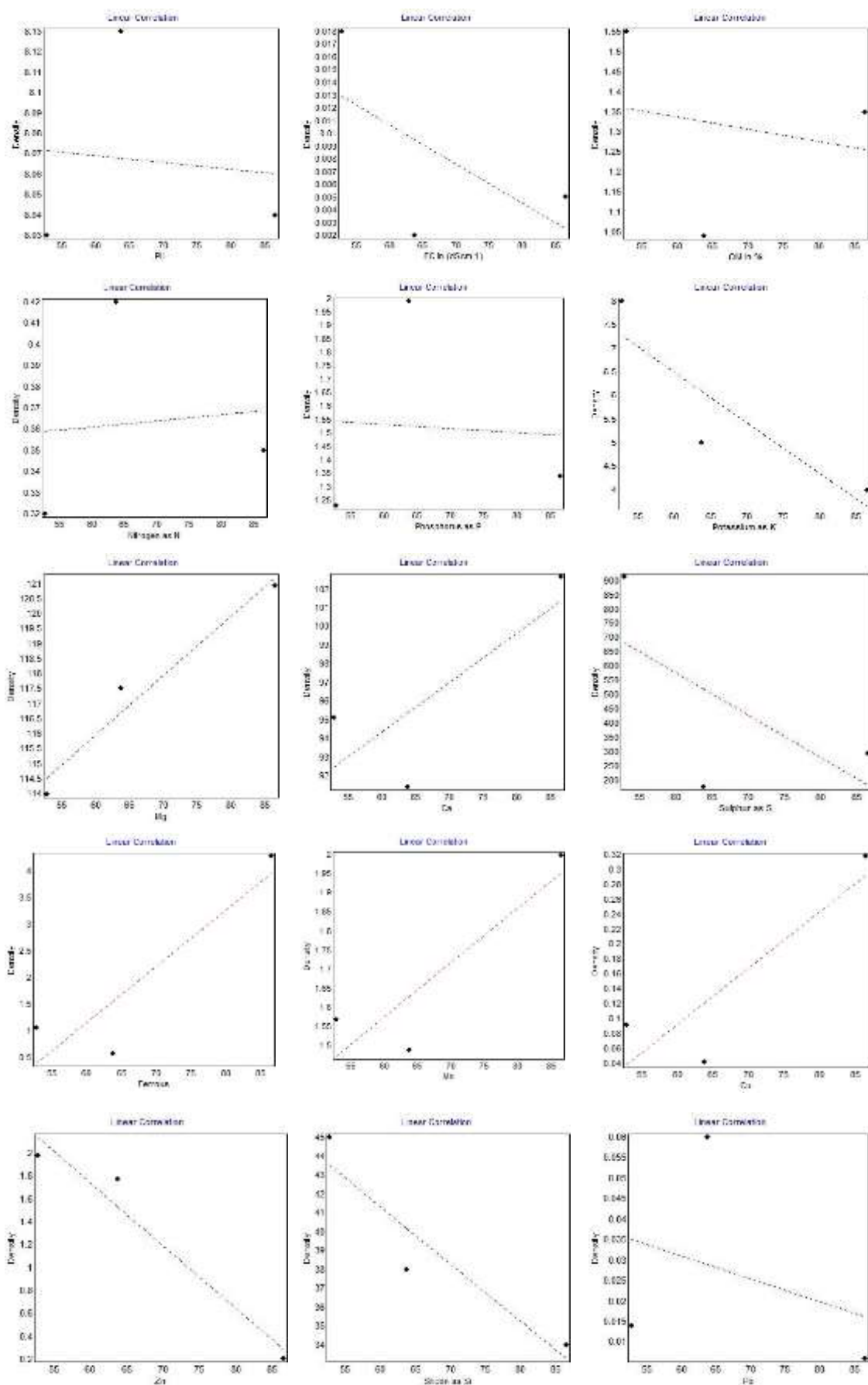
S/N	Parameter	R	F	T	DF	P
1	pH	-0.008	< .001	1	1	0.98
2	EC in (dScm ⁻¹)	-0.69	1.88	-1	1	0.09
3	OM in %	-0.29	0.19	-1	1	0.503
4	N	0.19	0.08	1	1	0.65
5	P	0.035	0.002	1	1	0.93
6	K	-0.92	12.5	-1	1	0.009
7	Mg	0.99	165.99	-1	1	< .001
8	Ca	0.72	2.25	1	1	0.08
9	S	-0.71	2.1	-1	1	0.087
10	Fe	0.85	5.47	1	1	0.027
11	Mn	0.84	4.85	1	1	0.03
12	Cu	0.82	4.36	1	1	0.036
13	Zn	-0.95	18.74	-1	1	0.005
14	Si	-0.96	29.3	-1	1	0.003
15	Pb	-0.23	0.11	-1	1	0.59
16	Ni	-0.58	1.05	-1	1	0.173
17	Cr	0.024	0.001	1	1	0.95
18	Cd	0.98	59.27	-1	1	< .001

Table 30. Correlation of different soil variables at three different sites with total cover. Macroelements are from S/No 1-9 and microelements are from 10-18. Significant P Value stands for probability and R for Pearson's Co-efficient are bold. DF stands for degree of freedom, R stands for Pearson's r, F stands for Pearson's F and T stands for Spearman's t.

S/N	Parameter	R	F	T	DF	P
1	pH	0.85	5.26	1	1	0.02
2	EC in (dScm ⁻¹)	-0.23	0.11	-1	1	0.59
3	OM in %	-0.65	1.47	-1	1	0.12
4	N	0.72	2.23	1	1	0.08
5	P	0.82	4.35	1	1	0.03
6	K	0.17	0.06	1	1	0.68
7	Mg	-0.43	0.47	-1	1	0.32
8	Ca	-0.96	29.44	-1	1	0.003
9	S	-0.21	0.09	-1	1	0.63
10	Fe	-0.89	7.89	-1	1	0.017
11	Mn	-0.9	9.05	-1	1	0.014
12	Cu	-0.91	10.3	-1	1	0.011
13	Zn	0.96	2.88	1	1	0.06
14	Si	0.3	0.19	1	1	0.49
15	Pb	0.94	17.76	-1	1	0.005
16	Ni	0.99	436.81	-1	1	< .001
17	Cr	0.83	4.56	1	1	0.034
18	Cd	-0.67	1.68	-1	1	0.11

Table 31. Correlation of different soil variables at three different sites with total importance values. Macroelements are from S/No 1-9 and microelements are from 10-18. Significant P Value stands for probability and R for Pearson's Co-efficient are bold. DF stands for degree of freedom, R stands for Pearson's r, F stands for Pearson's F and T stands for Spearman's t.

S/N	Parameter	R	F	T	DF	P
1	pH	-0.997	321.265	-1	1	< .001
2	EC in (dScm ⁻¹)	0.654	1.496	-1	1	0.124
3	OM in %	0.926	12.004	-1	1	0.009
4	N	-0.96	23.393	-1	1	0.004
5	P	-0.993	132.734	-1	1	< .001
6	K	0.289	0.182	1	1	0.513
7	Mg	-0.022	< .001	1	1	0.96
8	Ca	0.746	2.512	1	1	0.07
9	S	0.633	1.338	-1	1	0.139
10	Fe	0.59	1.068	1	1	0.171
11	Mn	0.611	1.194	1	1	0.155
12	Cu	0.631	1.32	1	1	0.141
13	Zn	0.392	0.363	1	1	0.373
14	Si	0.168	0.058	1	1	0.705
15	Pb	0.989	87.726	-1	1	< .001
16	Ni	-0.857	5.537	-1	1	0.027
17	Cr	-0.994	161.223	-1	1	< .001
18	Cd	0.266	0.152	-1	1	0.548



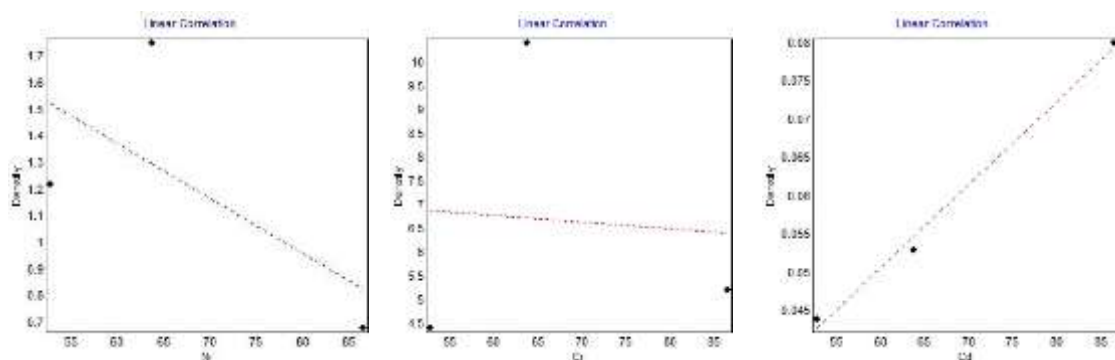
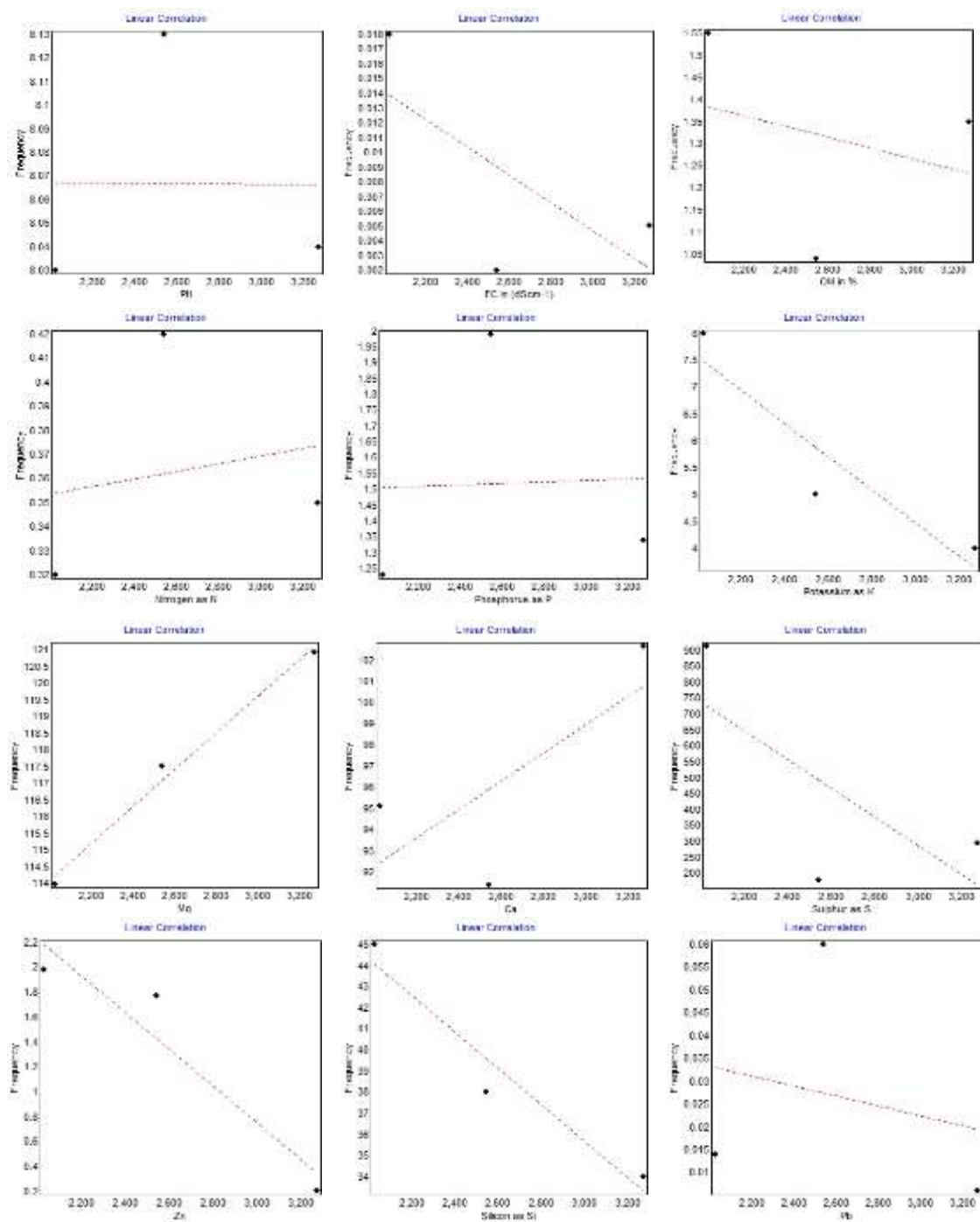


Figure 10. Spectras of linear correlation of total density of plant community with soil variables



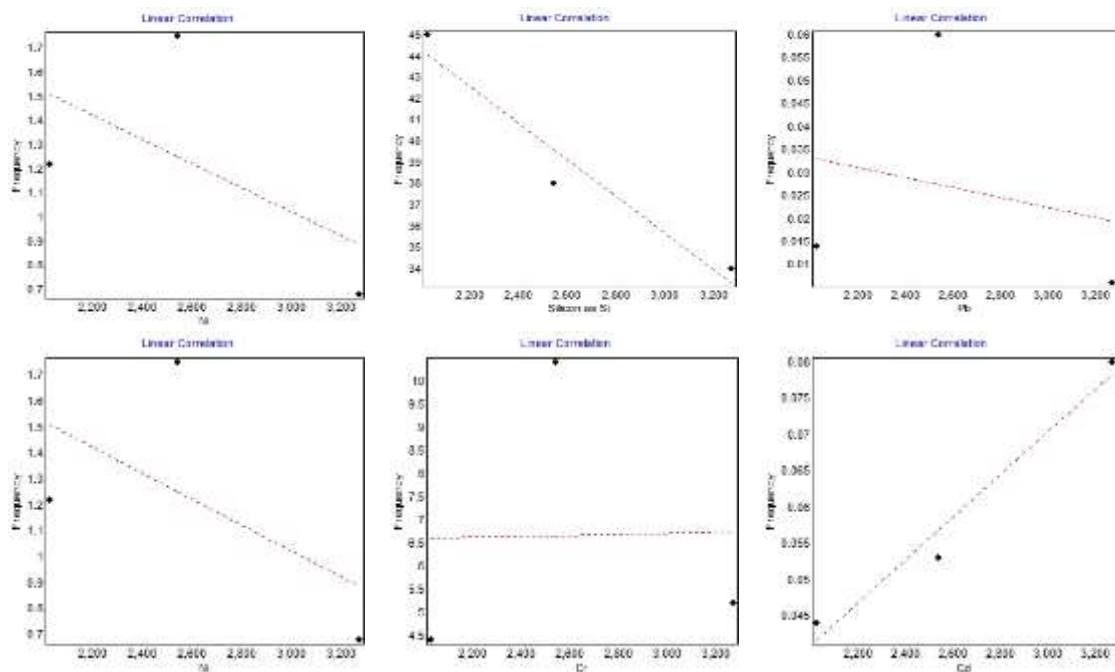
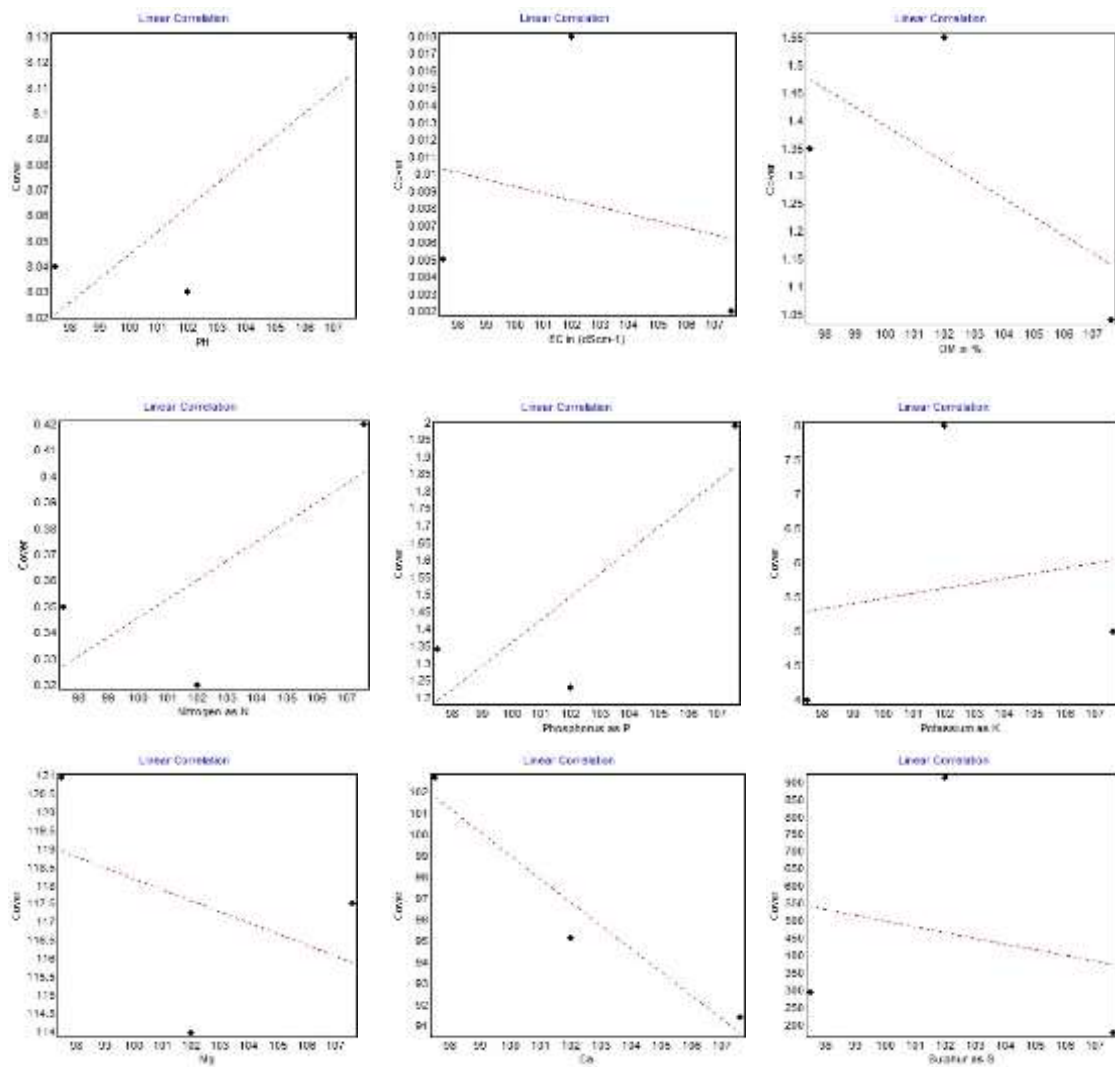


Figure 11. Spectras of linear correlation of total frequency of plant community with soil variables



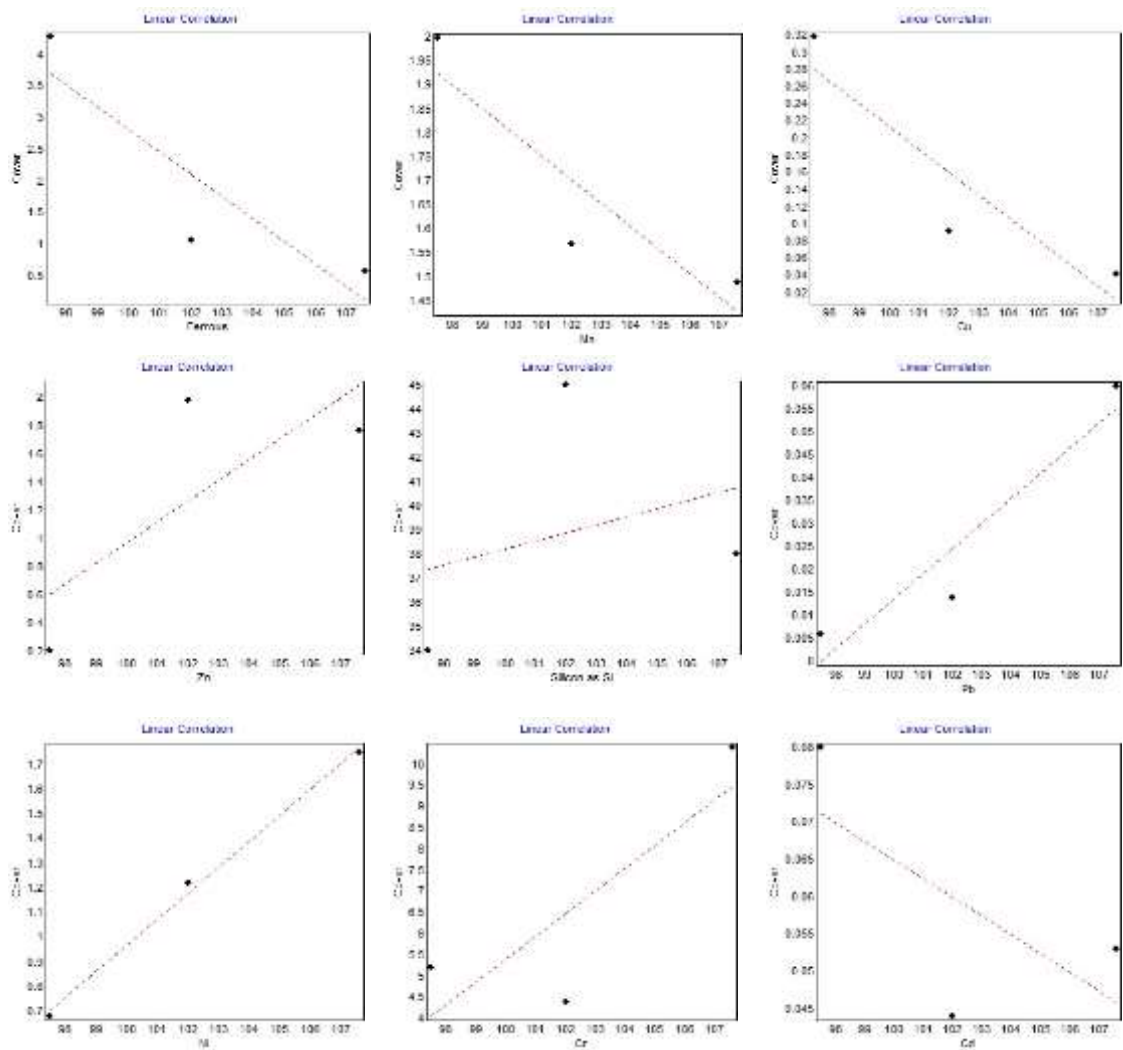
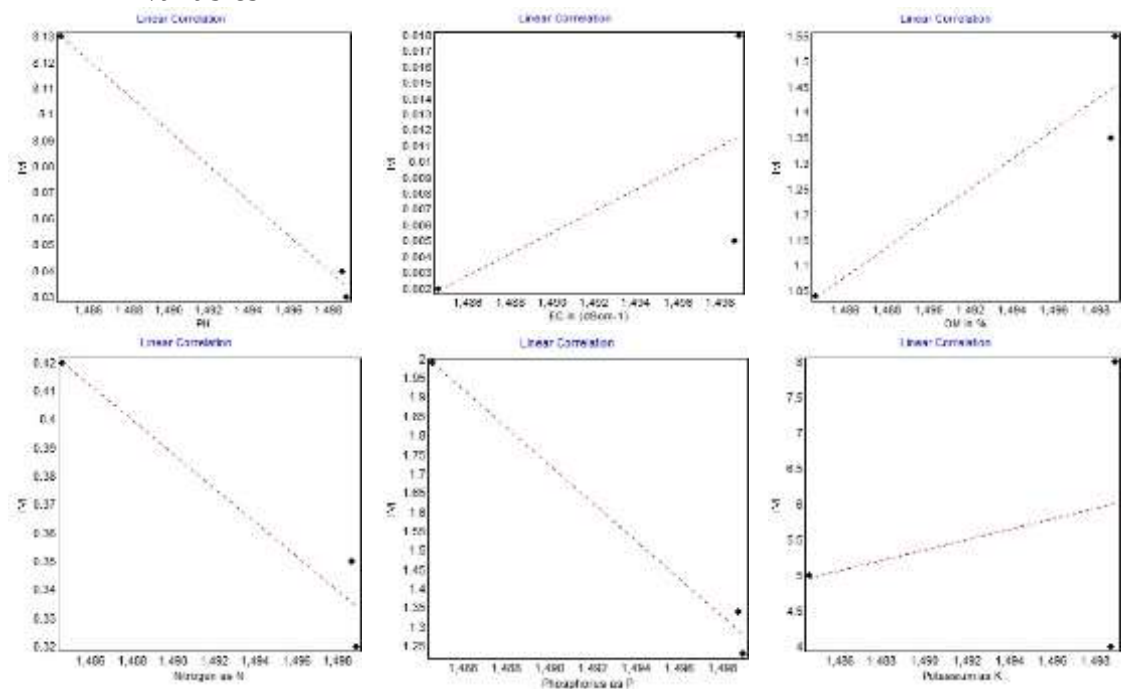


Figure 12. Spectras of linear correlation of total cover of plant community with soil variables



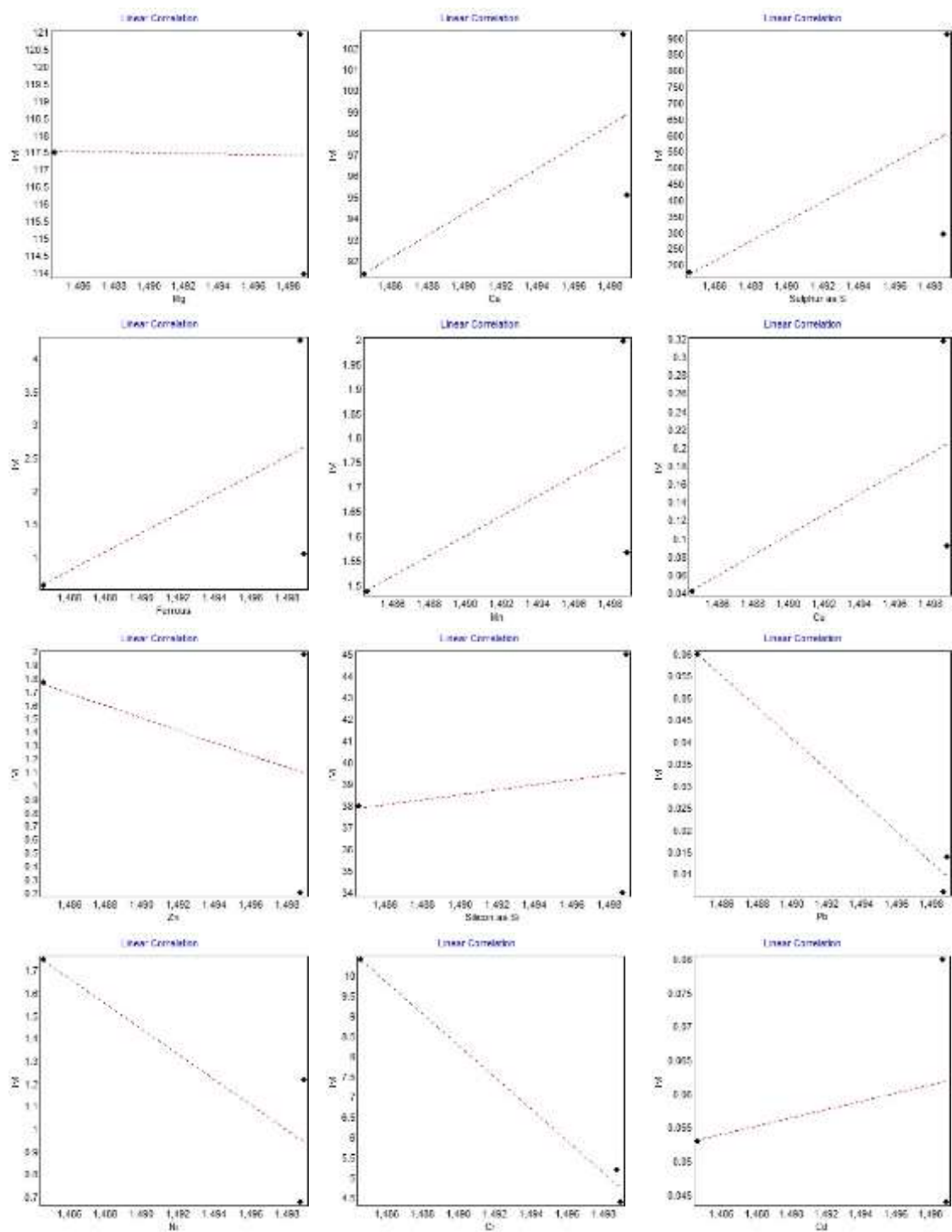


Figure 13. Spectras of linear correlation of total IV of plant community with soil variables

4.6.3 Multiple correlation of different soil variables at three different sites of herbs in spring season

i. Multiple correlation of different soil variables at three different sites of herbs in spring season with density.

The correlation of different soil variables with herbs density in spring season (Appendix 2, 3, 4) is expressed in Table 32. Dry habitat had sandy soil with probability values Mg ($r = 0.855$, $p = 0.027$), Ca ($r = 0.949$, $p = 0.005$), Fe ($r = 0.994$, $p = < .001$), Mn ($r = 0.991$, $p = < .001$), Cu ($r = 0.987$, $p = < .001$) and Cd ($r = 0.968$, $p = 0.003$) show that these were positively significant with herbs density in spring season. These results were agreed with earlier study. That were the effect of soil properties on the dispersal of flora. Aweto, (1981) and identified organic matter and clay proportion as soil variables that exerted marked effect on the distribution and abundance of tree species. The herbaceous density was negative and significant in the spring season with Zn ($r = - 0.993$, $p = < .001$) and Ni ($r = - 0.874$, $p = 0.022$). These were also according to Ukpong, (1994) who was identified nutrient and salinity as factors amplification species variation in mangrove swamps. Similarly, John *et al.* (2007) identified soil pH as the strongest soil feature that influenced the distribution of species in three-tropical forest.

ii. Multiple correlation of different soil variables at three different sites of herbs in spring season with frequency.

The correlation of different soil variables with herbs frequency in spring season (Appendix 2, 3, 4) is expressed in Table 33. Dry habitats had sandy soil. The correlation of herbaceous frequency in the spring season was positive and significant with Mg ($r = 0.895$, $p = 0.016$), Ca ($r = 0.92$, $p = 0.01$), Fe ($r = 0.982$, $p = 0.001$), Mn ($r = 0.976$, $p = 0.002$), Cu ($r = 0.971$, $p = 0.002$) and Cd ($r = 0.985$, $p = < .001$). These results accordance with earlier study like Udoh *et al.* (2007) that showed Mn, clay content and TN as soil factors that influenced species distribution mostly weeds. Similarly, Zare *et al.* (2011) also identified that soil texture, salinity, effective soil depth, available nitrogen, potassium, organic matter, and lime and soil moisture as chief soil factors responsible for variations in the pattern of vegetation. The correlation of herbaceous frequency in the spring season was negative and significant with Zn ($r = - 0.999$, $p = < .001$), Si ($r = - 0.821$, $p = 0.039$) and Ni ($r = - 0.831$, $p =$

0.035). These were also agreed with Cannone *et al.* (2008) who observed that vegetation was related to the chemistry of the surface layer of soil, water content, and also the active-layer depth.

iii. Multiple correlation of different soil variables at three different sites of herbs in spring season with cover.

The correlations of different soil variables with herbage cover in spring season (Appendix 2, 3, 4) is expressed in Table 34. Dry habitats had sandy soil and probability values of different soil variables like Mg ($r = 0.791$, $p = 0.005$), Ca ($r = 0.979$, $p = 0.001$), Fe ($r = 1$, $p = < .001$), Mn ($r = 1$, $p = < .001$), Cu ($r = 0.999$, $p = < .001$) and Cd ($r = 0.934$, $p = 0.008$) showed that these were positively significant with herbage cover in spring season. These result were agreed with former study like Medinski, (2007) who showed that clay + silt, EC and pH to effect the distribution and life form richness. These results perhaps implicit that tree/shrub species were selective of nutrients as well as depended totally on the spatial heterogeneity of soil in nutrient distribution. Zn ($r = - 0.973$, $p = 0.002$) and Ni ($r = - 0.923$, $p = 0.01$) were the soil variables and their probability values showed that these were negative and significant effect on the herbage cover in spring season. The correlation of different soil variables results agreed with previous study (Nagy and Proctor, 1997 and Martre *et al.*, 2002).

iv. Multiple correlation of different soil variables at three different sites of herbs in spring season with importance value.

The correlation of different soil variables with herbage importance value in spring season (Appendix 2, 3, 4) is expressed in Table 35. The correlation of herbs IVI in spring season was positive and significant with Zn ($r = 0.93$, $p = 0.008$), Pb ($r = 0.801$, $p = 0.047$) and Ni ($r = 0.969$, $p = 0.002$). Similarly, Ca ($r = - 0.998$, $p = < .001$), Fe ($r = - 0.989$, $p = < .001$), Mn ($r = - 0.993$, $p = < .001$), Cu ($r = - 0.995$, $p = < .001$) and Cd ($r = - 0.873$, $p = 0.022$) were the soil variables that have negatively significant effect on the herbage IVI in the spring season. These result agreement with study (Mulyanto *et al.*, 1999; Akter and Akagi, 2005 and Bashan *et al.*, 2006).

Correlation of herbaceous density with soil variables in spring season is expressed in Figure 14. It showed that there is linear correlation of herbaceous density with soil

elements like Mg, Ca, Fe, Mn, Cu and Cd in the area. It is evident that these elements have positive affects on herbaceous flora in spring season. While Zn and Ni are the soil elements that have reciprocal affects on herbaceous density in the area. Correlation of herbaceous frequency with soil variables in spring season is expressed in Figure 15. From these figures it is expressed that Mg, Ca, Fe, Mn, Cu and Cd have linear correlation with herbaceous frequency in spring season while Zn, Si and Ni are also soil elements that have reciprocal affects on herbaceous frequency in spring season. Correlation of the cover with soil variables in spring season is showed in (Figure 16). In these figure values, it is clear that Mg, Ca, Fe, Mn, Cu and Cd have positive affects on the herbaceous cover values while Zn and Ni have negative significant affects on hercacous cover in the area. Similarly, Correlation of importance values of herbaceous flora in spring season with different soil variables is expressed in Figure 17. From these it is evident that Zn, Pb and Ni have positively signifanct on the importance values of herbs while Ca, Fe, Mn, Cu and Cd also have affects on importance values of herbaceous community in the area but these affects is reciprocal. These results were also according to (John *et al.*, 2007; Zare *et al.*, 2011 and Martre *et al.*, 2002).

Table 32. Multiple correlation of different soil variables at three different sites of herbs in spring season with density. Macroelements are from S/No 1-9 and microelements are from 10-18. Significant P Value stands for probability and R for Pearson's Co-efficient are bold. DF stands for degree of freedom, R stands for Pearson's r, F stands for Pearson's F and T stands for Spearman's t.

S/N	Parameter	R	F	T	DF	P
1	pH	-0.43	0.453	1	1	0.328
2	EC in (dScm ⁻¹)	-0.329	0.242	1	1	0.457
3	OM in %	0.135	0.037	1	1	0.761
4	N	-0.236	0.118	1	1	0.593
5	P	-0.39	0.359	-1	1	0.376
6	K	-0.685	1.768	-1	1	0.105
7	Mg	0.855	5.439	1	1	0.027
8	Ca	0.949	18.298	-1	1	0.005
9	S	-0.354	0.287	1	1	0.422
10	Fe	0.994	170.029	-1	1	< .001
11	Mn	0.991	108.703	-1	1	< .001
12	Cu	0.987	77.485	-1	1	< .001
13	Zn	-0.993	137.387	-1	1	< .001
14	Si	-0.77	2.92	-1	1	0.06
15	Pb	-0.623	1.27	-1	1	0.146
16	Ni	-0.874	6.493	-1	1	0.022
17	Cr	-0.4	0.382	-1	1	0.363
18	Cd	0.968	29.651	1	1	0.003

Table 33. Multiple correlation of different soil variables at three different sites of herbs in spring season with frequency. Macroelements are from S/No 1-9 and microelements are from 10-18. Significant P Value stands for probability and R for Pearson's Co-efficient are bold. DF stands for degree of freedom, R stands for Pearson's r, F stands for Pearson's F and T stands for Spearman's t

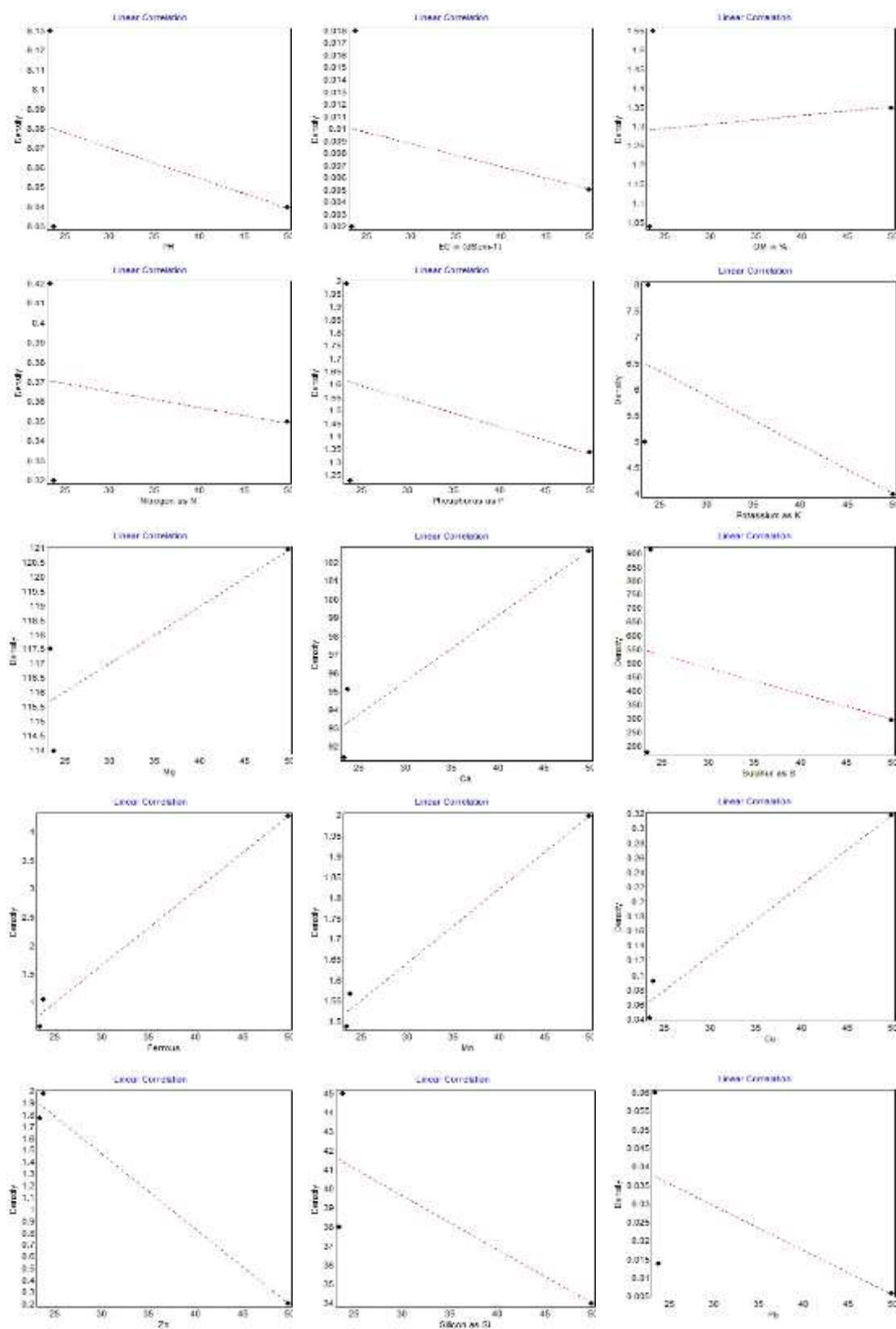
S/N	Parameter	R	F	T	DF	P
1	pH	-0.353	0.284	1	1	0.424
2	EC in (dScm ⁻¹)	-0.406	0.395	-1	1	0.356
3	OM in %	0.052	0.005	-1	1	0.907
4	N	-0.154	0.049	1	1	0.728
5	P	-0.312	0.216	1	1	0.48
6	K	-0.743	2.471	-1	1	0.072
7	Mg	0.895	8.086	-1	1	0.016
8	Ca	0.92	11.011	1	1	0.01
9	S	-0.431	0.457	-1	1	0.326
10	Fe	0.982	53.144	1	1	0.001
11	Mn	0.976	40.604	1	1	0.002
12	Cu	0.971	32.579	1	1	0.002
13	Zn	-0.999	1500.336	-1	1	< .001
14	Si	-0.821	4.134	1	1	0.039
15	Pb	-0.556	0.894	-1	1	0.2
16	Ni	-0.831	4.456	-1	1	0.035
17	Cr	-0.323	0.232	1	1	0.465
18	Cd	0.985	67.453	-1	1	< .001

Table 34. Multiple correlation of different soil variables at three different sites of herbs in spring season with cover. Macroelements are from S/No 1-9 and microelements are from 10-18. Significant P Value stands for probability and R for Pearson's Co-efficient are bold. DF stands for degree of freedom, R stands for Pearson's r, F stands for Pearson's F and T stands for Spearman's t.

S/N	Parameter	R	F	T	DF	P
1	pH	-0.528	0.775	-1	1	0.225
2	EC in (dScm ⁻¹)	-0.22	0.102	1	1	0.619
3	OM in %	0.245	0.128	1	1	0.579
4	N	-0.344	0.268	-1	1	0.436
5	P	-0.491	0.636	-1	1	0.261
6	K	-0.599	1.118	-1	1	0.164
7	Mg	0.791	3.353	1	1	0.005
8	Ca	0.979	45.462	-1	1	0.001
9	S	-0.247	0.13	1	1	0.576
10	Fe	1	98042.856	-1	1	< .001
11	Mn	1	4031.701	-1	1	< .001
12	Cu	0.999	913.848	-1	1	< .001
13	Zn	-0.973	35.633	-1	1	0.002
14	Si	-0.694	1.858	-1	1	0.099
15	Pb	-0.707	2	-1	1	0.092
16	Ni	-0.923	11.564	-1	1	0.01
17	Cr	-0.501	0.67	-1	1	0.251
18	Cd	0.934	13.562	1	1	0.008

Table 35. Multiple correlation of different soil variables at three different sites of herbs in spring season with importance values. Macroelements are from S/No 1-9 and microelements are from 10-18. Significant P Value stands for probability and R for Pearson's Co-efficient are bold. DF stands for degree of freedom, R stands for Pearson's r, F stands for Pearson's F and T stands for Spearman's t.

S/N	Parameter	R	F	T	DF	P
1	pH	0.644	1.417	1	1	0.131
2	EC in (dScm ⁻¹)	0.079	0.013	-1	1	0.858
3	OM in %	-0.381	0.34	-1	1	0.387
4	N	0.474	0.58	1	1	0.279
5	P	0.61	1.186	1	1	0.156
6	K	0.479	0.595	1	1	0.274
7	Mg	-0.696	1.883	-1	1	0.098
8	Ca	-0.998	488.804	-1	1	< .001
9	S	0.107	0.023	-1	1	0.81
10	Fe	-0.989	90.741	-1	1	< .001
11	Mn	-0.993	136.18	-1	1	< .001
12	Cu	-0.995	212.138	-1	1	< .001
13	Zn	0.93	12.871	1	1	0.008
14	Si	0.584	1.037	1	1	0.176
15	Pb	0.801	3.57	-1	1	0.047
16	Ni	0.969	30.358	-1	1	0.002
17	Cr	0.619	1.242	1	1	0.149
18	Cd	-0.873	6.407	-1	1	0.022



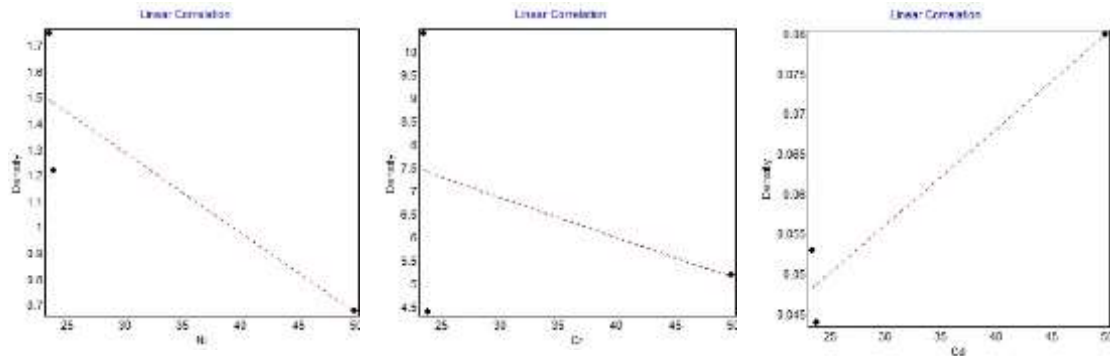
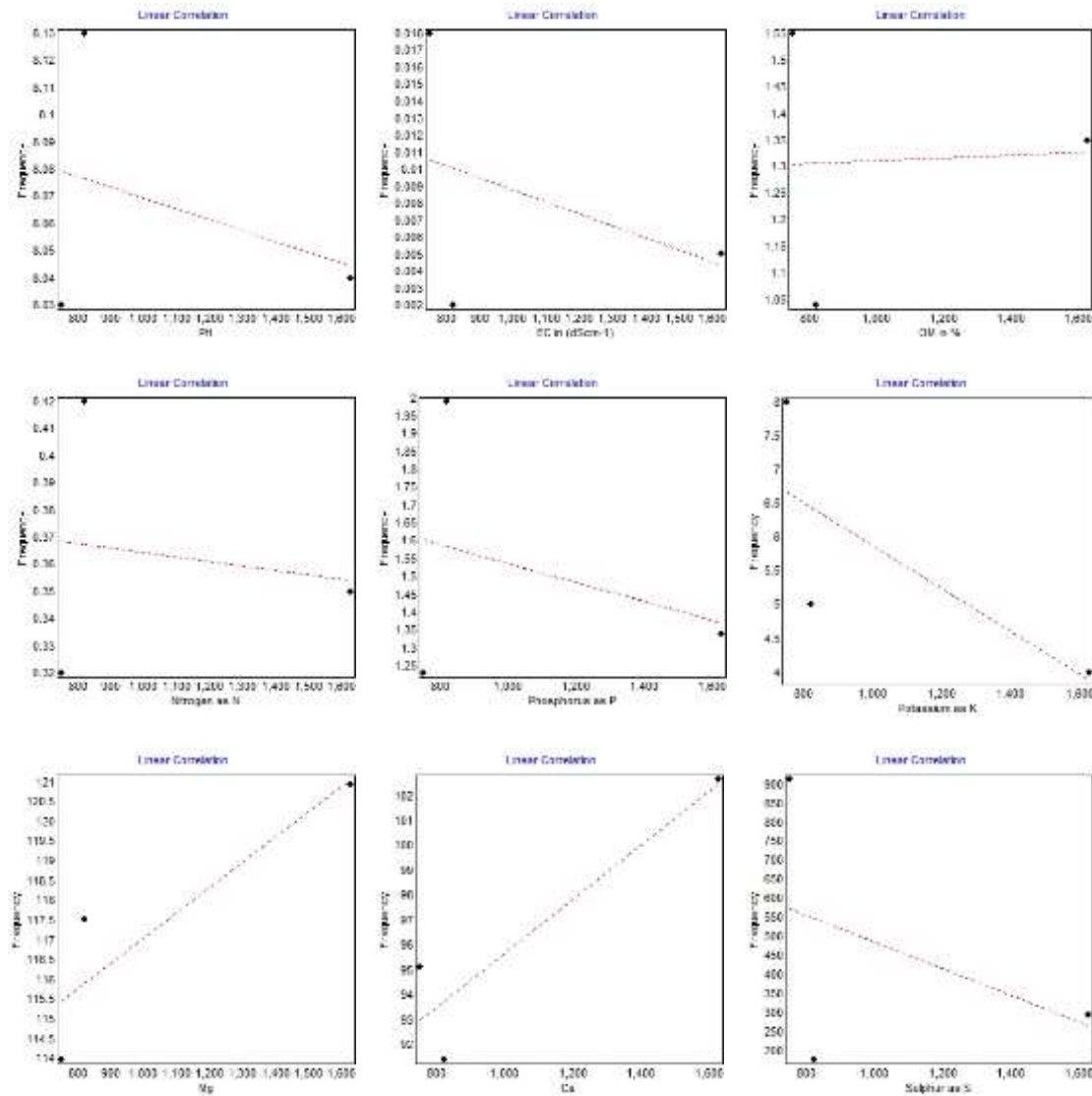


Figure 14. Spectras of linear correlation of herbaceous density with soil variables in spring season.



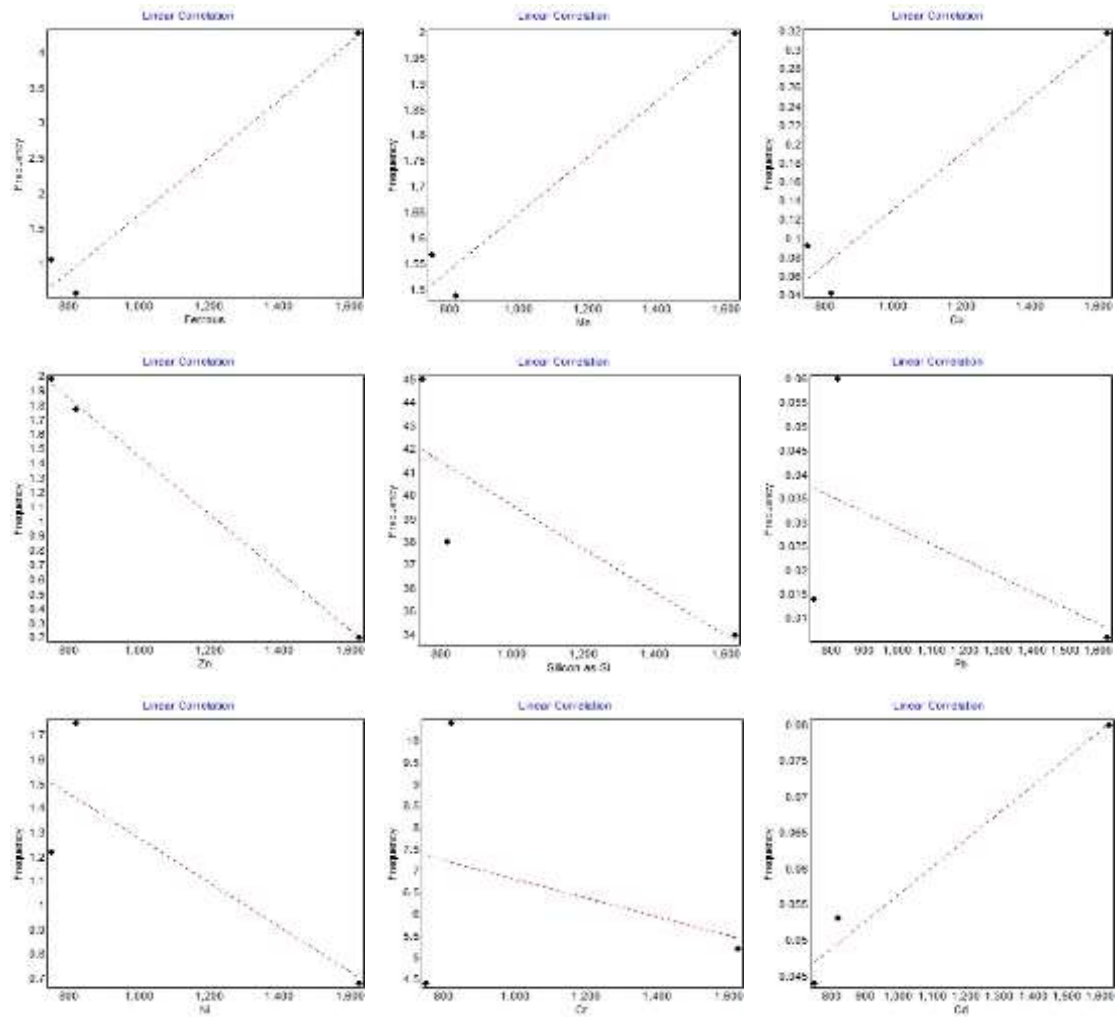
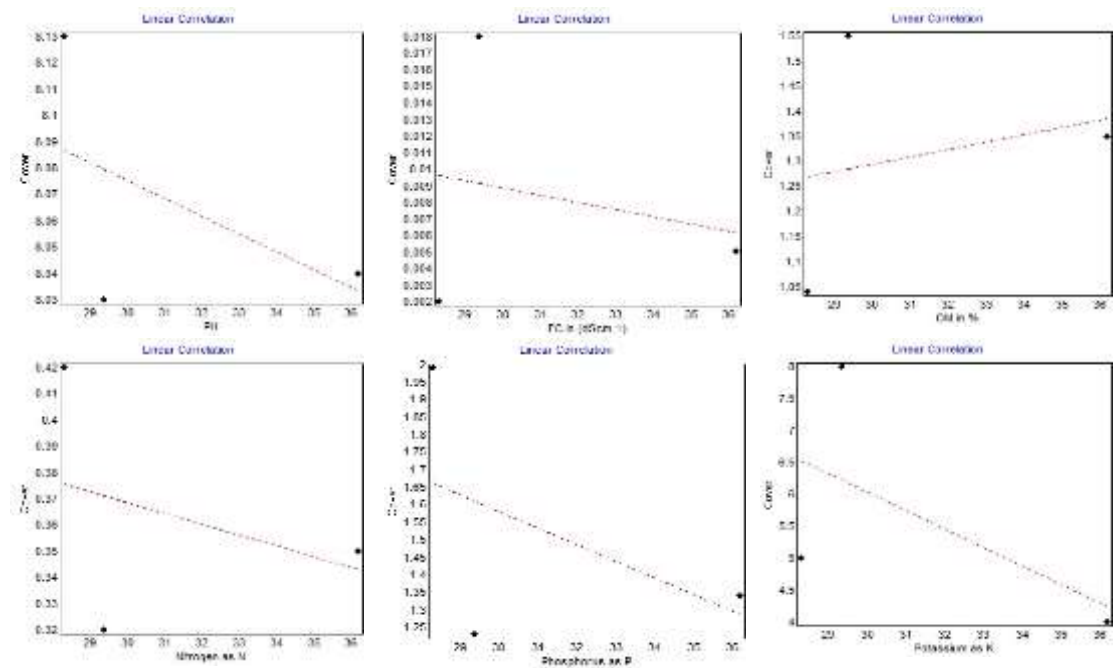


Figure 15. Spectras of linear correlation of herbaceous frequency with soil variables in spring season.



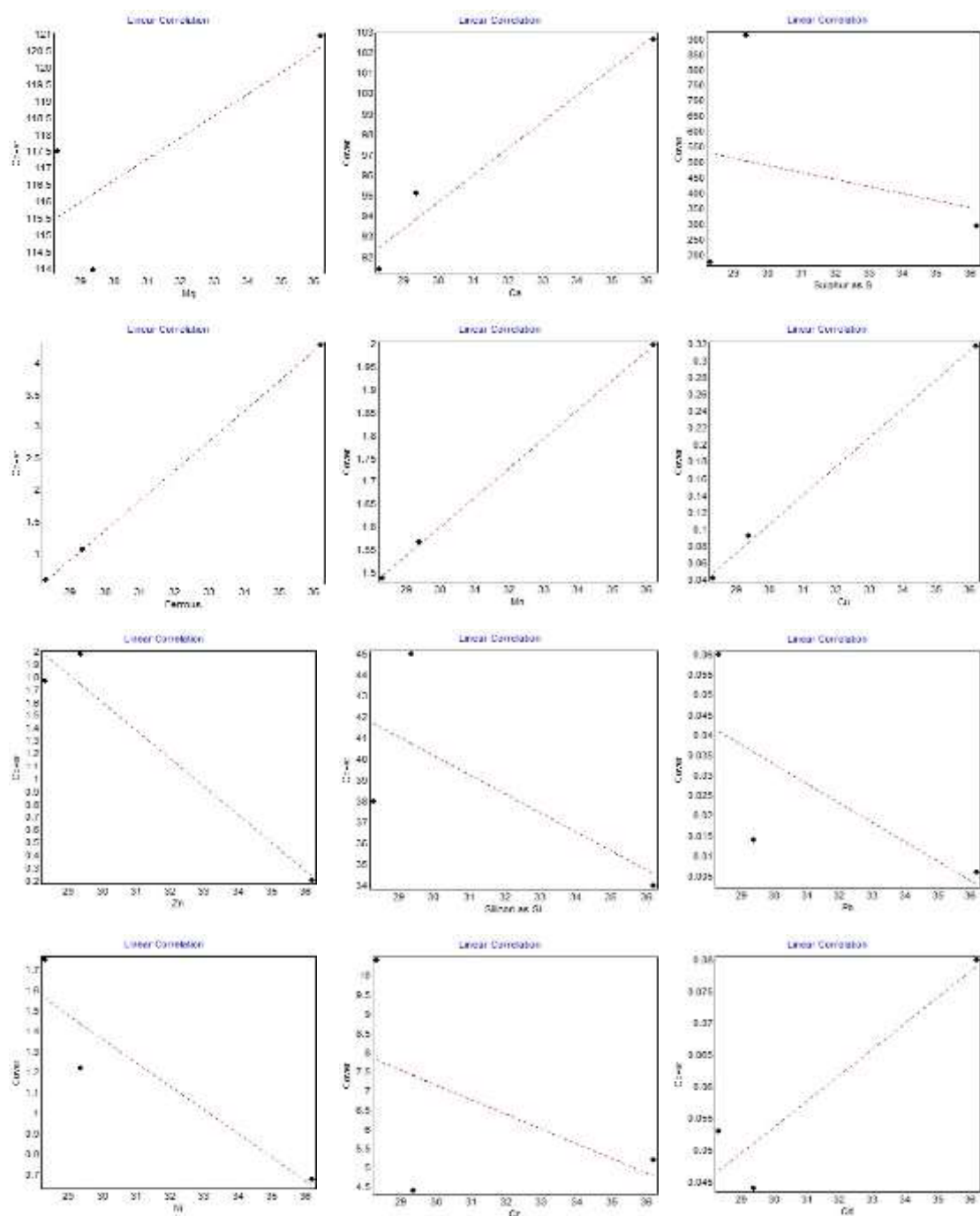
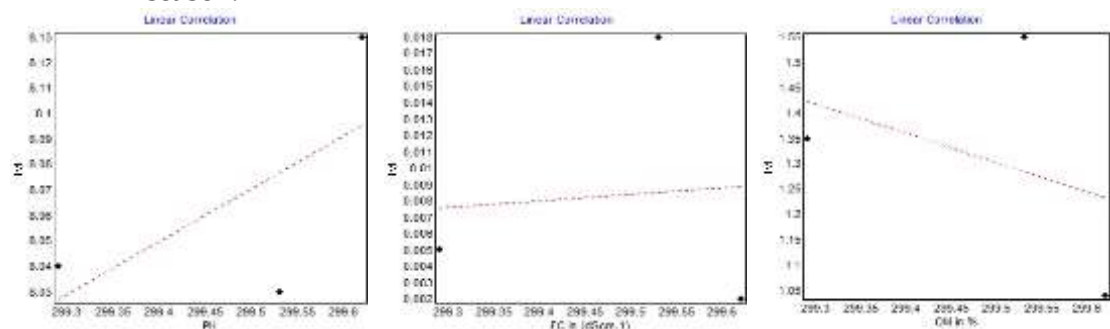


Figure 16. Spectras of linear correlation of herbage cover with soil variables in spring season.



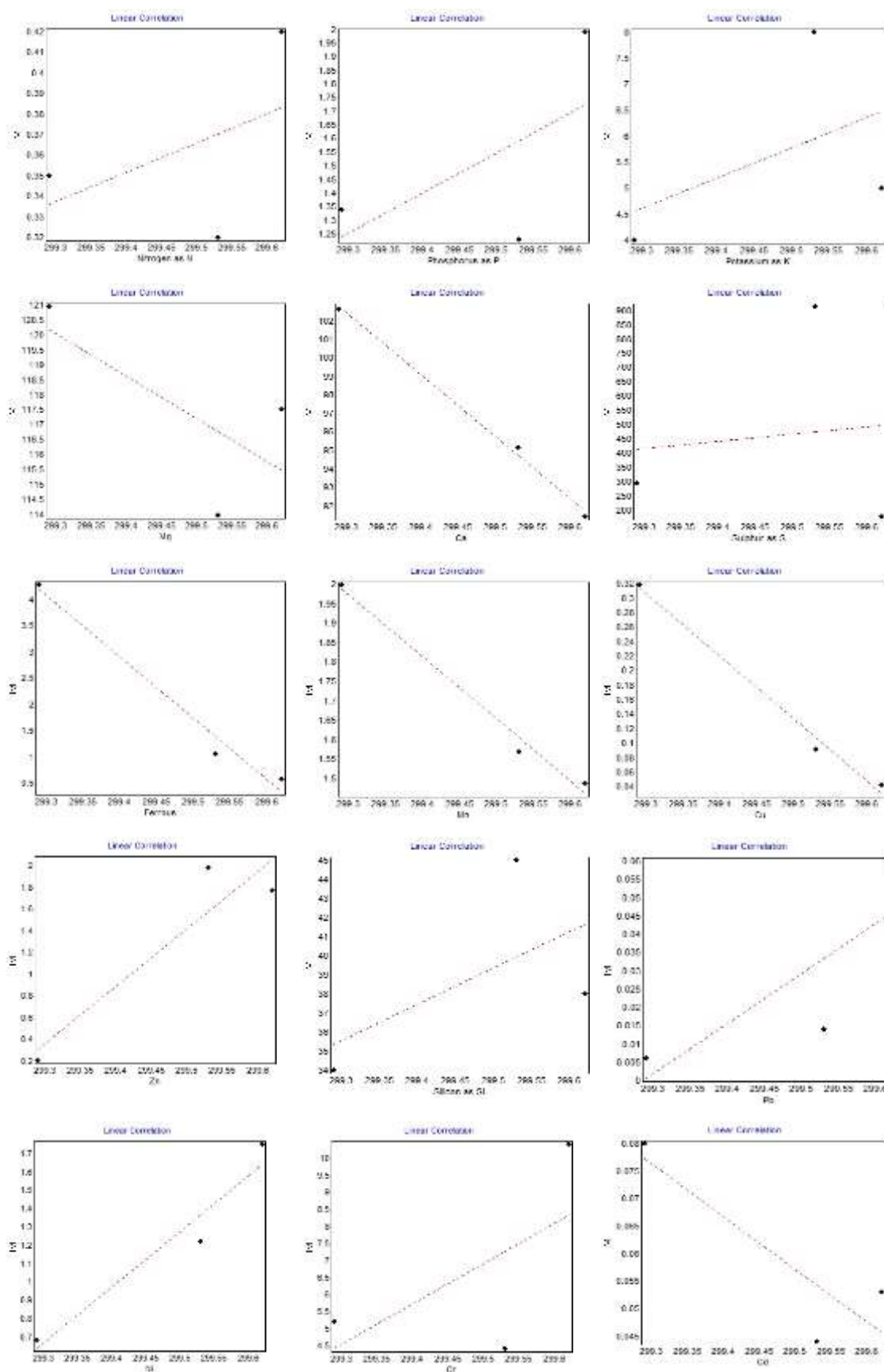


Figure 17. Spectras of linear correlation of herbaceous IV with soil variables in spring season.

4.6.4 Multiple correlation of different soil variables at three different sites of herbs in autumn season

i. Multiple correlation of different soil variable at three different sites of herbs in autumn season with density.

The correlation of different soil variables with herbs density in autumn season (Appendix 2, 3, 4) is expressed in Table 36. The correlation of herbs density in autumn season was positive and significant with Mg ($r = 0.986$, $p = < .001$) and Cd ($r = 0.898$, $p = 0.015$). Similarly, the correlation of herbs density in autumn season was negative and significant with EC ($r = -0.865$, $p = 0.024$), K ($r = -0.994$, $p = < .001$), Zn ($r = -0.831$, $p = 0.035$) and Si ($r = -1$, $p = < .001$). These results are in agreement with the previous study like Bashan *et al.* (2006) who studied the Plants settling barren desert rocks have a significant ecological benefit over species incapable of handling extreme substrate conditions.

ii. Multiple correlation of different soil variables at three different sites of herbs in autumn season with frequency.

The correlation of different soil variables with herbs frequency in autumn season (Appendix 2, 3, 4) is expressed in Table 37. The correlation of herbs frequency in autumn season was positive and significant with Mg ($r = 0.977$, $p = 0.001$) and Cd ($r = 0.876$, $p = 0.021$). Similarly, the correlation of herbs frequency in autumn season was negative and significant with EC ($r = -0.888$, $p = 0.018$), K ($r = -0.998$, $p = < .001$), S ($r = -0.9$, $p = 0.015$), Zn ($r = -0.803$, $p = 0.046$) and Si ($r = -0.998$, $p = < .001$). These results also agreed with the earlier study Taiz and Zeiger, (2006).

iii. Multiple correlation of different soil variables at three different sites of herbs in autumn season with cover.

The correlations of different soil variables with herbage cover in autumn season (Appendix 2, 3, 4) is expressed in Table 38. The probability values of N ($r = 0.825$, $p = 0.037$) and Mg ($r = 0.788$, $p = 0.052$) were positive and significant affect on the herbage cover of plant community in autumn season of the area. Similarly, the probability values of EC ($r = -1$, $p = < .001$), OM ($r = -0.879$, $p = 0.02$), K ($r = -0.924$, $p = 0.01$), S ($r = -1$, $p = < .001$) and Si ($r = -0.869$, $p = 0.023$) were negatively significant affect on the herbage cover of plant communities in autumn season. The

correlation of different soil variables result in autumn season agreed with previous study (Nagy and Proctor, 1997 and Martre *et al.*, 2002).

iv. Multiple correlation of different soil variables at three different sites of herbs in autumn season with importance value.

The correlation of different soil variables with herbs IVI in autumn season (Appendix 2, 3, 4) is expressed in Table 39. The correlation of herbs IVI of plant community in autumn season was positive and significant with EC ($r = 0.984$, $p = < .001$), K ($r = 0.97$, $p = < .002$) and Mg ($r = 0.87$, $p = 0.023$). Similarly, the correlation of herbs IVI of plant community in autumn season was negative and significant with OM ($r = -0.798$, $p = 0.048$), S ($r = -0.989$, $p = < .001$) and Si ($r = -0.933$, $p = 0.008$). These results were agreed with study (Mulyanto *et al.*, 1999 and Akter and Akagi, 2005).

Correlation of herbaceous density with soil variables in autumn season is expressed in Figure 18. It showed that there is linear correlation of herbaceous density with soil elements like Mg and Cd in autumn season in the area. It is evident that these elements have positive affects on herbaceous flora in autumn season while EC, K, Zn and Si are the soil elements that have reciprocal affects on herbaceous density in autumn season. Correlation of herbaceous frequency with soil variables in autumn season is expressed in (Figure 19). From these figures it is expressed that Mg and Cd have linear correlation with herbaceous frequency in autumn season while EC, K, S, Zn and Si are also soil elements that have reciprocal affects on herbaceous frequency in autumn season. Correlation of the cover with soil variables in autumn season is showed in Figure 20. In these figure values, it is clear that N and Mg have positive affects on the herbaceous cover values while EC, OM, K, S and Si have negative significant affects on hercacous cover in the area. Similarly, Correlation of importance values of herbaceous flora in spring autumn season with different soil variables is expressed in Figure 21. From these it is evident that EC, K, Mg have positively signifanct affects on the importance values of herbs in autumn season while OM, S and Si also have affects on importance values of herbaceous community in the area but these affects is reciprocal. These results were also according to (Bashan *et al.*, 2006; Zeiger *et al.*, 2006; Nagy and Proctor, 1997 and Akter and Akagi, 2005).

Table 36. Multiple correlation of different soil variables at three different sites of herbs in autumn season with density. Macroelements are from S/No 1-9 and microelements are from 10-18. Significant P Value stands for probability and R for Pearson's Co-efficient are bold. DF stands for degree of freedom, R stands for Pearson's r, F stands for Pearson's F and T stands for Spearman's t.

S/N	Parameter	R	F	T	DF	P
1	pH	0.263	0.149	1	1	0.552
2	EC in (dScm ⁻¹)	-0.865	5.947	-1	1	0.024
3	OM in %	-0.024	0.84	-1	1	0.211
4	N	0.455	0.521	1	1	0.3
5	P	0.305	0.205	1	1	0.49
6	K	-0.994	177.852	-1	1	< .001
7	Mg	0.986	71.749	-1	1	< .001
8	Ca	0.515	0.722	1	1	0.238
9	S	-0.879	6.765	-1	1	0.2
10	Fe	0.683	1.751	1	1	0.106
11	Mn	0.663	1.573	1	1	0.118
12	Cu	0.645	1.425	1	1	0.131
13	Zn	-0.831	4.453	-1	1	0.035
14	Si	-1	5418.964	-1	1	< .001
15	Pb	0.038	0.003	-1	1	0.932
16	Ni	-0.346	0.273	-1	1	0.433
17	Cr	0.294	0.189	1	1	0.506
18	Cd	0.898	8.296	-1	1	0.015

Table 37. Multiple correlation of different soil variables at three different sites of herbs in autumn season with frequency. Macroelements are from S/No 1-9 and microelements are from 10-18. Significant P Value stands for probability and R for Pearson's Co-efficient are bold. DF stands for degree of freedom, R stands for Pearson's r, F stands for Pearson's F and T stands for Spearman's t.

S/N	Parameter	R	F	T	DF	P
1	pH	0.309	0.211	1	1	0.485
2	EC in (dScm ⁻¹)	-0.888	7.457	-1	1	0.018
3	OM in %	-0.583	1.031	-1	1	0.177
4	N	0.497	0.655	1	1	0.256
5	P	0.35	0.279	1	1	0.428
6	K	-0.998	593.352	-1	1	< .001
7	Mg	0.977	42.719	-1	1	0.001
8	Ca	0.474	0.578	1	1	0.279
9	S	-0.9	8.555	-1	1	0.015
10	Fe	0.648	1.446	1	1	0.129
11	Mn	0.627	1.296	1	1	0.143
12	Cu	0.608	1.172	1	1	0.157
13	Zn	-0.803	3.637	-1	1	0.046
14	Si	-0.998	445.994	-1	1	< .001
15	Pb	0.085	0.015	-1	1	0.847
16	Ni	-0.301	0.2	1	1	0.495
17	Cr	0.339	0.26	1	1	0.442
18	Cd	0.876	6.573	-1	1	0.021

Table 38. Multiple correlation of different soil variables at three different sites of herbs in autumn season with cover. Macroelements are from S/No 1-9 and microelements are from 10-18. Significant P Value stands for probability and R for Pearson's Co-efficient are bold. DF stands for degree of freedom, R stands for Pearson's r, F stands for Pearson's F and T stands for Spearman's t.

S/N	Parameter	R	F	T	DF	P
1	pH	0.692	1.836	-1	1	0.101
2	EC in (dScm ⁻¹)	-1	2585.262	-1	1	< .001
3	OM in %	-0.879	6.766	-1	1	0.02
4	N	0.825	4.254	-1	1	0.037
5	P	0.722	2.184	-1	1	0.083
6	K	-0.924	11.7	-1	1	0.01
7	Mg	0.788	3.278	1	1	0.052
8	Ca	0.043	0.004	-1	1	0.922
9	S	-1	1×10 ⁷	-1	1	< .001
10	Fe	0.252	0.135	-1	1	0.569
11	Mn	0.226	0.107	-1	1	0.61
12	Cu	0.202	0.085	-1	1	0.648
13	Zn	-0.064	0.549	-1	1	0.289
14	Si	-0.869	0.189	-1	1	0.023
15	Pb	0.51	0.704	1	1	0.242
16	Ni	0.144	0.044	1	1	0.746
17	Cr	0.715	2.088	-1	1	0.087
18	Cd	0.578	1.005	1	1	0.181

Table 39. Multiple correlation of different soil variables at three different sites of herbs in autumn season with importance values. Significant values are bold. Macroelements are from S/No 1-9 and microelements are from 10-18. Significant P Value stands for probability and R for Pearson's Co-efficient are bold. DF stands for degree of freedom, R stands for Pearson's r, F stands for Pearson's F and T stands for Spearman's t.

S/N	Parameter	R	F	T	DF	P
1	pH	0.577	1	-1	1	0.182
2	EC in (dScm ⁻¹)	0.984	3.511	-1	1	< .001
3	OM in %	-0.798	3.511	-1	1	0.048
4	N	0.732	2.308	-1	1	0.078
5	P	0.612	1.199	-1	1	0.154
6	K	0.97	32.398	-1	1	0.002
7	Mg	0.87	6.256	1	1	0.023
8	Ca	0.191	0.075	-1	1	0.667
9	S	-0.989	88.936	-1	1	< .001
10	Fe	0.392	0.364	-1	1	0.373
11	Mn	0.367	0.312	-1	1	0.405
12	Cu	0.345	0.269	-1	1	0.435
13	Zn	-0.59	1.068	-1	1	0.171
14	Si	-0.933	13.423	-1	1	0.008
15	Pb	0.377	0.332	1	1	0.392
16	Ni	-0.004	< .001	1	1	0.992
17	Cr	0.603	1.145	-1	1	0.161
18	Cd	0.693	1.845	1	1	0.1

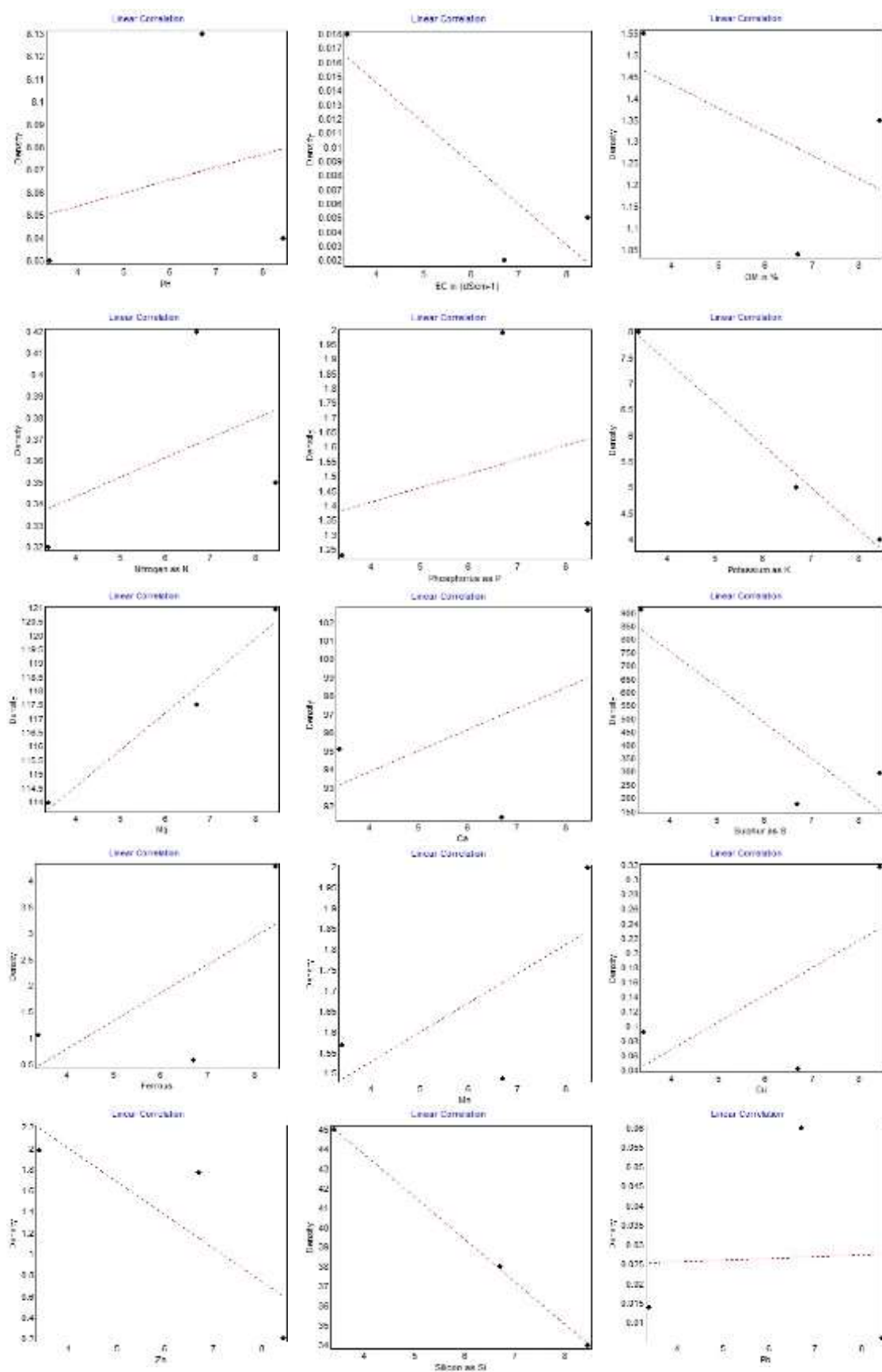
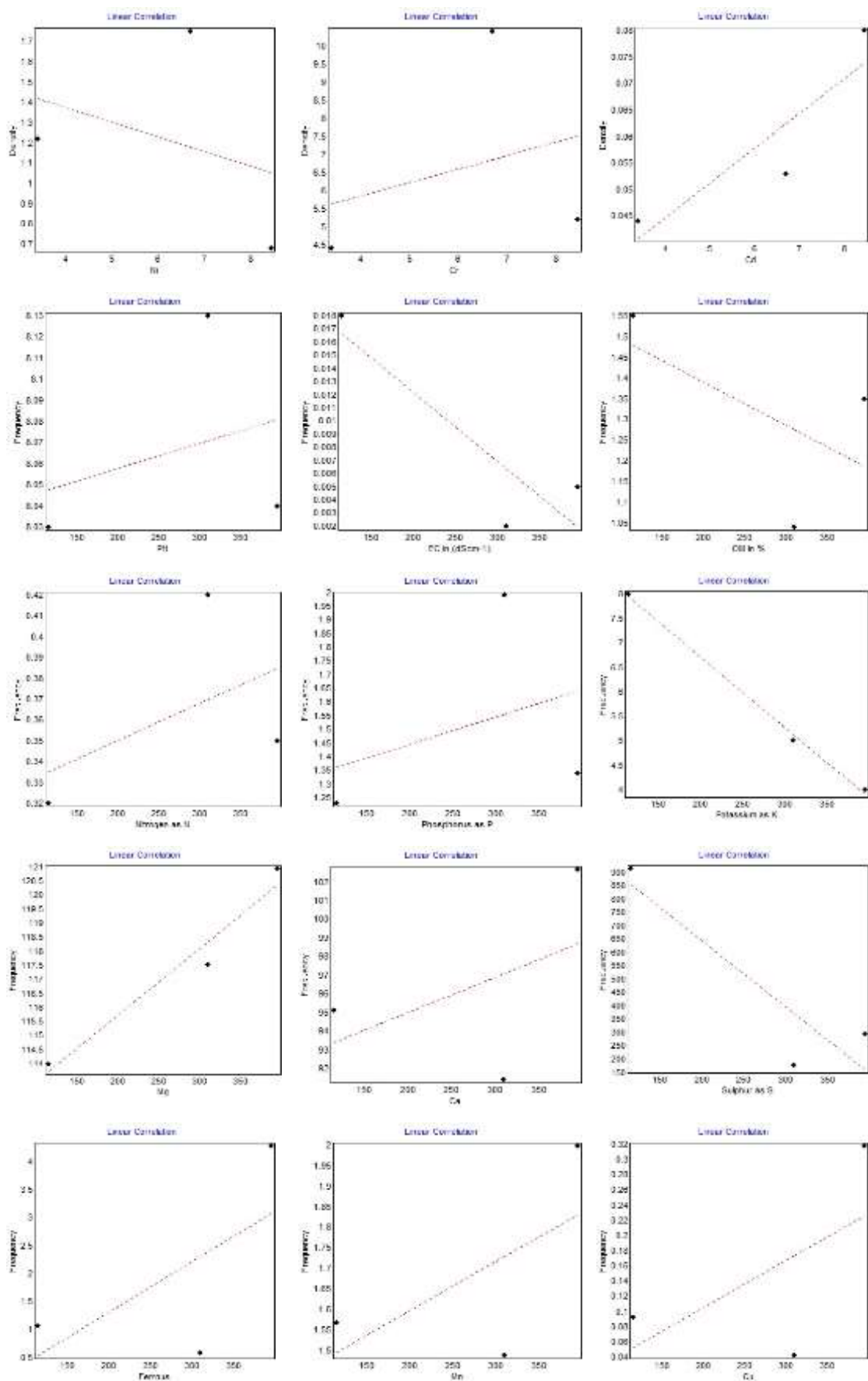


Figure 18. Spectras of linear correlation of herbaceous density with soil variables in autumn season.



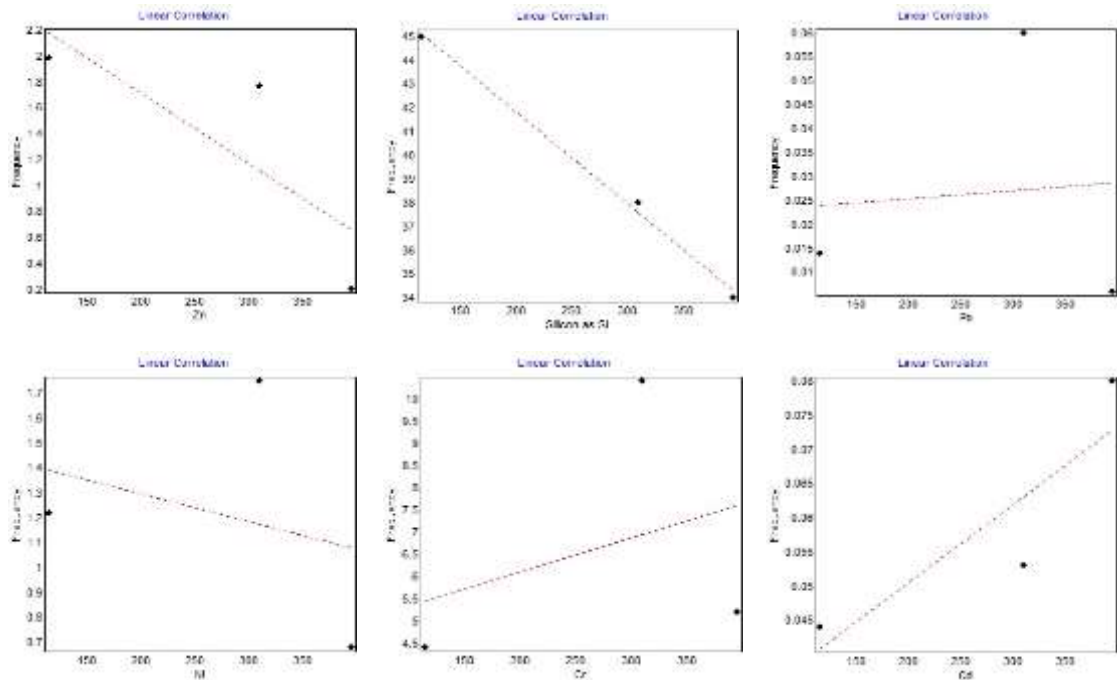
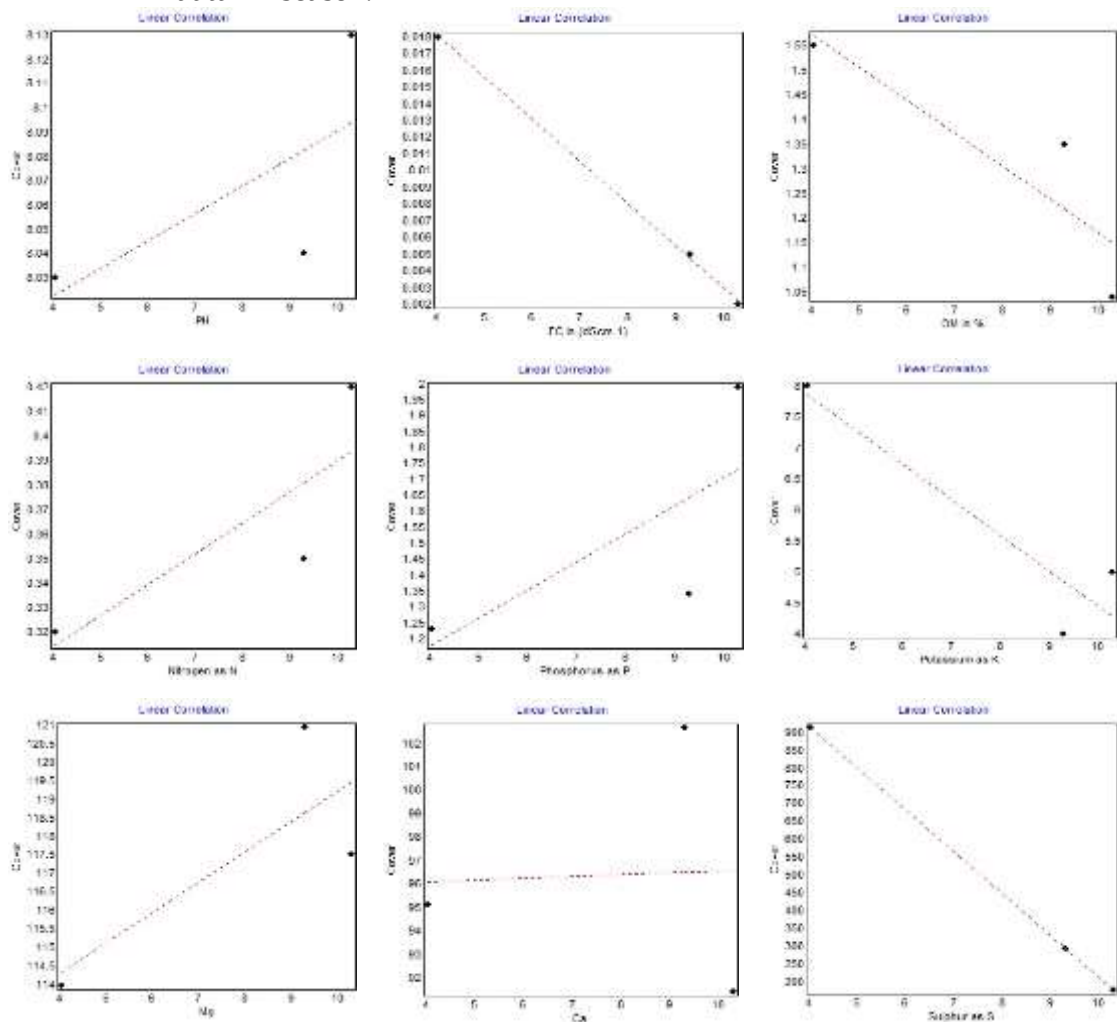


Figure 19. Spectras of linear correlation of herbaceous frequency with soil variables in autumn season.



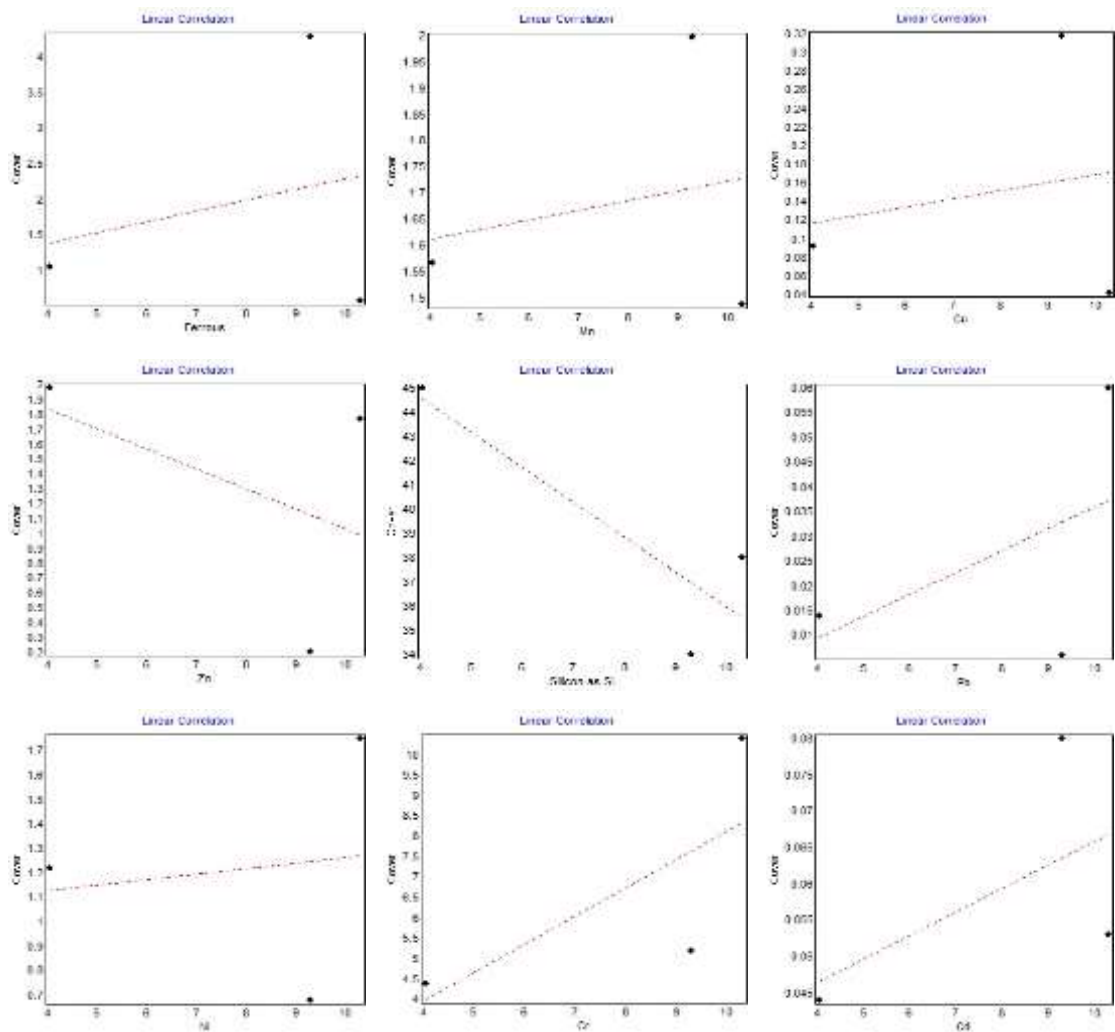
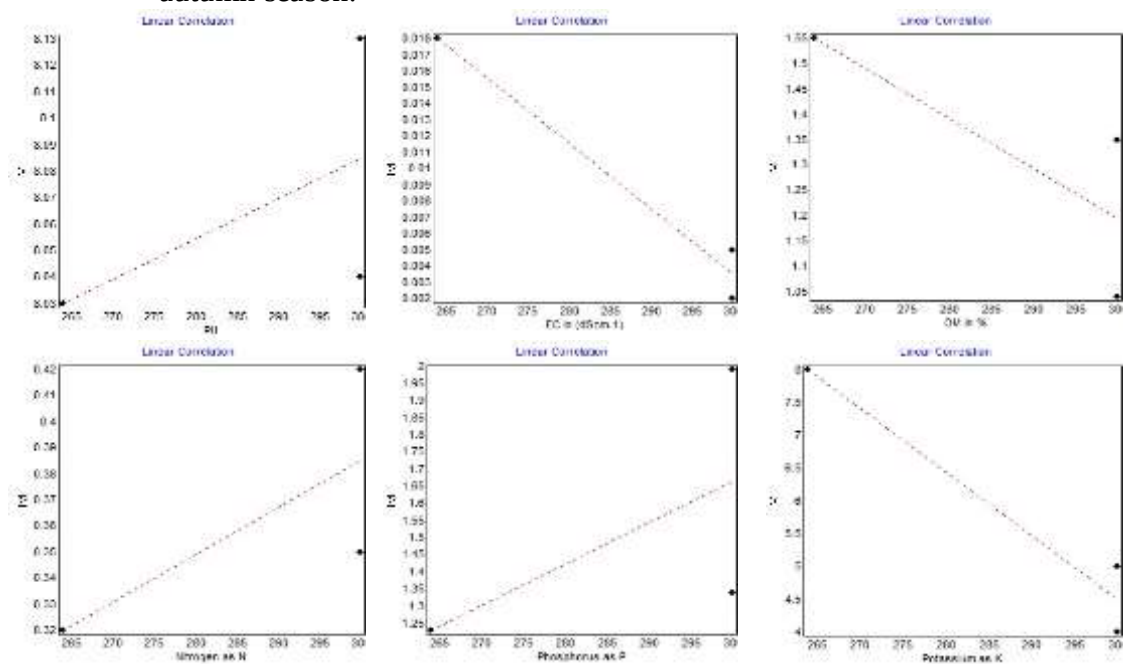


Figure 20. Spectras of linear correlation of herbage cover with soil variables in autumn season.



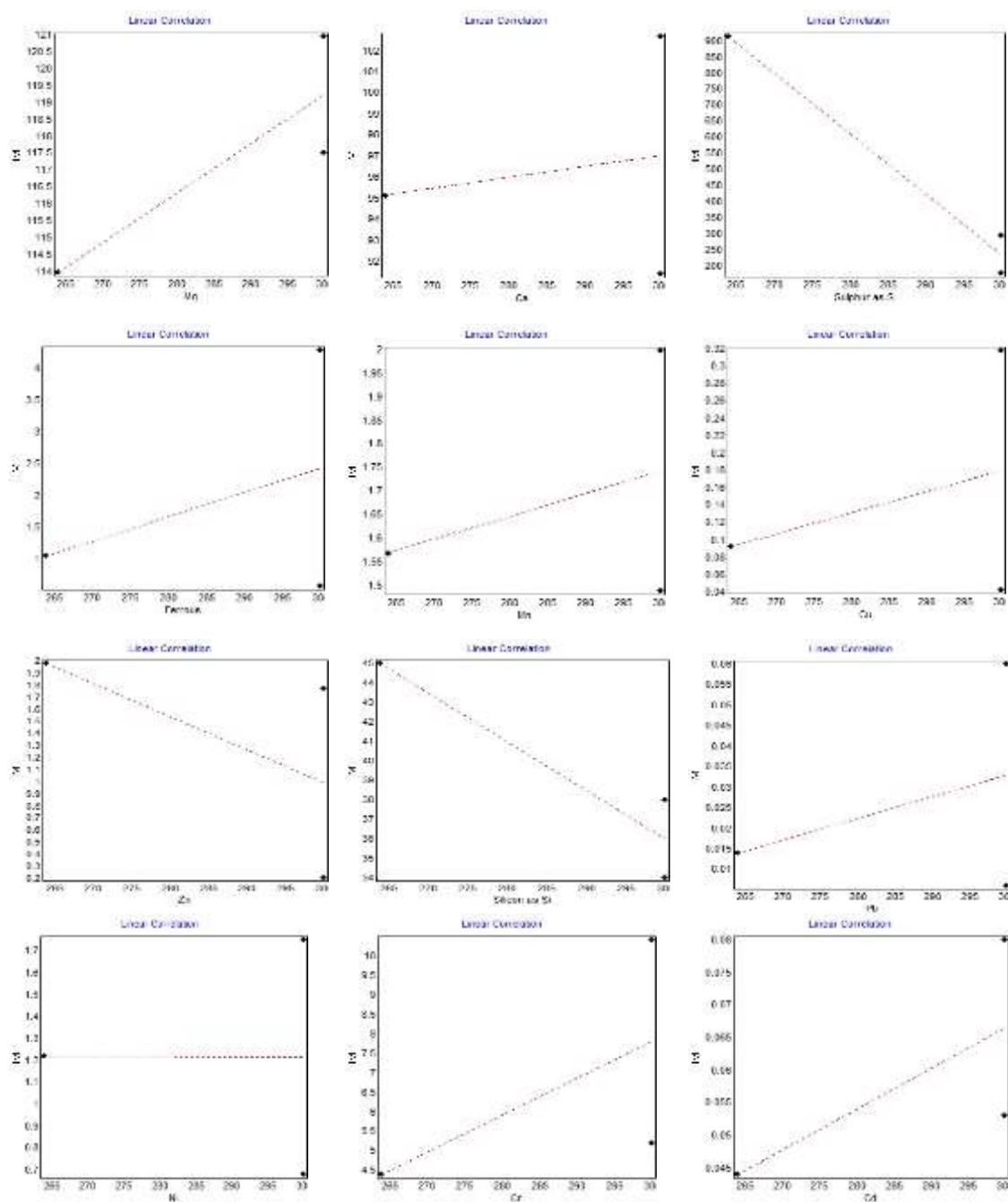


Figure 21. Spectras of linear correlation of herbaceous IV with soil variables in autumn season.

4.6.5 Multiple correlation of different soil variables at three different sites of herbs in winter season

i. Multiple correlation of different soil variables at three different sites of herbs in winter season with density.

The correlation of different soil variables with herbs density in winter season (Appendix 2, 3, 4) is expressed in Table 40. The correlation of herbs density of plant communities were positive and significant with Mg ($r = 0.932$, $p = 0.008$), Ca ($r = 0.88$, $p = 0.02$), Fe ($r = 0.96$, $p = 0.004$), Mn ($r = 0.952$, $p = 0.005$), Cu ($r = 0.945$, $p = 0.006$) and Cd ($r = 0.997$, $p = < .001$). Similarly, the correlation of herbs density of plant communities were negative and significant with K ($r = -0.802$, $p = 0.046$), Zn ($r = -0.998$, $p = < .001$), Si ($r = -0.87$, $p = 0.023$) and Ni ($r = -0.776$, $p = 0.057$). These results agree with earlier study who described the cacti often growing on rocky substrates in Mexico (Bashan *et al.*, 2002 and Taiz & Zeiger 2006).

ii. Multiple correlation of different soil variables at three different sites of herbs in winter season with frequency.

The correlation of different soil variables with herbs frequency in winter season (Appendix 2, 3, 4) is expressed in Table 41. The probability value of soil variables like Ca ($r = 0.987$, $p = < .001$), Fe ($r = 0.999$, $p = < .001$), Mn ($r = 1$, $p = < .001$), Cu ($r = 1$, $p = < .001$) and Cd ($r = 0.91$, $p = < .011$) were positive and significant with frequency of herbs communities in winter season of the area. Similarly, the correlation of herbs frequency was negative and significant with Zn ($r = -0.961$, $p = 0.003$) and Ni ($r = -0.94$, $p = 0.007$). These results are in agreement with earlier studies who described the correlation of different soil variables with the plant communities (Martre *et al.*, 2002; Nobel and Zutta, 2007; Nagy & Proctor, 1997 and Martre *et al.*, 2002).

iii. Multiple correlation of different soil variables at three different sites of herbs in winter season with cover.

The correlation of different soil variables with herbs cover in winter season (Appendix 2, 3, 4) is expressed in Table 42. The correlation of herbage cover in winter season was positive and significant with EC ($r = 0.998$, $p = < .001$), OM ($r = 0.918$, $p = 0.011$), K ($r = 0.886$, $p = 0.018$), S ($r = 0.996$, $p = < .001$) and ($r = 0.822$, p

= 0.039). These results compared with the study like Iwara *et al.* (2011) who were also detected that P influenced in a higher weed density. The authors ascribed this result to the fact that P is a macroelement and, therefore, very essential for most species because it directly effects their growth and development. The correlation of herbage cover in winter season was negative and significant with N ($r = -0.872$, $p = 0.022$), P ($r = -0.782$, $p = 0.055$) and Cr ($r = -0.774$, $p = 0.058$). There results also agreed with earlier study like Shiratsuchi *et al.* (2005) who pointed and study the correlation between soil properties and SSB, observed a positive correlation between the prevalence of *Cyperus rotundus*, *Brachiaria plantaginea* and *Commelina benghalensis* with K and a negative correlation with pH, Ca, Mg.

iv. Multiple correlation of different soil variables at three different sites of herbs in winter season with importance value.

The correlation of different soil variables with herbs importance value in winter season (Appendix 2, 3, 4) is expressed in Table 43. The correlation of importance value (IV) of plants communities was positive and significant in winter season with K ($r = 0.97$, $p = 0.002$) and Mg ($r = 0.869$, $p = 0.023$). These results were compared with Mulyanto *et al.* (1999) and Akter and Akagi, (2005). Similarly, the correlation of IV of plants communities was negatively significant in winter season with EC ($r = -0.985$, $p = <.001$), OM ($r = -0.8$, $p = 0.047$), S ($r = -0.989$, $p = <.001$) and Si ($r = -0.932$, $p = 0.008$). These results agreed with the earlier study (Nobel and Zutta, 2007) who studied the physical factors and focus of specific minerals the degree of weathering of rock minerals to clay minerals and salts availability of plant nutrients may be vital factors affecting of plants distribution.

Correlation of herbaceous density with soil variables in winter season is expressed in Figure 22. It showed that there is linear correlation of herbaceous density with soil elements like Mg, Ca, Fe, Mn, Cu and Cd in winter season in the area. It is evident that these elements have positive affects on herbaceous flora in autumn season while K, Zn, Si and Si are the soil elements that have reciprocal affects on herbaceous density in winter season. Correlation of herbaceous frequency with soil variables in winter season is expressed in (Figure 23). From these figures it is expressed that Ca, Fe, Mn, Cu and Cd have linear correlation with herbaceous frequency in winter season while Zn and Ni are also soil elements that have reciprocal affects on

herbaceous frequency in winter season. Correlation of the cover with soil variables in winter season is showed in Figure 24. In these figure values, it is clear that EC, OM, K, S and Si have positive affects on the herbaceous cover values while N, P, and Cr have negative significant affects on hercacous cover in the area. Similarly, correlation of importance values of herbaceous flora in winter winter season with different soil variables is expressed in Figure 25. From these it is evident that K and Mg have positively signifanct affects on the importance values of herbs in winter season while EC, OM, S and Si also have affects on importance values of herbaceous community in the area but these affects is reciprocal. These results were also according to (Taiz & Zeiger 2006; Nobel and Zutta 2007; Shiratsuchi *et al.*, 2005 and Shiratsuchi *et al.*, 2005).

Table 40. Multiple correlation of different soil variables at three different sites of herbs in winter season with density. Significant values are bold. Macroelements are from S/No 1-9 and microelements are from 10-18. Significant P Value stands for probability and R for Pearson's Co-efficient are bold. DF stands for degree of freedom, R stands for Pearson's r, F stands for Pearson's F and T stands for Spearman's t.

S/N	Parameter	R	F	T	DF	P
1	pH	-0.266	0.152	1	1	0.548
2	EC in (dScm ⁻¹)	-0.488	0.626	-1	1	0.264
3	OM in %	-0.04	0.003	-1	1	0.928
4	N	-0.063	0.008	1	1	0.887
5	P	-0.223	0.105	1	1	0.614
6	K	-0.802	3.597	-1	1	0.046
7	Mg	0.932	13.321	-1	1	0.008
8	Ca	0.88	6.872	1	1	0.02
9	S	-0.512	0.711	-1	1	0.24
10	Fe	0.96	23.569	1	1	0.004
11	Mn	0.952	19.459	1	1	0.005
12	Cu	0.945	16.533	1	1	0.006
13	Zn	-0.998	651.489	-1	1	< .001
14	Si	-0.87	6.219	-1	1	0.023
15	Pb	-0.477	0.59	-1	1	0.276
16	Ni	-0.776	3.032	-1	1	0.057
17	Cr	-0.234	0.116	1	1	0.596
18	Cd	0.997	321.778	-1	1	< .001

Table 41. Multiple correlation of different soil variables at three different sites of herbs in winter season with frequency. Significant values are bold. Macroelements are from S/No 1-9 and microelements are from 10-18. Significant P Value stands for probability and R for Pearson's Co-efficient are bold. DF stands for degree of freedom, R stands for Pearson's r, F stands for Pearson's F and T stands for Spearman's t.

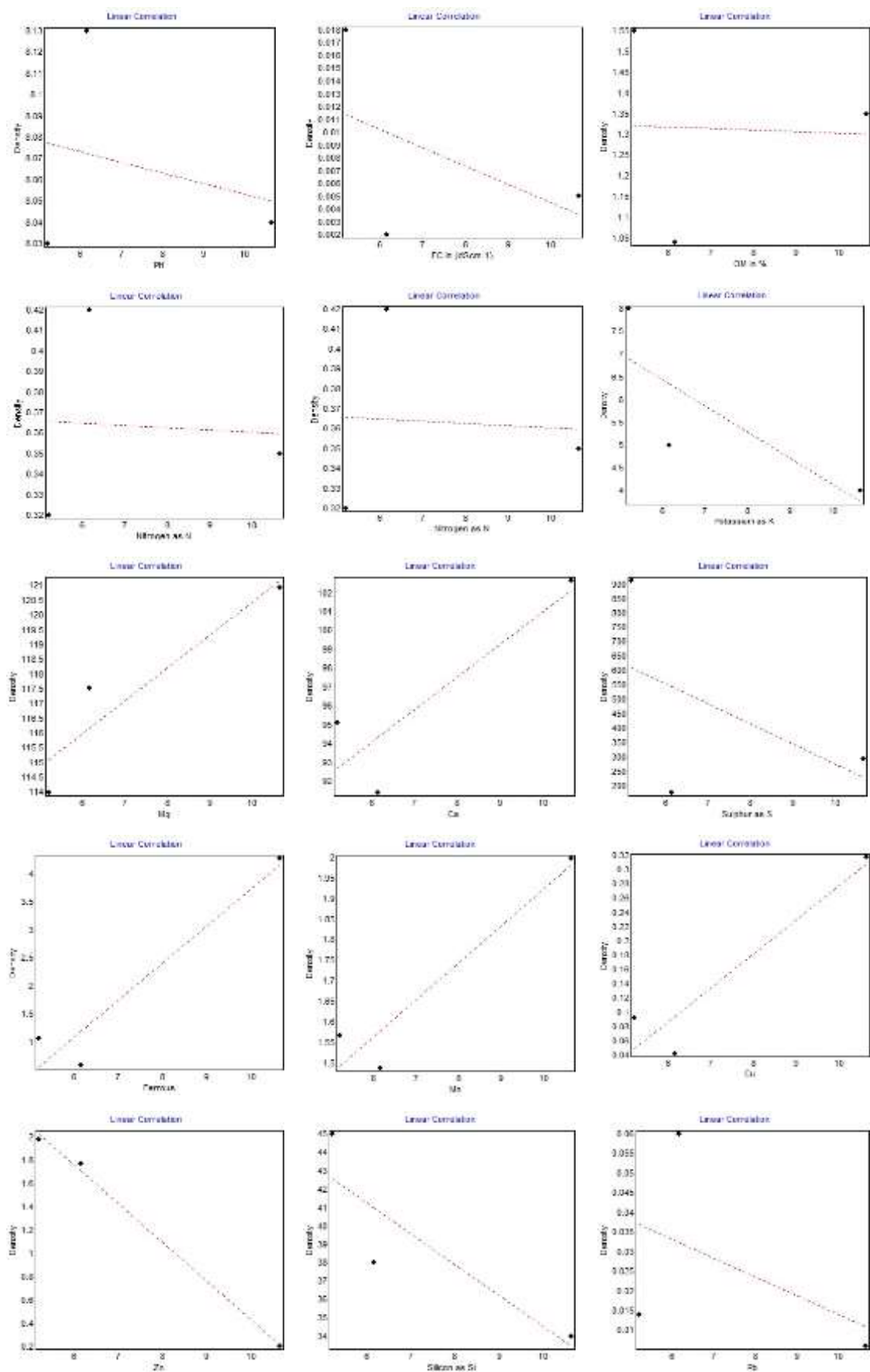
S/N	Parameter	R	F	T	DF	P
1	pH	-0.568	0.953	-1	1	0.189
2	EC in (dScm ⁻¹)	-0.174	0.062	1	1	0.695
3	OM in %	0.291	0.185	1	1	0.51
4	N	-0.388	0.354	-1	1	0.378
5	P	-0.352	0.789	-1	1	0.222
6	K	-0.56	0.915	-1	1	0.196
7	Mg	0.762	2.762	1	1	0.064
8	Ca	0.987	77.454	-1	1	< .001
9	S	-0.201	0.084	1	1	0.65
10	Fe	0.999	740.182	-1	1	< .001
11	Mn	1	3160.871	-1	1	< .001
12	Cu	1	>4×10 ^{A6}	-1	1	< .001
13	Zn	-0.961	24.18	-1	1	0.003
14	Si	-0.659	1.536	-1	1	0.121
15	Pb	-0.74	2.418	-1	1	0.074
16	Ni	-0.94	15.322	-1	1	0.007
17	Cr	-0.541	0.829	-1	1	0.213
18	Cd	0.91	10.355	1	1	0.011

Table 42. Multiple correlation of different soil variables at three different sites of herbs in winter season with cover. Significant values are bold. Macroelements are from S/No 1-9 and microelements are from 10-18. Significant P Value stands for probability and R for Pearson's Co-efficient are bold. DF stands for degree of freedom, R stands for Pearson's r, F stands for Pearson's F and T stands for Spearman's t.

S/N	Parameter	R	F	T	DF	P
1	pH	-0.754	2.631	-1	1	0.067
2	EC in (dScm ⁻¹)	0.998	520.677	-1	1	< .001
3	OM in %	0.918	10.687	-1	1	0.011
4	N	-0.872	6.351	-1	1	0.022
5	P	-0.782	3.138	-1	1	0.055
6	K	0.886	7.316	1	1	0.018
7	Mg	-0.73	2.278	-1	1	0.079
8	Ca	0.046	0.004	1	1	0.917
9	S	0.996	249.028	-1	1	< .001
10	Fe	-0.164	0.055	1	1	0.711
11	Mn	-0.138	0.039	1	1	0.756
12	Cu	-0.113	0.026	1	1	0.798
13	Zn	0.383	0.344	1	1	0.385
14	Si	0.822	4.154	1	1	0.039
15	Pb	-0.585	1.042	-1	1	0.175
16	Ni	-0.232	0.113	-1	1	0.601
17	Cr	-0.774	2.998	-1	1	0.058
18	Cd	-0.503	0.677	-1	1	0.249

Table 43. Multiple correlation of different soil variables at three different sites of herbs in winter season with importance value. Significant values are bold. Macroelements are from S/No 1-9 and microelements are from 10-18. Significant P Value stands for probability and R for Pearson's Co-efficient are bold. DF stands for degree of freedom, R stands for Pearson's r, F stands for Pearson's F and T stands for Spearman's t.

S/N	Parameter	R	F	T	DF	P
1	pH	0.58	1.014	-1	1	0.179
2	EC in (dScm ⁻¹)	-0.985	65.526	-1	1	< .001
3	OM in %	-0.8	3.561	-1	1	0.047
4	N	0.734	2.34	-1	1	0.077
5	P	0.615	1.216	-1	1	0.152
6	K	0.97	31.484	-1	1	0.002
7	Mg	0.869	6.158	1	1	0.023
8	Ca	0.187	0.073	-1	1	0.672
9	S	-0.989	93.167	-1	1	< .001
10	Fe	0.389	0.357	-1	1	0.377
11	Mn	0.364	0.306	-1	1	0.409
12	Cu	0.341	0.264	-1	1	0.439
13	Zn	-0.587	1.053	-1	1	0.174
14	Si	-0.932	13.157	-1	1	0.008
15	Pb	0.38	0.338	1	1	0.388
16	Ni	-0.001	< .001	1	1	0.998
17	Cr	0.606	1.161	-1	1	0.159
18	Cd	0.69	1.82	1	1	0.102



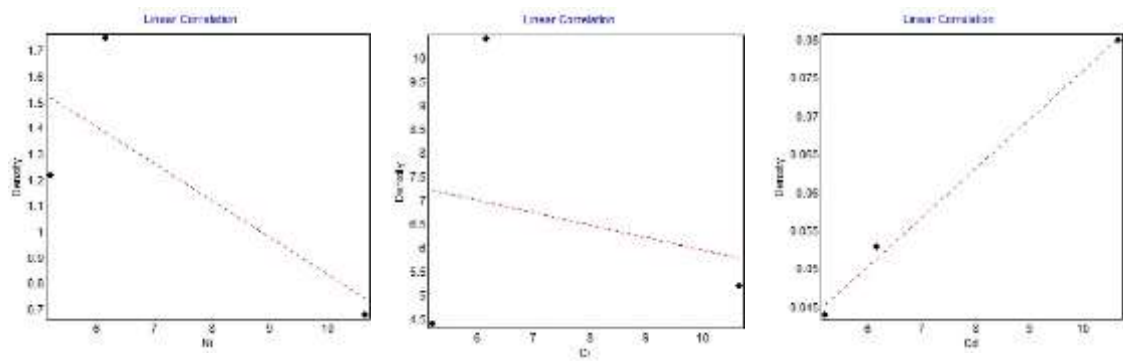
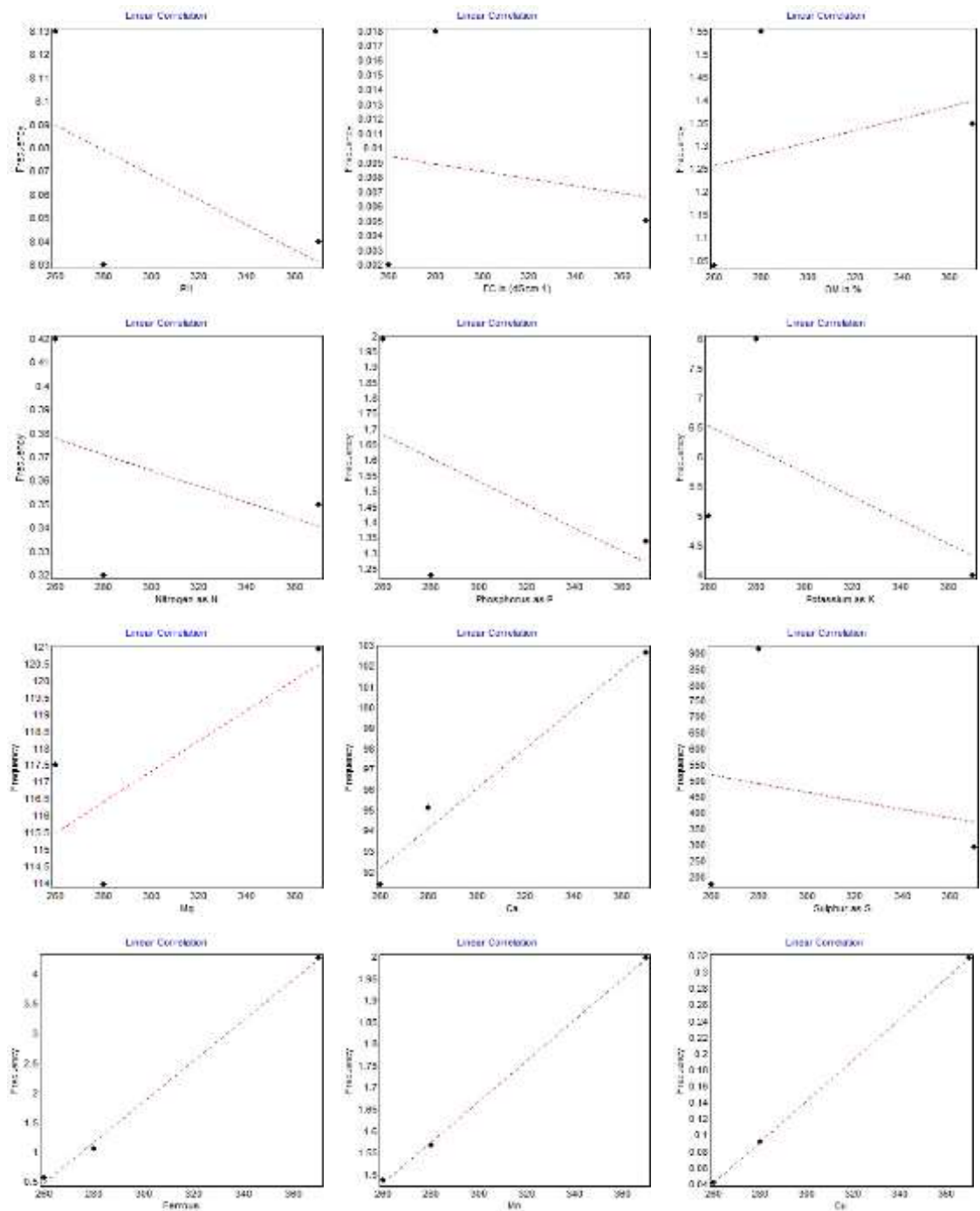


Figure 22. Spectras of linear correlation of herbaceous density with soil variables in winter season.



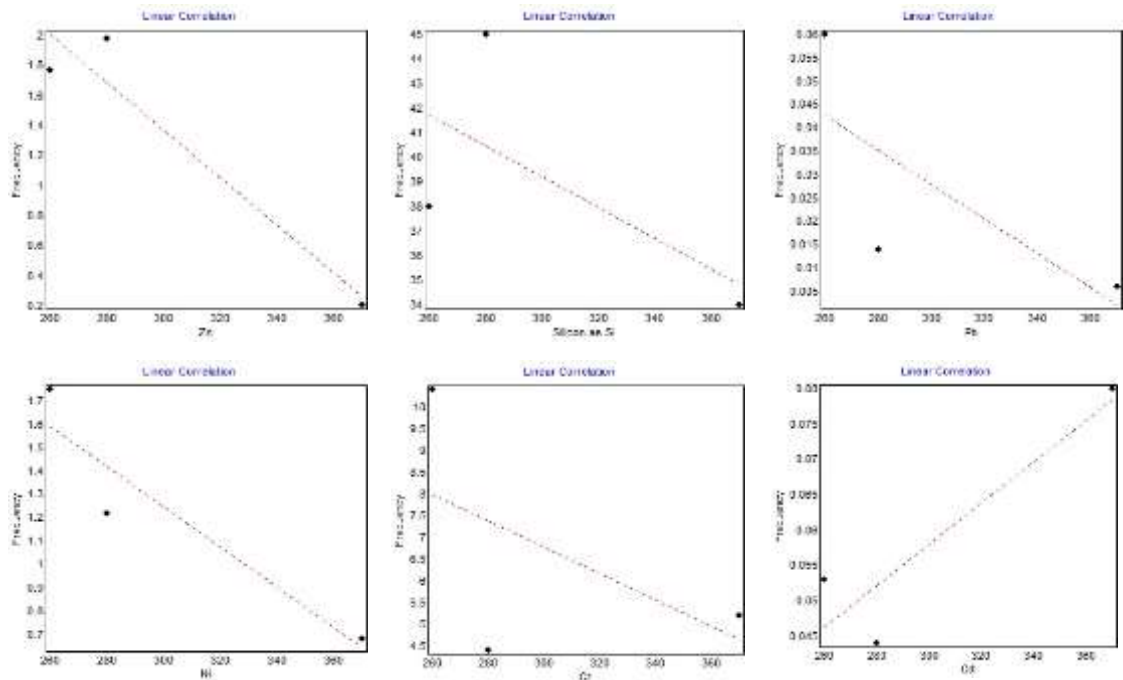
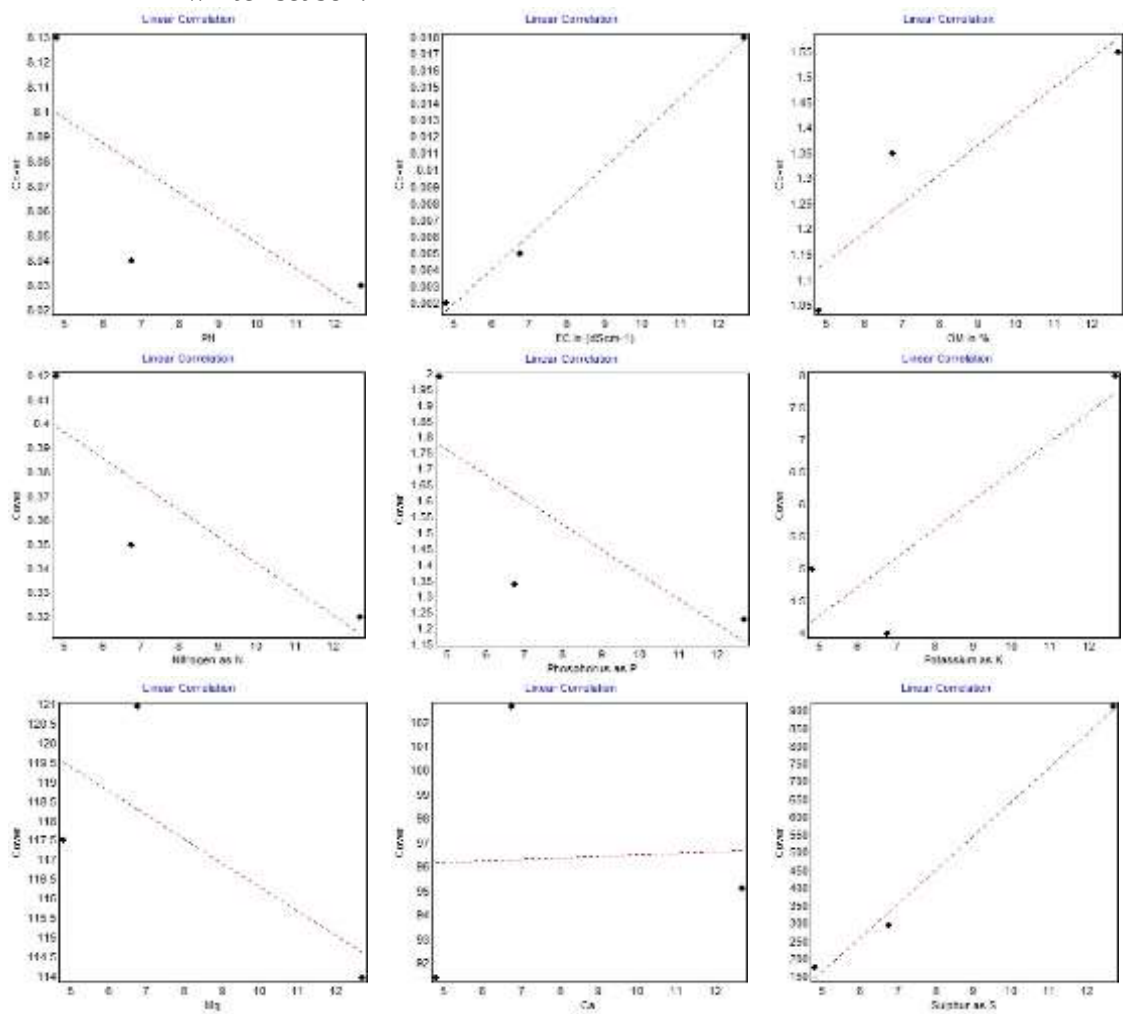


Figure 23. Spectras of linear correlation of herbaceous frequency with soil variables in winter season.



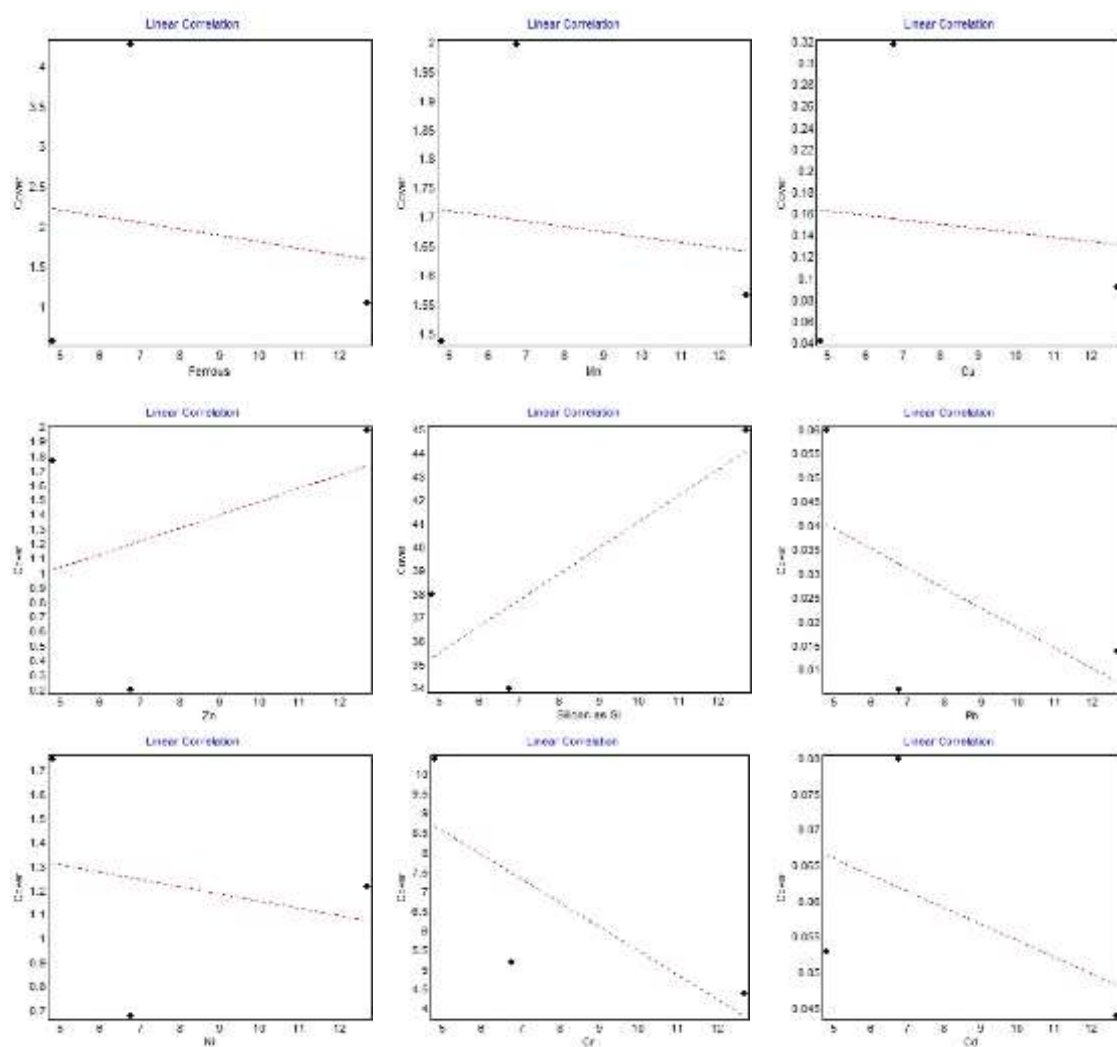
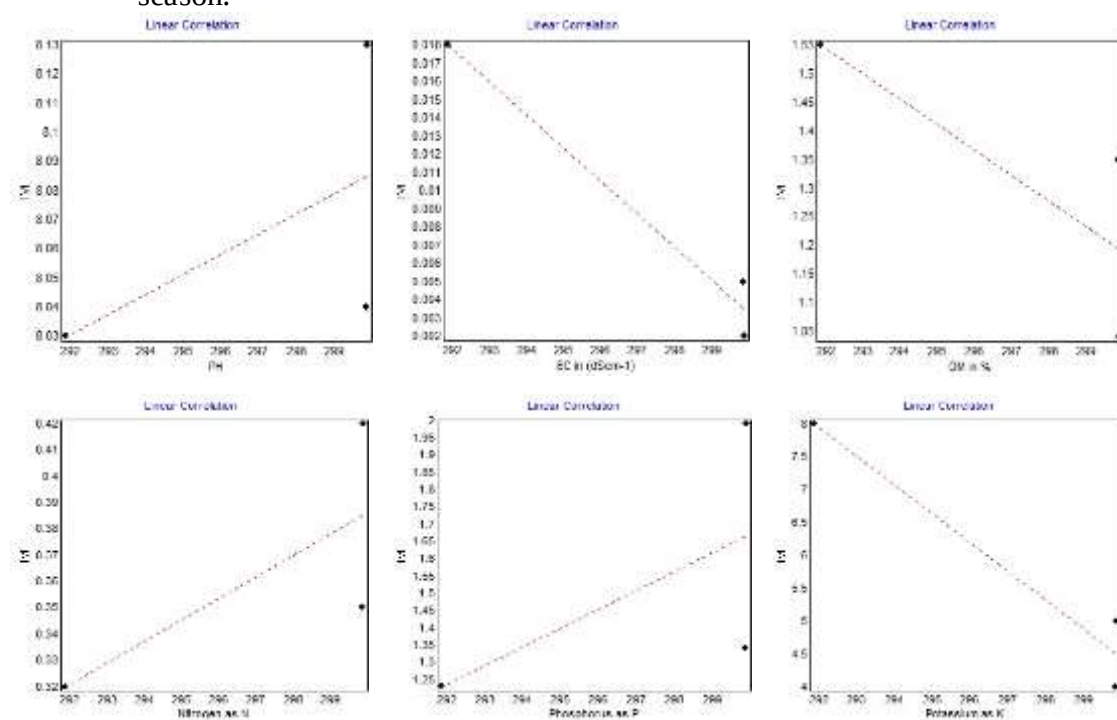


Figure 24. Spectras of linear correlation of herbage cover with soil variables in winter season.



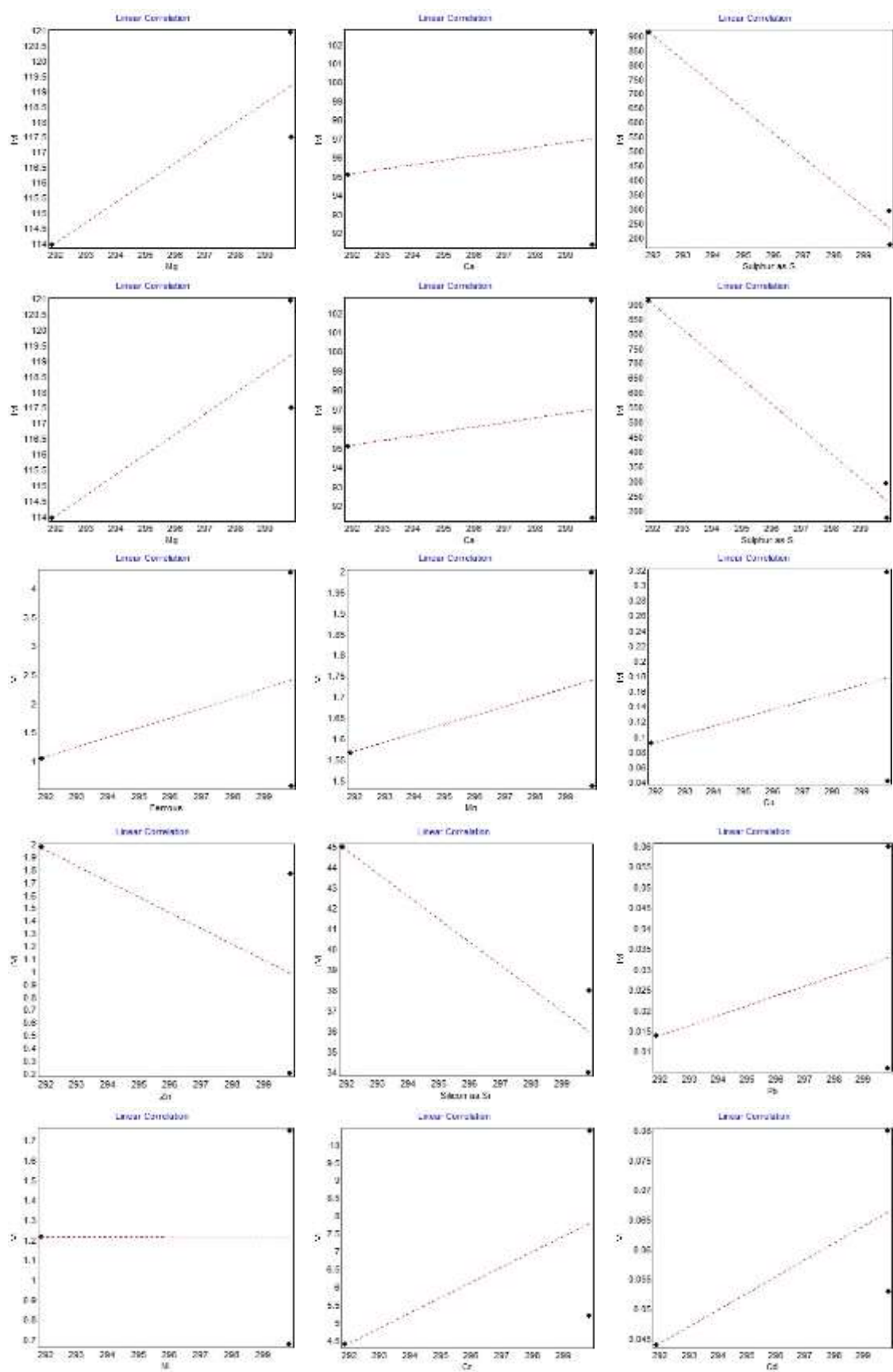


Figure 25. Spectras of linear correlation of herbaceous IV with soil variables in winter season.

4.6.6 Multiple correlation of different soil variables at three different sites of herbs in summer season

i. Multiple correlation of different soil variables at three different sites of herbs in summer season with density.

The correlation of different soil variables with herbs density in summer season (Appendix 2, 3, 4) is expressed in Table 44. The probability value of soil variables i.e. Zn ($r = 0.914$, $p = 0.012$), Pb ($r = 0.825$, $p = 0.037$) and Ni ($r = 0.978$, $p = 0.001$) were positive and significant affect with density of herbaceous communities in summer season. Similarly, the correlation of herbaceous density in summer season was negative and significant with Ca ($r = -1$, $p < .001$), Fe ($r = -0.982$, $p = 0.001$), Mn ($r = -0.987$, $p < .001$), Cu ($r = -0.99$, $p < .001$), Si ($r = -0.988$, $p < .001$) and Cd ($r = -0.851$, $p = 0.028$). These results compared with Valverde *et al.* (2004).

ii. Multiple correlation of different soil variables at three different sites of herbs in summer season with frequency.

The correlation of different soil variables with herbs frequency in summer season (Appendix 2, 3, 4) expressed in Table 45. The correlation of herbaceous frequency was positive and significant in summer season with pH ($r = 0.856$, $p = 0.027$) P ($r = 0.833$, $p = 0.034$), Pb ($r = 0.951$, $p = 0.005$), Ni ($r = 0.997$, $p < .027$) and Cr ($r = 0.839$, $p = 0.03$). Similarly, the correlation of herbs frequency in summer season was negatively significant with Ca ($r = -0.965$, $p = 0.003$), Fe ($r = -0.889$, $p = 0.018$), Mn ($r = -0.901$, $p = 0.015$) and Cu ($r = -0.911$, $p = 0.012$). These results were agreed with ealierr study who described plants often developing on rocky substrates in Mexico Bashan *et al.* (2002).

iii. Multiple correlation of different soil variables in three different sites of herbs in summer season with cover.

The correlations of different soil variables with herbs cover in summer season (Appendix 2, 3, 4) is expressed in Table 46. The correlation of herbage cover was positive and significant in summer season with Pb ($r = 0.801$, $p = 0.047$) and Ni ($r = 0.969$, $p = 0.002$). Similarly, Ca ($r = -0.998$, $p < .001$), Mn ($r = -0.993$, $p < .001$), Cu ($r = -0.995$, $p < .001$) and Cd ($r = -0.873$, $p = 0.022$). These results were compared with earlier studies who described the correlation of different soil variables with the plant communities (Martre *et al.*, 2002 and Nobel & Zutta 2007).

iv. Multiple correlation of different soil variables at three different sites of herbs in summer season with importance value.

The correlation of different soil variables with herbs importance values in summer season (Appendix 2, 3, 4) is expressed in Table 47. The probability values of different soil variables i.e. EC ($r = 0.898$, $p = 0.015$), OM ($r = 1$, $p = < .001$), P ($r = 0.961$, $p = 0.003$) and S ($r = 0.886$, $p = 0.019$) were positively significant affect on the herbs IVI in summer season of the area. Similarly, the correlation of IVI of plant communities were negative and significant with pH ($r = -0.948$, $p = 0.005$), N ($r = -0.993$, $p = < .001$), Pb ($r = -0.851$, $p = 0.028$) and Cr ($r = -0.958$, $p = 0.004$). These results were agreed and with compared Nobel and Zutta (2007) who studied the physical factors, it is known that the presence and focus of specific minerals the degree of weathering of rock minerals to clay minerals and salts availability of plant nutrients may be vital factors affecting of plants distribution.

Correlation of herbaceous density with soil variables in summer season is expressed in Figure 26. It showed that there is linear correlation of herbaceous density with soil elements like Zn, Pb and Ni in summer season in the area. It is evident that these elements have positive affects on herbaceous flora in autumn season while Ca, Fe, Mn, Cu, Si and Cd are the soil elements that have reciprocal affects on herbaceous density in summer season. Correlation of herbaceous frequency with soil variables in summer season is expressed in Figure 27. From these figures it is expressed that pH, P, Pb, Ni and Cr have linear correlation with herbaceous frequency in summer season while Ca, Fe, Mn and Cu are also soil elements that have reciprocal affects on herbaceous frequency in summer season. Correlation of the cover with soil variables in summer season is showed in (Figure 28). In these figure values, it is clear that Pb and Ni have positive affects on the herbaceous cover values while Ca, Mn, Cu and Cd have negative significant affects on herbaceous cover in the area. Similarly, correlation of importance values of herbaceous flora in summer season with different soil variables is expressed in Figure 29. From these it is evident that EC, OM, P and S have positively significant affects on the importance values of herbs in summer season while pH, N, Pb and Cr also have affects on importance values of herbaceous community in the area but these affects is reciprocal. These results were also according to (Valverde *et al.*, 2004; Martre *et al.*, 2002 and Nobel & Zutta 2007).

Table 44. Multiple correlation of different soil variables at three different sites of herbs in summer season with density. Significant values are bold. Macroelements are from S/No 1-9 and microelements are from 10-18. Significant P Value stands for probability and R for Pearson's Co-efficient are bold. DF stands for degree of freedom, R stands for Pearson's r, F stands for Pearson's F and T stands for Spearman's t.

S/N	Parameter	R	F	T	DF	P
1	pH	0.676	1.683	1	1	0.11
2	EC in (dScm ⁻¹)	0.037	0.003	-1	1	0.934
3	OM in %	-0.42	0.429	-1	1	0.339
4	N	0.511	0.708	1	1	0.241
5	P	0.643	1.413	1	1	0.132
6	K	0.441	0.482	1	1	0.315
7	Mg	-0.665	1.586	-1	1	0.117
8	Ca	-1	4452.241	-1	1	< .001
9	S	0.064	0.008	-1	1	0.885
10	Fe	-0.982	54.031	-1	1	0.001
11	Mn	-0.987	73.681	-1	1	< .001
12	Cu	-0.99	102.469	-1	1	< .001
13	Zn	0.914	10.127	1	1	0.012
14	Si	-0.988	80.667	-1	1	< .001
15	Pb	0.825	4.276		1	0.037
16	Ni	0.978	44.652	-1	1	0.001
17	Cr	0.652	1.478	1	1	0.126
18	Cd	-0.851	5.268	-1	1	0.028

Table 45. Multiple correlation of different soil variables at three different sites of herbs in summer season with frequency. Significant values are bold. Macroelements are from S/No 1-9 and microelements are from 10-18. Significant P Value stands for probability and R for Pearson's Co-efficient are bold. DF stands for degree of freedom, R stands for Pearson's r, F stands for Pearson's F and T stands for Spearman's t.

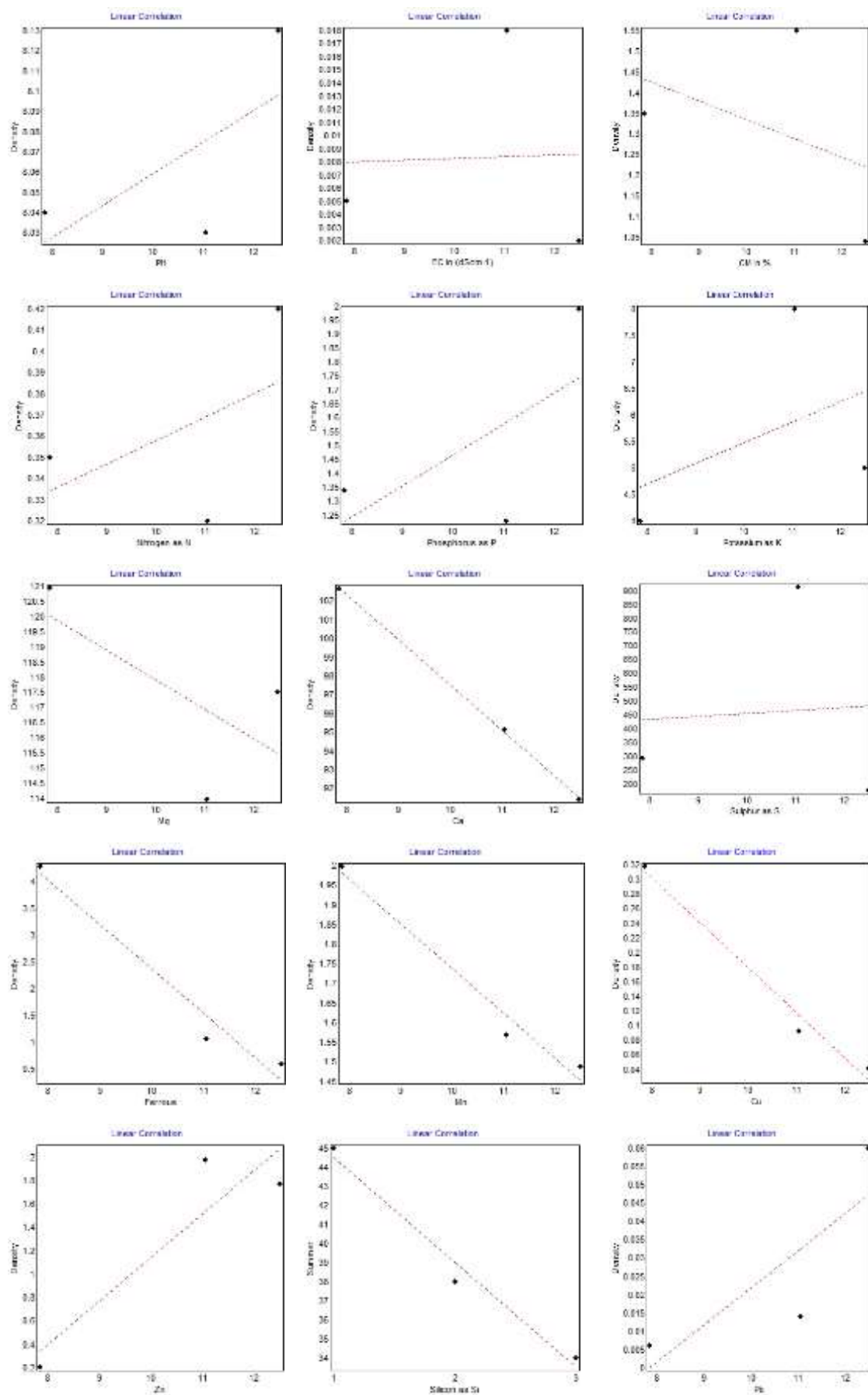
S/N	Parameter	R	F	T	DF	P
1	pH	0.856	5.504	1	1	0.027
2	EC in (dScm ⁻¹)	-0.247	0.13	-1	1	0.577
3	OM in %	-0.659	1.536	-1	1	0.121
4	N	0.733	2.321	1	1	0.078
5	P	0.833	4.542	1	1	0.034
6	K	0.17	0.059	1	1	0.702
7	Mg	-0.427	0.447	-1	1	0.331
8	Ca	-0.965	27.197	-1	1	0.003
9	S	-0.22	0.102	-1	1	0.619
10	Fe	-0.889	7.522	-1	1	0.018
11	Mn	-0.901	8.602	-1	1	0.015
12	Cu	-0.911	9.774	-1	1	0.012
13	Zn	0.762	2.772	1	1	0.063
14	Si	0.291	0.185	1	1	0.51
15	Pb	0.951	18.982	-1	1	0.005
16	Ni	0.997	332.173	-1	1	< .001
17	Cr	0.839	4.77	1	1	0.032
18	Cd	-0.669	1.619	-1	1	0.115

Table 46. Multiple correlation of different soil variables at three different sites of herbs in summer season with cover. Significant values are bold. Macroelements are from S/No 1-9 and microelements are from 10-18. Significant P Value stands for probability and R for Pearson's Co-efficient are bold. DF stands for degree of freedom, R stands for Pearson's r, F stands for Pearson's F and T stands for Spearman's t.

S/N	Parameter	R	F	T	DF	P
1	pH	0.644	1.417	1	1	0.131
2	EC in (dScm ⁻¹)	0.079	0.013	-1	1	0.858
3	OM in %	-0.381	0.34	-1	1	0.387
4	N	0.474	0.58	1	1	0.279
5	P	0.61	1.186	1	1	0.156
6	K	0.479	0.595	1	1	0.274
7	Mg	-0.696	1.883	-1	1	0.098
8	Ca	-0.998	488.804	-1	1	< .001
9	S	0.107	0.023	-1	1	0.81
10	Fe	0.584	1.037	1	1	0.176
11	Mn	-0.993	136.18	-1	1	< .001
12	Cu	-0.995	215.138	-1	1	< .001
13	Zn	0.93	12.871	1	1	0.008
14	Si	0.584	1.037	1	1	0.176
15	Pb	0.801	3.57	-1	1	0.047
16	Ni	0.969	30.358	-1	1	0.002
17	Cr	0.619	1.242	1	1	0.149
18	Cd	-0.873	6.407	-1	1	0.022

Table 47. Multiple correlation of different soil variables at three different sites of herbs in summer season with importance value. Significant values are bold. Macroelements are from S/No 1-9 and microelements are from 10-18. Significant P Value stands for probability and R for Pearson's Co-efficient are bold. DF stands for degree of freedom, R stands for Pearson's r, F stands for Pearson's F and T stands for Spearman's t.

S/N	Parameter	R	F	T	DF	P
1	pH	-0.948	17.78	-1	1	0.005
2	EC in (dScm ⁻¹)	0.898	8.339	-1	1	0.015
3	OM in %	1	9127.347	-1	1	< .001
4	N	-0.993	142.613	-1	1	< .001
5	P	0.961	24.151	-1	1	0.003
6	K	0.641	1.393	1	1	0.133
7	Mg	-0.412	0.408	-1	1	0.349
8	Ca	0.426	443	1	1	0.332
9	S	0.886	0.277	-1	1	0.019
10	Fe	0.227	0.108	1	1	0.609
11	Mn	0.253	0.136	1	1	0.568
12	Cu	0.276	0.165	1	1	0.532
13	Zn	< .001	< .001	1	1	1
14	Si	0.54	0.824	1	1	0.214
15	Pb	-0.851	5.268	-1	1	0.028
16	Ni	-0.587	1.051	-1	1	0.174
17	Cr	-0.958	22.228	-1	1	0.004
18	Cd	-0.133	0.036	-1	1	0.764



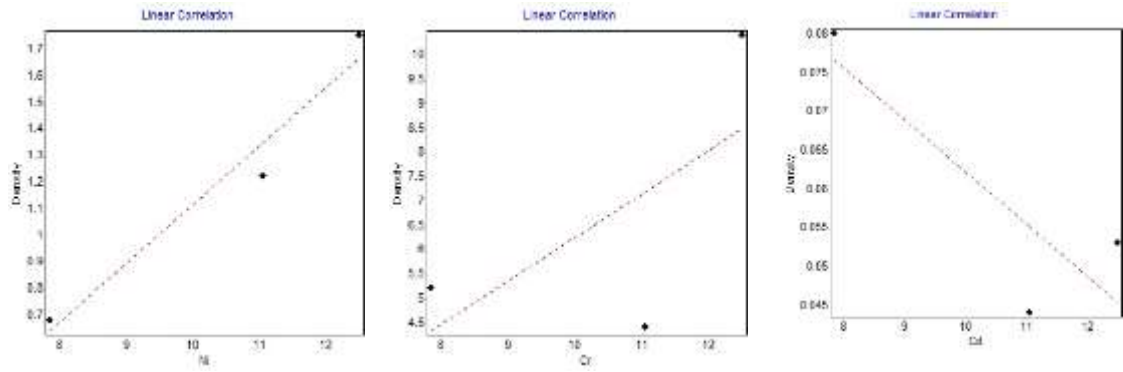
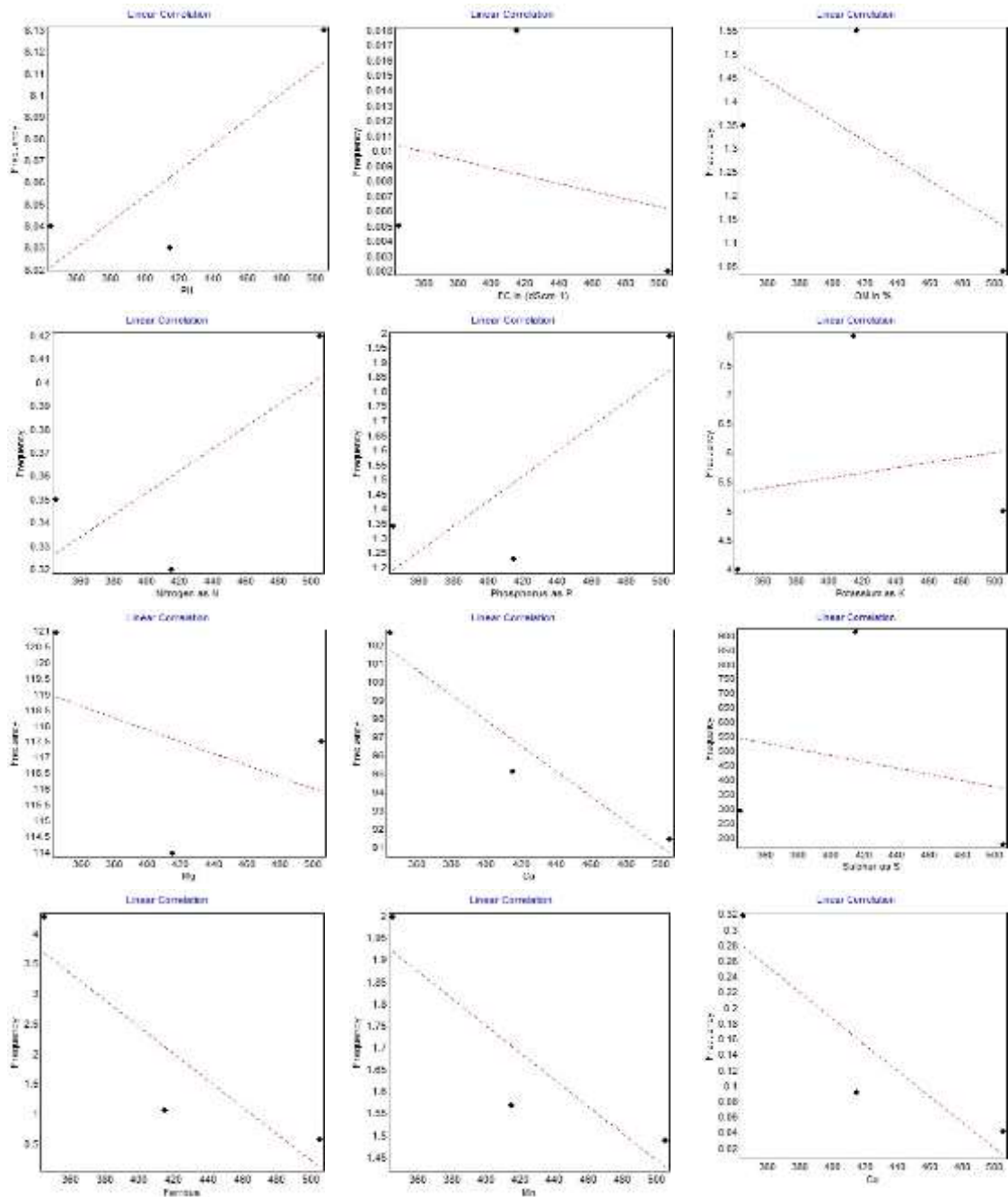


Figure 26. Spectras of linear correlation of herbaceous density with soil variables in summer season.



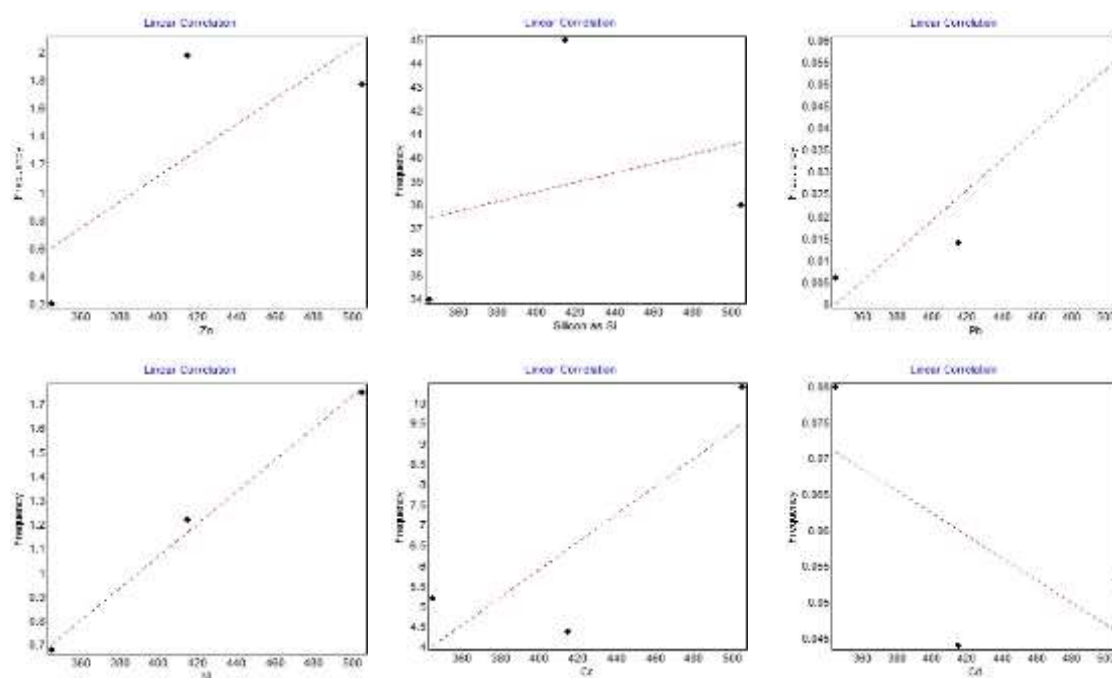
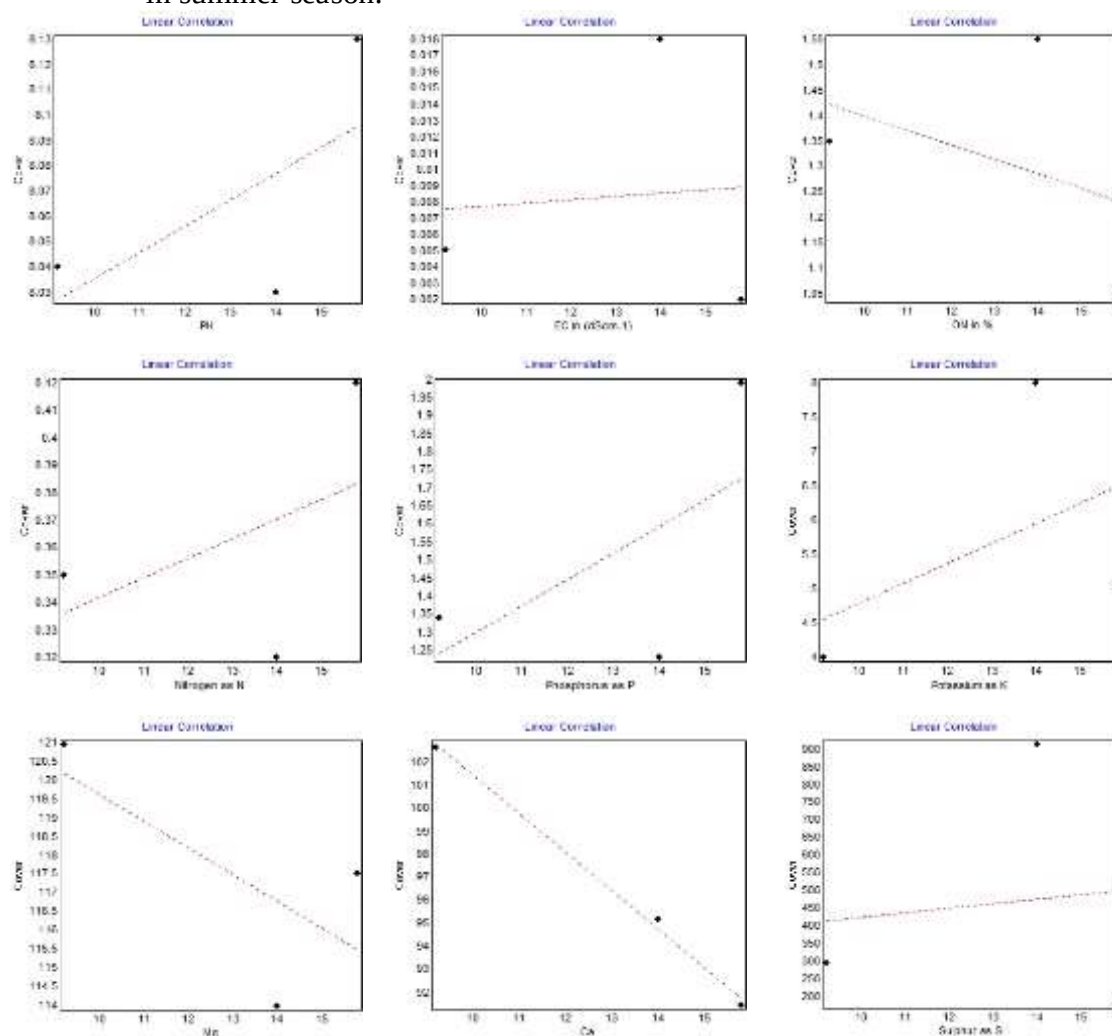


Figure 27. Spectras of linear correlation of herbaceous frequency with soil variables in summer season.



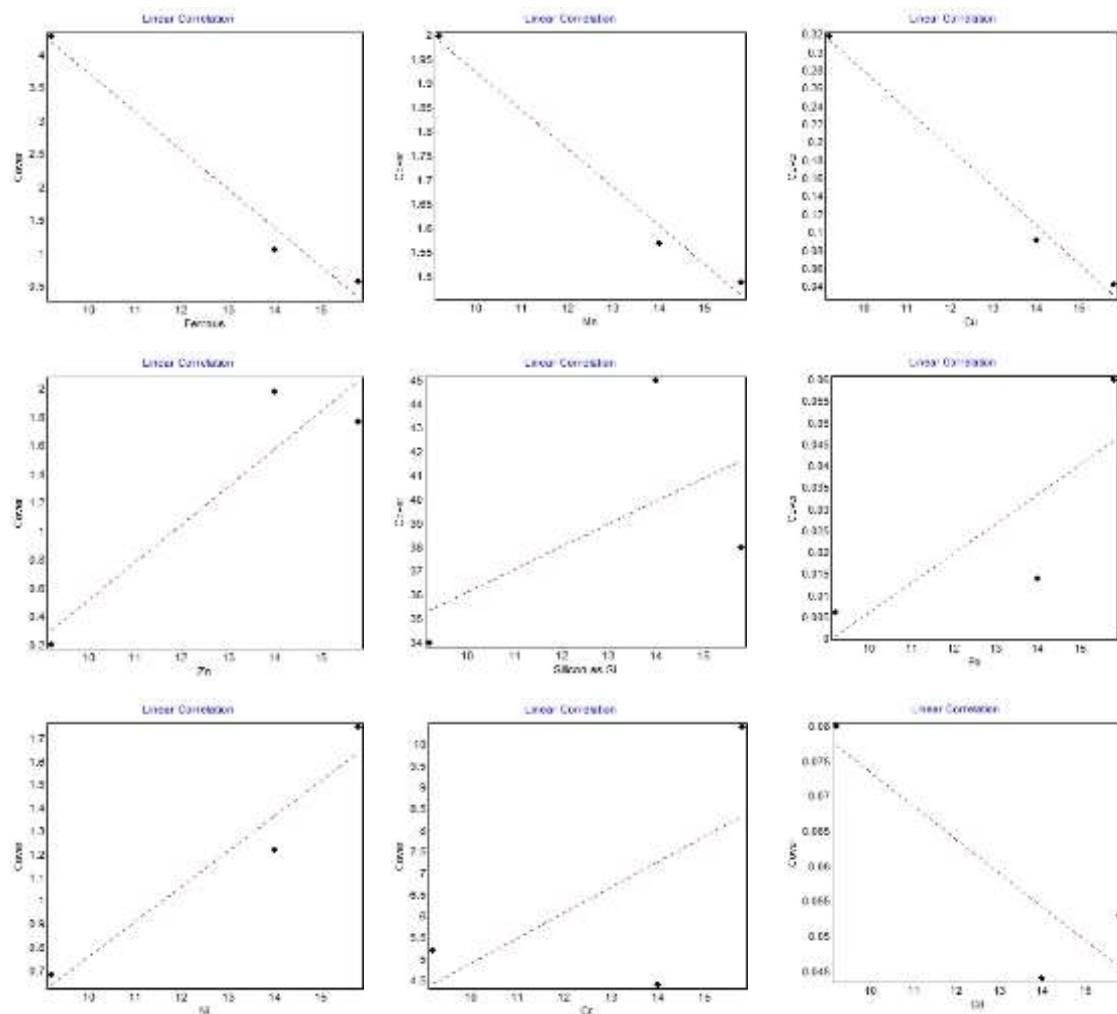
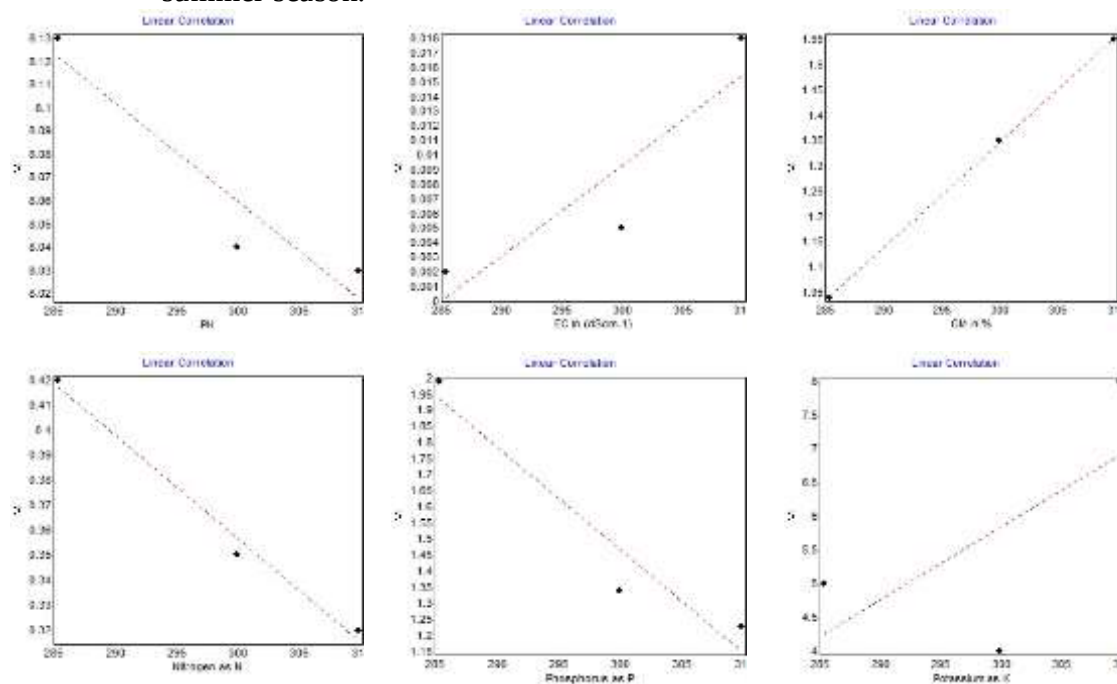


Figure 28. Spectras of linear correlation of herbage cover with soil variables in summer season.



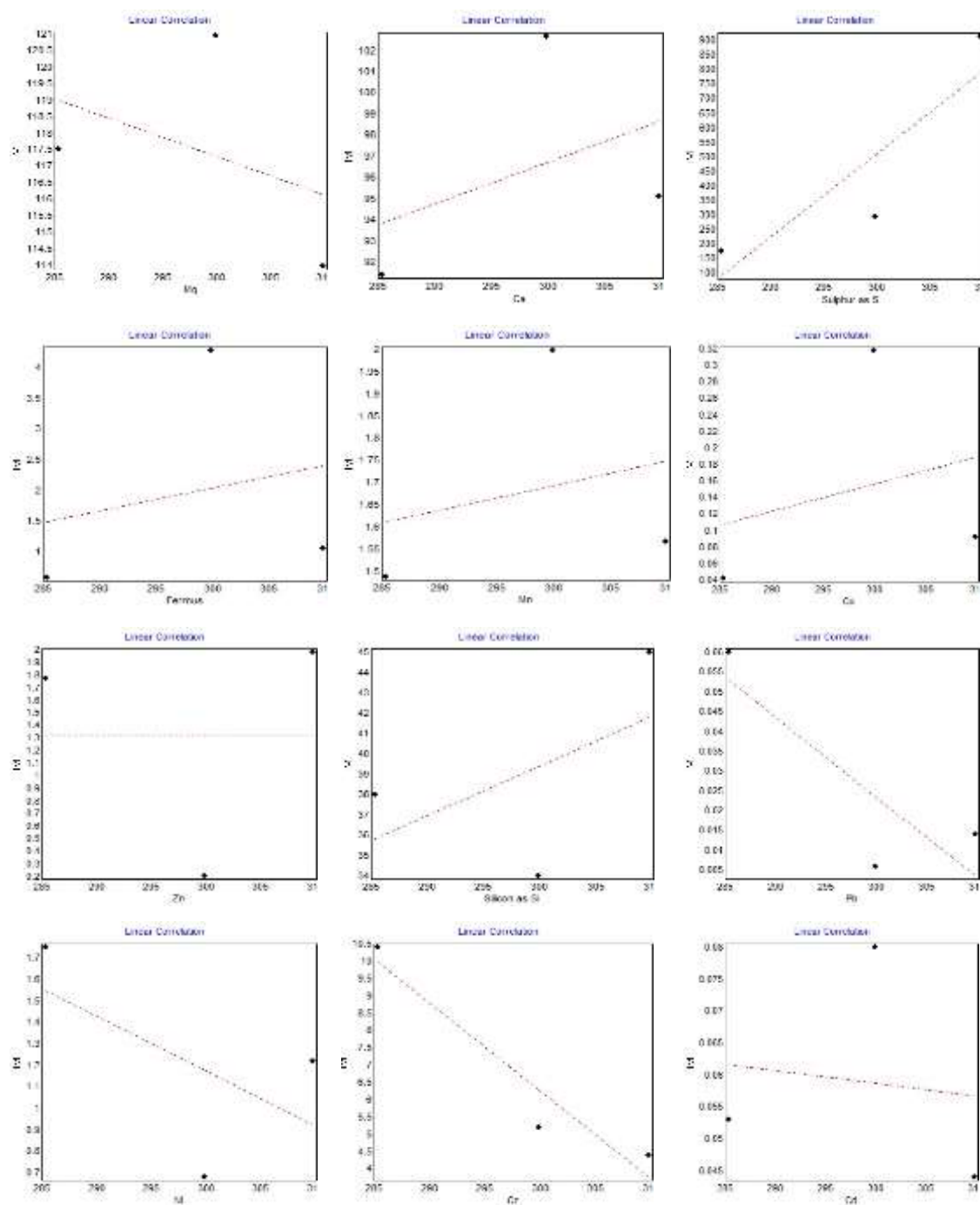


Figure 29. Spectras of linear correlation of herbaceous IV with soil variables in summer season.

4.7 Palatability

Palatability is plant characteristic or plant condition that motivates the animal to graze the plant (Hady, 1964). There were 193 plant species, which belonged to 54 families of district Bannu. Out of them 37 species (19.17%) were non-palatable due to poisonous in nature while 156 (80.83%) species were palatable due to various degree of palatability in the area (Table 48). Palatability ratios of plant species were greater than non-palatable ones in the area. Among the palatable plants there were 24 species (12.43%) which were highly palatable. High palatable trees such as *Acacia modesta*, *Acacia nilotica*, *Capparis decidua* and *Ziziphus jujuba* preferred by browsing animal. Similarly, *Amaranthus viridis*, *Cicer arietinum*, *Lathyrus aphaca*, *Trifolium species*, *Triticum aestivum* and *Zea mays* were usually grazed by ruminant (Akram *et al.*, 2009). There were 37 species (19.17%) which were mostly palatable. The mostly palatable plant species were *Boerhavia procumbens*, *Chenopodium album*, *Convolvulus arvensis*, *Cyamopsis tetragonoloba*, and *Eruca sativa* in the area (Karki *et al.*, 2000). There were 59 species (30.56%) which were less palatable to animal. The less palatable plants were *Abelmoschus esculentus*, *Achyranthes aspera*, *Arnebia hispidissima*, *Atriplex stocksii*, *Brassica tournefortii*, *Bromus pectinatus*, *Calligonum polygonoides*, *Carthamus tinctorus*, *Chrozophora plicata* etc. When high palatable plants are unavailable to animals then they on less palatable plant (Watson & Smith, 2000). There were 35 species (18.13%) which were rarely palatable. Similarly, goat and sheep also depend on these species for some extent (Neal & Miller, 2007). Herbivory is intensely avoided due to spiny in nature or odorous of the plant species (Lee *et al.*, 2000).

On the basis of part used, it was found that shoot/whole were used 96 (61.53%). In 57 (37.17%) species leaves were used as a food for animal while in 3 (1.92%) floral parts were consumed (Table 48). Morphological feature of species reduce the palatability of plants to animal (Milewsk & Madden, 2006) who studied the intensive browsing led plants to produce thorn and showed resistance against browsing for their survival. Chemical nature and nutrition also played role against the grazing.

On the basis of condition, 109 (68.98%) species were utilized in fresh condition and 16 (10.12%) in dry condition. While 32 (20%) were used in both dry and fresh condition (Table 48). In the present study it was noted that Cattle utilize plant usually

in fresh condition. Similarly, cow preferred most of the grasses in fresh as well as in dry condition (wheat straw) these finding are in accordance with Knop and Smith, (2006).

The palatability of the plant stimulates the animal to select the plant as constituent of its diet. In other words the reaction of stimulation is to graze the plant. The stimulation-reaction relationship in food selection and acceptance is controlled by a complex chain of events (Young, 1948). Among the palatable plants 50 (17.66%) were grazed by cow, 92 (32.50%) were by goat and 90 (31.80%) by sheep. While 51 (18.02%) were browsed by camel (Table 48). Cattle usually preferred herbaceous flora and also utilized shrubs to some extent. Cows mostly consumed mostly grasses while camel utilized trees and spiny plants these finding were agreed with Durrani, (2005) who found that cattle and sheep preferred forbs and camel preferred trees.

Table 48. Palatability, part used, condition and animal preferences of forage plants in District Bannu.

S/No.	Plant name	Palatability classes						Part used			Condition			Livestock			
		NP	P	H	M	L	R	W	L	I	F	D	B	C	G	S	Ca
01	<i>Abelmoschus esculentus</i> (Linn.) Moench.	-	+	-	-	+	-	-	+	-	+	-	-	-	+	+	+
02	<i>Achyranthes aspera</i> L.	-	+	-	-	+	-	-	+	-	+	-	-	+	-	+	-
03	<i>Acacia modesta</i> Wall.	-	+	+	-	-	-	-	+	-	+	-	-	-	+	-	+
04	<i>Acacia nilotica</i> (L.) Wild.ex Delile	-	+	+	-	-	-	-	+	-	+	-	-	-	+	+	+
05	<i>Aerva javanica</i> (Burm. F.) Juss.	-	+	-	-	-	+	-	+	-	-	+	-	-	+	-	+
06	<i>Albiza lebbeck</i> (L.) Benth	-	+	-	-	-	+	-	+	-	+	-	-	-	-	-	+
07	<i>Alhagi maurorum</i> Medic.	-	+	-	-	-	+	+	-	-	+	-	-	-	-	-	+
08	<i>Allium sativum</i> L.	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09	<i>Allium cepa</i> L.	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	<i>Alopecurus nepalensis</i> Trin.Ex Steud.	-	+	-	-	-	+	+	-	-	+	-	-	+	-	-	-
11	<i>Aloe vera</i> (L.) Brum	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12	<i>Anagallis arvensis</i> L.	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13	<i>Amaranthus blitoides</i> S. Watson	-	+	+	+	-	-	-	+	-	+	-	-	+	-	-	-
14	<i>Amaranthus viridis</i> L.	-	+	-	+	-	-	-	+	-	+	-	-	+	-	-	+
15	<i>Aristida adscensionis</i> L.	-	+	-	+	-	-	+	-	-	+	-	-	+	+	-	-

16	<i>Aristida cyanantha</i> Nees ex Steud.	-	+	-	+	-	-	+	-	-	+	-	-	+	+	-	-
17	<i>Arnebia hispidissima</i> (Lehm.) A. DC.	-	+	-	-	+	-	-	-	-	+	-	-	-	-	-	+
18	<i>Asphadelus tunifolius</i> Caven.	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19	<i>Astragalus scorpiurus</i> Bunge.	-	+	-	-	-	-	+	-	-	+	-	-	+	+	+	+
20	<i>Atriplex stocksii</i> Boiss	-	+	-	-	+	-	-	+	-	-	-	+	-	+	-	+
21	<i>Avena fatua</i> L.	-	+	+	-	-	-	+	-	-	+	-	-	-	+	+	-
22	<i>Boerhavia procumbens</i> Banks ex Roxb	-	+	-	+	-	-	+	-	-	+	-	-	-	-	+	-
23	<i>Brassica campestris</i> L.	-	+	-	+	-	-	+	-	-	+	-	-	+	+	+	+
24	<i>Brassica tournefortii</i> Gouan	-	+	-	-	+	-	+	-	-	+	-	-	-	-	-	+
25	<i>Bromus pectinatus</i> Thunb.	-	+	-	-	+	-	+	-	-	+	-	-	+	-	-	-
26	<i>Calendula officinalis</i> L.	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27	<i>Calligonum polygonoides</i> L.	-	+	-	-	+	-	-	+	-	+	-	-	-	+	-	+
28	<i>Calotropis procera</i> (Willd.) R. Br.	-	+	-	-	+	-	-	+	-	+	-	-	-	+	+	-
29	<i>Capsicum annum</i> L.	-	+	-	-	+	-	+	+	-	+	-	-	-	+	+	-
30	<i>Capparis decidua</i> (Frossk.) Edgew.	-	+	+	-	-	-	+	-	-	+	-	-	-	+	-	+
31	<i>Carduus argentatus</i> L.	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
32	<i>Carthamus persicus</i> Willd.	-	+	-	-	+	-	+	-	-	+	-	-	-	-	-	+
33	<i>Carthamus tinctorius</i> L.	-	+	-	-	+	-	+	-	-	+	-	-	-	-	-	+

34	<i>Celosia argentea</i> L.	-	+	-	-	+	-	+	-	-	+	-	-	-	+	+	-
35	<i>Cenchrus biflorus</i> Roxb.	-	+	-	+	-	-	+	-	-	+	-	-	-	-	+	-
36	<i>Cenchrus ciliaris</i> L.	-	+	-	-	-	+	+	-	-	+	-	-	+	-	-	-
37	<i>Centaurea iberica</i> Spreng.	-	+	-	-	+	-	-	+	-	-	+	-	-	+	-	-
38	<i>Centaureum pulchellum</i> (Sw.) Druce	-	+	-	+	-	-	+	-	-	+	-	-	-	-	+	-
39	<i>Chenopodium album</i> L.	-	+	-	+	-	-	+	-	-	-	-	+	-	-	+	-
40	<i>Chenopodium murale</i> L.	-	+	-	+	-	-	+	-	-	+	-	-	-	-	-	+
41	<i>Chrozophora tinctoris</i> (L.) Raf.	-	+	-	-	+	-	-	+	-	+	-	-	-	-	-	+
42	<i>Cicer arietinum</i> L.	-	+	+	-	-	-	+	-	-	-	-	+	+	+	+	+
43	<i>Cirsium arvense</i> (L.) Scop.	-	+	-	-	+	-	+	-	-	+	-	-	-	+	+	-
44	<i>Cistanche tubulosa</i> (Schrenk.) Hook. f.	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
45	<i>Citrullus colocynthis</i> (L.) Shred.	-	+	-	-	+	-	-	-	+	-	-	+	-	-	-	+
46	<i>Citrus limon</i> (L.)Burm.f	-	+	-	-	+	-	-	+	-	+	-	-	-	+	+	-
47	<i>Citrus reticulata</i> Blanco	-	+	-	-	+	-	-	+	-	+	-	-	-	+	-	-
48	<i>Convolvulus arvensis</i> L.	-	+	-	+	-	-	+	-	-	+	-	-	+	+	+	-
49	<i>Convolvulus spicatus</i> Hallier f.	-	+	-	+	-	-	+	-	-	+	-	-	+	+	+	-
50	<i>Conyza bonariensis</i> (L.) Cronquist	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
51	<i>Corchorus depressus</i> (L.)	-	+	-	-	+	-	+	-	-	+	-	-	-	-	+	-

52	<i>Croton bonplandianus</i> Bat.	-	+	-	-	+	-	+	-	-	+	-	-	+	+	+	-
53	<i>Cucumis sativus</i> L.	-	+	-	+	-	-	+	-	-	+	-	-	-	+	+	-
54	<i>Cucurbita maxima</i> Duch Ex. Lam.	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
55	<i>Cucurbita pepo</i> L.	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
56	<i>Cuscuta reflexa</i> Roxb.	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
57	<i>Cymbopogon distans</i> Schutt.	-	+	-	-	+	-	-	-	-	-	-	+	-	+	+	-
58	<i>Cyamopsis tetragonoloba</i> (L.) Taubert	-	+	-	+	-	-	+	-	-	-	-	+	+	+	+	+
59	<i>Cynodon dactylon</i> (L.) Pers.	-	+	-	+	-	-	+	-	-	-	-	+	+	+	+	-
60	<i>Cyperus difformis</i> L.	-	+	-	-	+	-	-	+	-	+	-	-	-	+	+	-
61	<i>Cyperus rotundus</i> L.	-	+	-	-	+	-	-	+	-	+	-	-	-	+	+	-
62	<i>Dalbergia sissoo</i> Roxb.	-	+	-	-	-	+	-	+	-	+	-	-	-	+	+	+
63	<i>Datura alba</i> Nees.	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
64	<i>Desmostachya bipinnata</i> (L.) Stapf.	-	+	-	-	-	+	-	+	-	-	+	-	+	-	-	-
65	<i>Dichanthium annulatum</i> Forssk.	-	+	+	-	-	-	+	-	-	-	-	+	+	-	-	-
66	<i>Digera muricata</i> (L.) Mart	-	+	-	-	-	+	-	+	-	-	+	-	-	+	+	-
67	<i>Dinebra retroflexa</i> (Vahl) Panzer.	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
68	<i>Daucus carota</i> Linn.	-	+	-	-	+	-	-	-	-	+	-	-	+	+	+	-
69	<i>Echinochloa crus-galli</i> (L.) P. Beauv.	-	+	-	-	-	+	-	+	-	-	+	-	+	-	-	-

70	<i>Echinops echinatus</i> L.	-	+	-	-	-	-	+	-	-	+	-	-	-	-	-	+
71	<i>Eleusine indica</i> (L.) Gaertn.	-	+	-	-	+	-	+	-	-	+	-	-	+	-	-	-
72	<i>Eragrostis pilosa</i> (L.)P. Beauv.	-	+	-	-	-	+	-	+	-	-	+	-	-	+	-	-
73	<i>Eragrostis minor</i> Host.	-	+	-	-	-	+	-	+	-	-	+	-	-	+	-	-
74	<i>Eruca sativa</i> Mill.	-	+	-	+	-	-	+	-	-	+	-	-	-	+	+	+
75	<i>Eucalyptus camaldulaensis</i> Dehnh.	-	+	-	-	+	-	-	+	-	+	-	-	-	+	+	+
76	<i>Euphorbia dracunculoides</i> Lam.	-	+	-	-	+	-	-	+	-	-	+	-	+	+	+	-
77	<i>Euphorbia helioscopia</i> L.	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
78	<i>Euphorbia prostrata</i> Ait.	-	+	-	-	-	+	+	-	-	+	-	-	+	-	-	-
79	<i>Fagonia indica</i> L.	-	+	-	-	+	-	+	-	-	+	-	-	-	-	-	+
80	<i>Farsetia jacquemontii</i> (Hook. F. & thoms.) Jafri	-	+	-	-	-	+	+	-	-	+	-	-	+	+	+	+
81	<i>Ficus carica</i> L.	-	+	-	-	+	-	-	+	-	-	+	-	-	+	-	-
82	<i>Ficus religiosa</i> L.	-	+	-	-	+	-	-	+	-	-	+	-	-	+	-	-
83	<i>Filago pyramidata</i> L.	-	+	-	-	-	+	+	-	-	-	+	-	-	-	+	-
84	<i>Fumaria indica</i> Hausskn.	-	+	-	+	-	-	-	+	+	-	-	-	-	+	-	-
85	<i>Galium tricornis</i> Stokes	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
86	<i>Heliotropium crispum</i> Desf.	-	+	-	-	+	-	+	-	-	+	-	-	-	+	+	+
87	<i>Heliotropium europaeum</i> (F. & M.) Kazmi	-	+	-	-	+	-	+	-	-	+	-	-	-	-	-	+

88	<i>Heliotropium strigosum</i> Wild	-	+	-	-	+	-	+	-	-	+	-	-	-	-	-	+
89	<i>Hibiscus rosa-sinensis</i> Linn.	-	+	-	-	+	-	-	+	-	+	-	-	-	+	+	-
90	<i>Hordeum vulgare</i> L.	-	+	-	+	-	-	+	-	-	+	-	-	+	+	+	+
91	<i>Hordeum murinum</i> Sub. Glacum (Steud) Tzveleve	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
92	<i>Hypecoum pendulum</i> L.	-	+	-	-	+	-	+	-	-	+	-	-	+	+	+	-
93	<i>Hyoscyamus niger</i> L.	-	+	-	-	+	-	+	-	-	+	-	-	-	+	+	+
94	<i>Juncus inflexus</i> L.	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
95	<i>Ifloga spicata</i> Forssk.	-	+	-	-	-	+	+	-	-	+	-	-	-	+	+	-
96	<i>Iris lactea</i> Pallas	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
97	<i>Lactuca sarriola</i> L.	-	+	-	-	+	-	+	-	-	+	-	-	-	+	+	-
98	<i>Lathyrus aphaca</i> L.	-	+	+	-	-	-	+	-	-	+	-	-	-	-	+	-
99	<i>Lathyrus sativus</i> L.	-	+	-	+	-	-	-	+	-	-	+	-	+	-	-	-
100	<i>Launaea angustifolia</i> (Desf.) Kuntze	-	+	-	-	+	-	+	-	-	+	-	-	-	+	+	-
101	<i>Launaea procumbens</i> Pravin Kawale	-	+	-	-	+	-	+	-	-	+	-	-	-	+	+	-
102	<i>Leptochloa panicea</i> Retz	-	+	-	-	+	-	+	-	-	+	-	-	+	+	+	-
103	<i>Linum corymbulosum</i> Reichenb.	-	+	-	-	+	-	+	-	-	+	-	-	+	+	+	-
104	<i>Luffa aegyptica</i> Mill.	-	+	-	-	+	-	-	+	-	+	-	-	-	+	+	-
105	<i>Lycopersicun esculentum</i> Miller	-	+	-	-	+	-	+	-	-	+	-	-	-	+	+	-

106	<i>Magifera indica</i> L.	-	+	-	-	-	+	-	+	-	+	-	-	-	+	+	-
107	<i>Malcolmia africana</i> (L.) R.Br.	-	+	-	-	+	-	-	+	-	+	-	-	+	+	+	-
108	<i>Malva neglecta</i> Wallr.	-	+	-	+	-	-	+	-	-	+	-	-	-	+	+	-
109	<i>Malvastrum coromendelianum</i> (L.) Gracke	-	+	-	-	-	+	-	+	-	+	-	-	-	+	-	-
110	<i>Mentha longifolia</i> L.	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
111	<i>Mentha spicata</i> (L.) L.	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
112	<i>Momordica charantia</i> L.	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
113	<i>Medicago polymorpha</i> L.	-	+	+	-	-	-	+	-	-	-	-	+	+	+	+	-
114	<i>Melia azedarach</i> L.	-	+	-	-	-	+	-	+	-	+	-	-	-	+	-	-
115	<i>Melilotus alba</i> Desr.	-	+	-	+	-	-	-	+	-	-	-	+	+	-	+	-
116	<i>Melilotus indica</i> (L.) All.	-	+	+	-	-	-	+	-	-	-	-	+	-	-	+	-
117	<i>Morus alba</i> L.	-	+	+	-	-	-	-	+	-	+	-	-	-	+	+	-
118	<i>Morus nigra</i> L.	-	+	+	-	-	-	-	+	-	+	-	-	-	+	+	-
119	<i>Nerium indicum</i> Mill.	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
120	<i>Neslia apiculata</i> Fisch.	-	+	-	-	-	+	+	-	-	+	-	-	-	+	-	-
121	<i>Nicotiana plumbaginifolia</i> Viv.	-	+	-	-	+	-	+	-	-	+	-	-	-	+	+	-
122	<i>Nonea edgeworthii</i> A. DC.	-	+	-	-	-	+	+	-	-	+	-	-	-	-	-	+
123	<i>Nonea pulla</i> (L.) DC.	-	+	-	-	-	+	+	-	-	+	-	-	-	-	-	+

124	<i>Oligomeris linifolia</i> (Vahl.) Macbride	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
125	<i>Oryza sativa</i> L.	-	+	+	-	-	-	+	-	-	-	-	+	+	+	+	+
126	<i>Ocimum basilicum</i> L.	+	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-
127	<i>Oxalis corniculata</i> L.	-	+	-	-	-	+	-	+	-	-	-	+	-	-	+	-
128	<i>Oxyria digyna</i> (L.) Hill.	-	+	-	+	-	-	+	-	-	+	-	-	-	+	+	+
129	<i>Pennisetum glaucum</i> L.	-	+	-	+	-	-	+	-	-	-	-	+	-	+	-	-
130	<i>Parthenium hysterophorus</i> L.	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
131	<i>Pegnum harmala</i> L.	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
132	<i>Periploca aphylla</i> Decne.	-	+	-	-	-	+	+	-	-	+	-	-	-	+	-	+
133	<i>Phalaris minor</i> Retz.	-	+	-	+	-	-	+	-	-	-	+	-	-	+	-	-
134	<i>Phoenix dactylifera</i> L.	-	+	-	-	-	+	-	+	-	+	-	-	-	+	+	-
135	<i>Phragmites karka</i> (Retz.) Trimn.ex Steud.	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
136	<i>Plantago lanceolata</i> L.	-	+	-	-	+	-	+	-	-	-	-	+	-	-	+	-
137	<i>Plantago ovata</i> Frossk.	-	+	-	-	+	-	+	-	-	-	-	+	-	-	+	-
138	<i>Poa annua</i> L.	-	+	+	-	-	-	+	-	-	-	-	+	-	-	+	-
139	<i>Poa botryoides</i> (Trin. Ex Griseb.) Kom.	-	+	+	-	-	-	+	-	-	-	-	+	-	-	+	-
140	<i>Poa bulbosa</i> L.	-	+	+	-	-	-	+	-	-	-	-	+	-	-	+	-
141	<i>Polygonum biaristatum</i> Aitch. & Hemsl.	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

142	<i>Polygonum plebejum</i> R.Br	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
143	<i>Polypogon monspeliensis</i> (L.) Desf.	-	+	+	-	-	-	-	+	-	-	-	+	+	-	-	-
144	<i>Portulaca oleracea</i> Linn.	-	+	-	-	-	+	+	-	-	+	-	-	-	+	+	+
145	<i>Psammogeton biternatum</i> Edgew.	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
146	<i>Psidium guajava</i> Linn.	-	+	-	+	-	-	-	+	-	+	-	-	-	+	-	+
147	<i>Prosopis cineraria</i> L.	-	+	-	+	-	-	-	+	-	+	-	-	-	+	-	+
148	<i>Prosopis juliflora</i> Swartz.	-	+	-	+	-	-	-	+	-	+	-	-	-	+	-	+
149	<i>Raphanus sativus</i> Linn.	-	+	-	+	-	-	+	-	-	+	-	-	+	+	+	-
150	<i>Ranunculus muricatus</i> L.	-	+	-	-	+	-	+	-	-	+	-	-	-	+	+	-
151	<i>Ranunculus scleratus</i> L.	-	+	-	-	+	-	+	-	-	+	-	-	-	+	+	-
152	<i>Rostraria cristata</i> Linn.	-	+	-	-	-	+	+	-	-	+	-	-	-	+	+	-
153	<i>Rostraria pumila</i> (Desf.) Tzvelev.	-	+	-	-	-	+	+	-	-	+	-	-	-	+	+	-
154	<i>Rhazya stricta</i> Decne.	-	+	-	-	-	+	-	+	-	+	-	-	-	+	-	-
155	<i>Rumex dentatus</i> (Meisn.) Rech.f.	-	+	-	-	+	-	+	-	-	+	-	-	+	-	-	-
156	<i>Saccharum bengalense</i> Retz.	-	+	+	-	-	-	-	+	-	-	-	+	+	-	-	-
157	<i>Saccharum officinarum</i> Linn.	-	+	-	+	-	-	-	+	-	+	-	+	+	+	+	-
158	<i>Saccharum spontaneum</i> Linn.	-	+	-	-	-	+	+	+	-	-	-	-	+	-	+	-
159	<i>Salsola foetida</i> Del.ex Spreng.	-	+	-	+	-	-	+	-	-	+	-	-	-	+	+	+

160	<i>Setaria pumila</i> (Poir.) Roem.	-	+	-	+	-	-	+	-	-	-	-	+	-	-	+	-
161	<i>Silene vulgaris</i> (Moench) Garcke.	-	+	-	-	+	-	+	-	-	+	-	-	-	+	+	-
162	<i>Sesbenia sesbans</i> (L.)Merrill.	-	+	-	-	+	-	-	+	-	+	-	-	+	+	+	-
163	<i>Sisymbrium irio</i> L	-	+	-	+	-	-	+	-	-	+	-	-	-	+	+	-
164	<i>Sonchus asper</i> (L.) Hill.	-	+	-	-	-	+	+	-	-	+	-	-	-	+	-	+
165	<i>Solanum nigrum</i> L.	-	+	-	+	-	-	+	-	-	-	-	+	+	-	+	-
166	<i>Solanum surattense</i> Burm.f.	-	+	-	+	-	-	+	-	-	-	-	+	-	-	-	+
167	<i>Sorghum halepense</i> (L.) Pers.	-	+	-	+	-	-	+	-	-	+	-	+	+	+	+	-
168	<i>Sorghum bicolor</i> (Linn.)Moench.	-	+	-	-	+	-	+	-	-	+	-	+	+	+	+	-
169	<i>Spergula fallax</i> (Lowe) E.H.L. Krause	-	+	-	-	+	-	-	-	+	-	+	-	-	+	-	-
170	<i>Suaeda fruticosa</i> Forssk.ex J.F. Gmelin.	-	+	-	+	-	-	+	-	-	-	-	+	-	-	-	+
171	<i>Taraxacum officinale</i> F.H. Wiggers	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
172	<i>Tamarix aphylla</i> (L.) Karst	-	+	-	-	-	+	-	+	-	+	-	-	-	+	-	+
173	<i>Tamarix dioica</i> Roxb. Ex Roth.	-	+	-	-	-	+	-	+	-	+	-	-	-	+	-	+
174	<i>Torilis nodosa</i> (L.) Gaertn.	-	+	-	-	+	-	+	-	-	-	-	+	-	+	-	-
175	<i>Tribulus terrestris</i> L.	-	+	+	-	-	-	+	-	-	+	-	-	-	-	+	-
176	<i>Trichosanthes dioica</i> Rxb.	-	+	-	-	+	-	+	-	-	+	-	-	-	+	+	-
177	<i>Trifolium alexandrianum</i> L.	-	+	+	-	-	-	+	-	-	-	-	+	+	-	-	-
178	<i>Trifolium repens</i> L.	-	+	+	-	-	-	+	-	-	-	-	+	+	-	-	-
179	<i>Trigonella crassipes</i> Boiss.	-	+	-	+	-	-	+	-	-	+	-	-	+	+	+	-

180	<i>Triticum aestivum</i> L	-	+	+	-	-	-	+	-	-	+	-	+	+	+	+	-
181	<i>Typha latifolia</i> L.	-	+	-	-	-	+	-	+	-	+	-	-	+	-	-	-
182	<i>Typha minima</i> Frunck ex Hoppe	-	+	-	-	-	+	-	+	-	+	-	-	+	-	-	-
183	<i>Verbena officinalis</i> L.	-	+	-	-	+	-	+	-	-	+	-	-	-	+	-	+
184	<i>Veronica aquatica</i> Bern.	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
185	<i>Vicia hirsuta</i> (L.) S.F. Gray, Nat.	-	+	-	-	+	-	-	+	-	-	+	-	-	+	-	-
186	<i>Vitex negundo</i> L.	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
187	<i>Vitis vinifera</i> Linn.	-	+	-	-	+	-	-	+	-	+	-	-	-	+	-	+
188	<i>Viola stockii</i> Boiss.	-	+	-	-	-	+	-	+	-	-	+	-	-	-	+	-
189	<i>Withania coagulans</i> Dunal.	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	<i>Withania somnifera</i> L.	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
191	<i>Xanthium strumarium</i> L.	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
192	<i>Zea mays</i> L.	-	+	+	-	-	-	+	-	-	-	-	+	+	+	+	+
193	<i>Ziziphus jujuba</i> Mill.	-	+	+	-	-	-	-	+	-	+	-	-	-	+	+	+
	Total	37	156	24	37	59	35	96	57	3	109	16	32	50	92	90	51
	Percentage	19.17 %	80.83 %	12.43 %	19.17 %	30.56 %	18.13 %	61.53 %	37.17 %	1.9 2%	68.98 %	10.1 2%	20.88 %	17.6 6%	32.50 %	31.50 %	18.02 %

Key: Np = Non palatable; P = palatable; H = highly palatable; M = mostly palatable; L = less palatable; R = rarely palatable. W = whole plant; L = leaves; I = inflorescence. F = fresh; D = dry; B = both. C = cow; G = goat; S = sheep and Ca = camel.

4.8 Nutritional values of selected plants species

During the current study 193 plant species were studied in dried areas of district Bannu. Among these, eight (08) plant species were selected for nutritional analysis in Table 49. Most of them belong to Poaceae. These selected plant species occur naturally in the area and used as a food for livestock. This was criteria for the selection of plants for nutritional analysis.

1. ***Aristida adscensionis*** L. is common grass which occur naturally in Bannu and used as food for cattle. This species has moisture contents (5.5%), Ash (10%), Fiber (28%), Fats (8%), Proteins (3.15%), Carbohydrates (45.37%) and Gross energy is 396.50 Kcal/100g (Table 49). The results were compared with the similar studies like Devi and Rehman, (2002) that the substances with well-known nutritional purposes, such as carbohydrate, proteins, vitamins, minerals, amino acids and fatty acids emanate under this category. The most frequently known nutrients are antioxidants, vitamins and vital minerals. The macro and micro elemental status of this plant was total nitrogen (0.50%), phosphorus (0.18 µg/gm), Potassium (6.895%), Calcium (3.892 µg/gm), Mg (1.124 µg/gm), Fe (2.209 µg/gm), Zn (0.434 µg/gm), Pb (0.244 µg/gm), Cr (0.027 µg/gm), Cd (0.010 µg/gm) and Ni (0.026 µg/gm) (Table 49). Similar results were displayed that macro and microelements are essential for growth and development which were present in wild edible fruits and vegetable (Pandey *et al.*, 2011)

2. ***Dichanthium annulatum*** Forssk. belongs to family Poaceae and occurs naturally in this area and used as food for cattle. This species has Moisture contents (6%), Ash (11%), Fiber (34%), Fats (6%), Proteins (4.44%), Carbohydrates (38.56%) and Gross energy is 380.20 Kcal/100g (Table 49). The Phyto-nutrients are ingredients that occur obviously in plants, have been originate to hold specific and powerful disease preventing potentials (Frasher, 2006). The macro and micro elemental status of this plant was total nitrogen (0.71%), phosphorus (0.11 µg/gm), Potassium (6.802 %), Calcium (2.337 µg/gm), Mg (1.183 µg/gm), Fe (2.510 µg/gm), Zn (0.570 µg/gm), Pb (0.281 µg/gm), Cr (0.024 µg/gm), Cd (0.002 µg/gm) and Ni (0.025 µg/gm) (Table 49). Similarly, Tucker (2003) reported that together essential and nonessential nutrients should be measured as bioactive food components centered on the specific

physiological purpose they communicate, including characterization of their metabolic and physiological utilities and related targets, and biomarkers.

3. *Polypogon mospeliensis* (L.) Desf. Belongs to Poaceae which occurs naturally in this area and used as food for cattle's and cows. This species has Moisture contents (5%), Ash (12%), Fiber (4.4%), Fats (8%), Proteins (4.88%), Carbohydrates (65.12%) and Gross energy is 373.94 Kcal/100g (Table 49). Ranfa *et al.*, (2013) carefully analyzed four plant species and showed the presence of all the dietary active principles, although in different meditations. After water, carbohydrates made up the superior part with values that sort from 1.0% in *B. perennis* to 6.0% in *S. minor*; middle values were found in *C. juncea* and *B. erucago*, which limited 2.0% and 3.0%, correspondingly. Protein content extended from 1.4% in *B. perennis* to 3.8g/100g of edible portion in *S. minor*, with *C. juncea* (1.9g/100g) and *B. erucago* (2.2g/100g) in an intermediary position. The total fat contents were very low in all four species, under 1.0%. The macro and micro elemental status in *Polypogon mospeliensis* was total nitrogen (0.78%), phosphorus (0.24 µg/gm), Potassium (6.982 %), Calcium (4.029 µg/gm), Mg (1.338 µg/gm), Fe (10.30 µg/gm), Zn (0.540 µg/gm), Pb (0.206 µg/gm), Cr (0.057 µg/gm), Cd (0.004 µg/gm) and Ni (0.100 µg/gm) (Table 49).

4. *Bromus pectinatus* Thunb. Belongs to Poaceae which occur naturally in this area and used as food for cattle. This species have Moisture contents (5.5%), Ash (10%), Fiber (23.5%), Fats (5%), Proteins (4.18%), Carbohydrates (51.81%) and Gross energy is 387.52 Kcal/100g (Table 49). Similarly, the beneficial effects of the mediterranean diet on human health are well recognized, such as high fiber content, vitamins with an antioxidant function, total polyphenols, vitamins and minerals were reported (Vanzani *et al.*, 2011). *Bromus pectinatus* have the following macro and micro elemental status of this plant was total nitrogen (0.67%), phosphorus (0.23 µg/gm), Potassium (8.896 %), Calcium (3.055 µg/gm), Mg (1.044 µg/gm), Fe (2.585 µg/gm), Zn (0.500 µg/gm), Pb (0.187 µg/gm), Cr (0.027 µg/gm), Cd (0.003 µg/gm) and Ni (0.004 µg/gm) (Table 49). This is why that this study goals at concentrating attention on these species and their significance for human nutrition, as knowledge and rediscovery of formulae in human and animal food could signify an economic potential (Guarrera *et al.*, 2006).

5. ***Rostraria cristata*** Linn. Belongs to Poaceae which occur naturally in this area and used as food for cattle. This species have Moisture contents (4.5%), Ash (16%), Fiber (18.5%), Fats (6%), Proteins (6.25%), Carbohydrates (48.75%) and Gross energy is 356.45 Kcal/100g (Table 49). The macro and micro elemental status of this plant was total nitrogen (1.00%), phosphorus (0.36 µg/gm), Potassium (9.892 %), Calcium (4.900 µg/gm), Mg (1.295 µg/gm), Fe (9.917 µg/gm), Zn (0.825 µg/gm), Pb (0.232 µg/gm), Cr (0.090 µg/gm), Cd (0.005 µg/gm) and Ni (0.080 µg/gm) (Table 49). Similar studied was conducted by Santayana *et al.*, (2007) that wild plants have been object of several studies as many have new and unfamiliar nutritional properties.

6. ***Farsetia jacquemontii*** (Hook. F. & Thoms) Jafri. Belongs to Brassicaceae which occur naturally in this area and used as food for cattle. This species have Moisture contents (6%), Ash (9%), Fiber (22.5%), Fats (9%), Proteins (6.25%), Carbohydrates (47.25%) and Gross energy is 393.65 Kcal/100g (Table 49). The macro and micro elemental status of this plant was total nitrogen (1.00%), phosphorus (0.16 µg/gm), Potassium (7.166 %), Calcium (22.36 µg/gm), Mg (1.204 µg/gm), Fe (3.049 µg/gm), Zn (0.349 µg/gm), Pb (0.331 µg/gm), Cr (0.029 µg/gm), Cd (0.027 µg/gm) and Ni (0.039 µg/gm) (Table 49). Ranfa *et al.*, (2013) found that the quality and quantity of the numerous components of the four-species under inspection could make an brilliant role to balancing and rationalizing diet and stopping metabolic pathologies. This study demonstrates how edible wild plants comprise many of the so-called slight nutrients (because they are originate in small amounts).

7. ***Astragalus scorpiurus*** Bunge belongs to Papilionaceae which occur naturally in this area and used as food for cattle. This species have Moisture contents (7.5%), Ash (12.5%), Fiber (19.5%), Fats (8%), Proteins (8.06%), Carbohydrates (44.43%) and Gross energy is 364.00 Kcal/100g (Table 49). The macro and micro elemental status of this plant was total nitrogen (1.29%), phosphorus (0.20 µg/gm), Potassium (9.078 %), Calcium (9.884 µg/gm), Mg (1.308 µg/gm), Fe (3.132 µg/gm), Zn (0.254 µg/gm), Pb (0.162 µg/gm), Cr (0.014 µg/gm), Cd (0.006 µg/gm) and Ni (0.005 µg/gm) (Table 49). Similarly, Kaur *et al.*, (2015) was studied and identified presence of an extensive range of phytoconstituents present in numerous old-style plants and spices. Certain plants such as *Lagenaria siceraria*, *Trigonella foenum graecum*, *Curcuma longa*, *Vigna mungo* etc. shows brilliant properties in remedial

hypertension, obesity, diabetes and hyper-cholestromia and also show the importance of several nutraceuticals that we eat in our daily diet and their role.

8. *Euphorbia dracunculoides* Lam. Belongs to Euphorbiaceae which occur naturally in this area and used as food for cattle's and cows. This species have Moisture contents (5.5%), Ash (15%), Fiber (14%), Fats (7%), Proteins (6.19%), Carbohydrates (52.31%) and Gross energy is 358.90 Kcal/100g (Table 49). The macro and micro elemental status of this plant was total nitrogen (0.29%), phosphorus (0.18 µg/gm), Potassium (10.26 %), Calcium (9.689 µg/gm), Mg (1.198 µg/gm), Fe (4.456 µg/gm), Zn (0.249 µg/gm), Pb (0.046 µg/gm), Cr (0.026 µg/gm), Cd (0.004 µg/gm) and Ni (0.026 µg/gm) (Table 49). Similar study was conducted by Sagar *et al.*, (2004) that substances with recognized nutritional functions, such as carbohydrate, proteins, vitamins, minerals, amino acids, fatty acids and elemental status emanate under this group. The most frequently known nutrients are antioxidants, vitamins and essential minerals. Antioxidants are ingredients, which check or prevent weakening, damage or annihilation caused by oxidation. Luckily, the body has military of antioxidants for injury limitation.

Table 49. Nutritional values of selected plant species.

S.No	Parameter	<i>Rostraria cristata</i> Linn.	<i>Polypogon mospeliensis</i> (L.) Desf.	<i>Bromus pectinatus</i> Thunb.	<i>Dichanthium annulatum</i> Forssk.	<i>Aristida adscensionis</i> L.	<i>Farsetia jacquemontii</i> (Hook. F. & Thoms) Jafri	<i>Astragalus scorpiurus</i> Bunge	<i>Euphorbia dracunculoides</i> Lam.
1	Moisture %	4.5%	5.0%	5.5%	6.0%	5.5%	6.0%	7.5%	5.5%
2	Ash%	16%	12.5%	10%	11%	10%	9%	12.5%	15%
3	Fiber%	18.5%	4.5%	23.5%	34%	28%	22.5%	19.5%	14%
4	Fats%	6%	8%	5%	6%	8%	9%	8%	7%
5	Protein%	6.25%	4.88%	4.18%	4.44%	3.15%	6.25%	8.06%	6.19%
6	Carbohydrates%	48.75%	65.12%	51.81%	38.56%	45.37%	47.25%	44.43%	52.31%
7	Gross Energy%	356.45 Kcal/100g	373.94 Kcal/100g	387.52 Kcal/100g	380.20 Kcal/100g	396.50 Kcal/100g	393.65 Kcal/100g	364.40 Kcal/100g	358.90 Kcal/100g
8	Total Nitrogen%	1.00%	0.78%	0.67%	0.71%	0.50%	1.00%	1.29%	0.29%
9	Phosphorus	0.36µg/gm	0.24µg/gm	0.23µg/gm	0.11µg/gm	0.18µg/gm	0.16µg/gm	0.20µg/gm	0.18µg/gm
10	K	9.892%	6.982%	8.896%	6.802%	6.895%	7.166%	9.078%	10.26%
11	Ca	4.900µg/gm	4.029µg/gm	3.055µg/gm	2.337µg/gm	3.892µg/gm	22.36µg/gm	9.884µg/gm	9.689µg/gm
12	Mg	1.295µg/gm	1.338µg/gm	1.044µg/gm	1.183µg/gm	1.124µg/gm	1.204µg/gm	1.308µg/gm	1.198µg/gm
13	Fe	9.917µg/gm	10.30µg/gm	2.585µg/gm	2.510µg/gm	2.209µg/gm	3.049µg/gm	3.132µg/gm	4.456µg/gm
14	Zn	0.822µg/gm	0.540µg/gm	0.500µg/gm	0.570µg/gm	0.434µg/gm	0.349µg/gm	0.254µg/gm	0.249µg/gm
15	Pb	0.232µg/gm	0.206µg/gm	0.187µg/gm	0.281µg/gm	0.244µg/gm	0.331µg/gm	0.162µg/gm	0.046µg/gm
16	Cr	0.090µg/gm	0.057µg/gm	0.027µg/gm	0.024µg/gm	0.027µg/gm	0.029µg/gm	0.014µg/gm	0.026µg/gm
17	Cd	0.005µg/gm	0.004µg/gm	0.003µg/gm	0.002µg/gm	0.010µg/gm	0.027µg/gm	0.006µg/gm	0.004µg/gm
18	Ni	0.080µg/gm	0.100µg/gm	0.024µg/gm	0.025µg/gm	0.026µg/gm	0.039µg/gm	0.005µg/gm	0.026µg/gm



Achyranthes aspera L.



Aerva javanica L.



Alhagi maurorum Medic.



Alopecurus nepalensis Trin.Ex Steud.



Anagallis arvensis L.



Amaranthus blitoides S. Watson



Amaranthus viridis L.



Aristida adscensionis L.



Aristida cyanantha Nees ex Steud.



Arnebia hispidissima (Lehm.) A.DC.



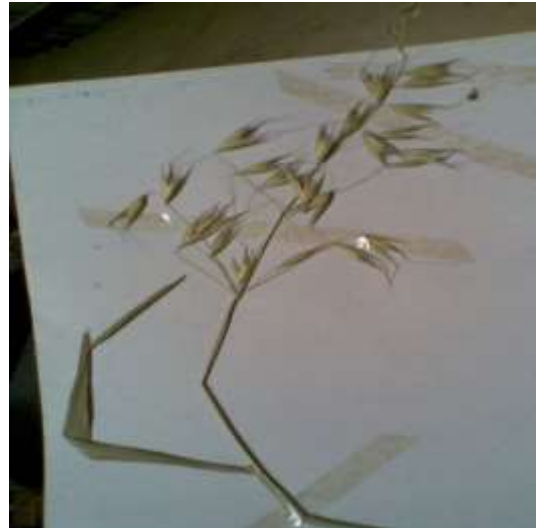
Asphadelus tunifolius Caven.



Astragalus scorpiurus Bunge.



Atriplex stocksii Boiss.



Avena fatua L.



Boerhavia procumbens Banks ex Roxb.



Brassica tournefortii Gouan



Calendula officinalis L.



Calotropis procera (Wild.) R. Br.



Carduus argentatus L.



Carthamus persicus Willd.



Carthamus tinctorius L.



Celosia argentea L.



Cenchrus ciliaris L.



Centaurea iberica Spreng.



Centaurium pulchellum (Sw.) Druce



Chenopodium murale L.



Chrozophora plicata (L.) Raf.



Cirsium arvense (L.) Scop.



Cistanche tubulosa (Schrenk.) Hook.F.



Convolvulus arvensis L.



Convolvulus spicatus L.



Conyza bonariensis (L.) Cronquist



Corchorus depressus L.



Croton bonplandianus Bat.



Cymbopogon distans Schutt.



Cynodon dactylon (L.) Pers



Cyperus rotundus L.



Datura alba Nees.



Dichanthium annulatum Forssk.



Digera muricata (L.) Mart



Dinebra retroflexa (Vahl) Panzer



Echinochloa crus-galli (L.) P. Beauv



Echinops echinatus L.



Eleusine indica (L.) Gaertn.



Eragrostis pilosa (L.) P. Beauv.



Eruca sativa Mill.



Euphorbia dracunculoides Lam.



Euphorbia helioscopia L.



Euphorbia prostrata Ait.



Fagonia indica L.



Farsetia jacquemontii (Hook. F & thoms.) Jafri



Filago pyramidata L.



Fumaria indica Hausskn.



Galium tricornis Stokes



Heliotropium crispum Wild



Heliotropium europaeum (F. & M.) Kazmi



Heliotropium strigosum Wild



Hypecoum pendulum L.



Hyoscyamus niger L.



Ifloga spicata Forssk.



Melilotus indica (L.) All.



Lactuca serriola L.



Lathyrus aphaca L.



Launaea angustifolia (Desf.) Kuntze



Launaea procumbens Pravin Kawale



Leptochloa panicea Retz.



Linum corymbulosum Reichenb.



Malcolmia africana (L.) R. Br.



Malva neglecta Wallr



Malvastrum coromendelianum (L.) Gracke



Neslia apiculata Fisch.



Nicotiana plumbaginifolia Viv.



Nonea philistaea Boiss



Nonea pulla (L.) DC.



Oligomeris linifolia (Vahl.) Macbride



Bromus pectinatus Thunb.



Oxyria digyna (L.) Hill.



Parthenium hysterophorus L.



Pegnum harmala L.



Phalaris minor Retz.



Plantago lanceolate L.



Plantago ovate Frossk.



Poa botryoides (Trin.ex Griseb.) Kom.



Poa bulbosa L.



Polygonum biaristatum Aitch. & Hemsl.



Polygonum plebejum R. Br.



Psammogeton biternatum Edgew.



Ranunculus muricatus L.



Rumex dentatus (Meisn.) Rech.f.



Saccharum arundinaceum Linn.



Setaria pumila (Poir.) Roem.



Silene vulgaris (Moench) Garcke.



Sisymbrium irio L.



Sonchus asper (L.) Hill.



Solanum surattense Burm. F.



Sorghum halepense (L.) Pers



Spergula fallax (Lowe) E.H.L. Krause



Taraxacum officinale F.H. Wiggers



Torilis nodosa (L.) Gaertn.



Tribulus terrestris L.



Trichosanthes dioica Rxb.



Trigonella crassipes Boiss



Verbena officinalis L.



Vicia hirsute (L.) S.F. Gray, Nat.



Withania somnifera L.



Withania coagulans Dunal



Xanthium strumarium L.



Rostraria cristata (Linn.) Tzvelev

Conclusions

- This study was conducted during 2013-2015 to explore the ethno floristic study, vegetation structure and nutraceutical aspect of selected plant species of district Bannu.
- During this study, a total 193 plants species of 153 genera that belonged to 54 families were reported from the area.
- Poaceae was dominant family with 37 species.
- Dry habitat condition was dominant (45.07%) over the rest of habitat condition.
- Spring season plants were dominant (41.37%) over other seasons.
- It is evident from biological spectrum that therophytes plants were dominant in the area.
- The plant bearing nanophyllous leaves were dominant over the other types.
- Simple leaves were dominant with 76.16%.
- 58 plant species were used for medicinal purposes.
- On the basis of soil variables and their micro and macro elements the area was divided into three sites. At each sites, the soil was analyzed for micro and macro elements.
- At site I, 60 plant species of 29 families and six-plant communities were established.
- At site I, Shannon diversity index (3.814) and Species Richness (54) were noted.
- At site II, 65 plant species of 26 families and six-plant communities were established.
- At site II, Shannon diversity index (3.742) and Species Richness (51) were noted.
- At site III, 85 plant species of 28 families and six-plant communities were established.
- At site III, Shannon diversity index (4.082) and Species Richness (72) were noted.
- Correlation of different soil variables with total values of Density, frequency, cover and IV in 3-sites of study area was examined.
- Correlation of different soil variables with herbs density, frequency, cover and IV in four seasons of study area was also examined.

- In this area, the palatable species were 80.83% while non-palatable were 19.17%.
- Nutritional values of eight selected plants of the area show that the maximum amount of protein contents in *Astragalus scorpiurus* were 8.06% while minimum amount in *Aristida adscensionis* (3.15%). Similarly, the higher gross energy in *Aristida adscensionis* was 396.50Kcal/100g while lowest in *Rostraria cristata* (356.45Kcal/100g).

Recommendations and Suggestions

- It has been concluded from these research that large numbers of area are barren and dry due to water short fall.
- Afforestation and proper water management system is needed to these areas in future.
- Control deforestation of the area from IDPs of North Waziristan agency.
- Control over grazing to protect the soil from erosion.
- Moderate grazing management is beneficial for future basis.
- Seminars should be arranged in this area, to create awareness about the benefits of afforestation and drastic effect of deforestation on the area.
- Palynological studies should be carried of species and genera of the area.
- Micromorphological and anatomical studies such as shape and size of phytolith, rows of bundle sheath cells, stomatal complex, microhairs and macrohairs should be employed.
- Conserve the medicinally important plant species of the area.
- To improve the overall sustainable biological productivity from the area, long term policies are necessary which might contain rehabilitation of degraded habitats by introducing fast growing fodder species, replacement of low yielding livestock with upgraded breeds, rotational and mixing grazing. Such long terms efforts might decrease pressure and permit the flora and fauna to return to its original position.

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QUESRIONARRAIRE

1. Age of the respondent
 - a. 20-40 years
 - b. 41-60 years
 - c. 61-80 years
2. Education level of the respondent.
 - a. Illiterate
 - b. Primary
 - c. Middle
 - d. Matric
3. List of the local name of the ethno botanically important plants.
4. Local uses of the plants.
5. How you will use the plant, especially the recipe for medicinal plant.
6. Which plant is ranked by you as 1st, 2nd and 3rd in the following categories?

1. Fodder

1st 2nd 3rd

2. Food and vegetable

1st 2nd 3rd

3. Fuel

1st 2nd 3rd

4. Furniture and agriculture

1st 2nd 3rd

5. Honey bee

1st 2nd 3rd

6. Medicinal

1st 2nd 3rd

7. Veterinary Medicine

1st 2nd 3rd

Appendix 1. Total values of density, frequency, cover and importance values in three sites.

No. Sites	Total Density	Total Frequency	Total Cover	Total Importance value
Site-I	52.8	2025	102	1801.13
Site-II	63.8	2540	107.6	1784.87
Site-III	86.5	3270	97.49	1798.82

Appendix 2. Phytosociological attributes of plant community at Site I

SNo	Name of plant	Family	Density	R/Density	Frequency	R/Frequency	Cover	R/Cover	Importance value
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During spring, trees

1	<i>Acacia nilotica</i> (L.) Wild.ex Delile	Mimosaceae	0.5	13.16	40	19.51	6.75	23.52	56.19
2	<i>Cappris decidua</i> (Frossk.) Edgew.	Cappridaceae	0.6	15.79	25	12.19	4.2	14.63	42.62
3	<i>Prosopis cineraria</i> L.	Mimosaceae	1.1	28.94	55	26.83	6.25	21.78	77.55
4	<i>Tamarix aphylla</i> (L.) Karst	Tamaricaceae	0.85	22.37	45	21.95	5.2	18.12	62.44
5	<i>Ziziphus jujuba</i> Mill	Rhamnaceae	0.75	19.74	40	19.51	6.3	21.95	61.20

During spring, shrubs

6	<i>Calligonum polygonoides</i> L.	Polygonaceae	1.5	26.79	60	23.08	4.95	37.53	87.4
7	<i>Periploca aphylla</i> Decne.	Asclepiadaceae	0.75	13.39	50	19.23	2.56	19.41	52.03
8	<i>Tamarix dioica</i> Roxb. Ex Roth.	Tamaricaceae	1.1	19.64	35	13.46	1.55	11.75	44.85
9	<i>Rhazya stricta</i> Decne.	Apocynaceae	0.7	12.5	40	15.38	2.15	1.30	44.18
10	<i>Echinops echinatus</i> L.	Asteraceae	0.5	8.92	40	15.38	1.23	9.32	33.63
11	<i>Cistanche tubulosa</i> (Shehenk.)	Orobanchaceae	1.03	18.75	35	13.46	0.75	5.68	37.89

During spring, herbs

12	<i>Arnebia hispidissima</i> (Lehm.) A. DC.	Boraginaceae	1	4.21	35	4.66	1.25	4.25	13.12
13	<i>Astragalus scorpiurus</i> Bunge.	Papilionaceae	1.35	5.68	45	6	1.44	4.90	16.58
14	<i>Boerhavia procumbens</i> Banks ex Roxb	Nyctaginaceae	0.7	2.94	40	5.33	1.75	5.96	14.23
15	<i>Cenchrus ciliaris</i> L.	Poaceae	1.6	6.73	40	5.33	2.25	7.66	19.72
16	<i>Chenopodium album</i> L.	Chenopodiaceae	1.05	4.42	35	4.66	1.85	6.30	15.38
17	<i>Convolvulus arvensis</i> L.	Convolvulaceae	0.8	3.36	35	4.66	1.11	3.780	11.8
18	<i>Cymbopogon distanse</i> Schutt.	Poaceae	2.25	9.47	60	8	4.55	15.49	32.96
19	<i>Cynodon dactylon</i> (L.) Pers.	Poaceae	1.55	6.52	35	4.66	2.15	7.32	18.5
20	<i>Euphobia dracunculoides</i> Lam.	Euphorbiaceae	1.2	5.05	25	3.33	0.88	2.99	11.37
21	<i>Farsetia jacquemontii</i> (Hook. F. & thoms.) Jafri	Brassicaceae	0.65	2.73	25	3.33	0.75	2.55	8.61
22	<i>Heliotropium europaeum</i> (F. & M.) Kazmi	Boraginaceae	0.55	2.31	25	3.33	0.95	3.23	8.87
23	<i>Hypocoum pendulum</i> L.	Papaveraceae	0.8	3.36	30	4	0.56	1.90	9.26
24	<i>Launaea procumbens</i> Pravin Kawale.	Asteraceae	0.95	4	35	4.66	1.16	3.95	12.61
25	<i>Melilotus indica</i> (L.) All.	Papilionaceae	0.9	3.78	30	4	0.56	1.90	9.68
26	<i>Oligomeris linifolia</i> (Vahl.)	Resedaceae	0.5	2.10	20	2.66	0.45	1.53	6.29

	Macbride								
27	<i>Plantago lanceolata</i> L.	Plantaginaceae	0.95	4	30	4	0.35	1.19	9.19
28	<i>Plantago ovata</i> Frossk.	Plantaginaceae	0.7	2.94	25	3.33	0.55	1.87	7.98
29	<i>Psammogeton biternatum</i> Edgew.	Apiaceae	0.9	3.78	25	3.33	0.65	2.21	9.32
30	<i>Rostraria cristata</i> Linn.	Poaceae	1.65	6.94	45	6	0.35	1.19	14.13
31	<i>Rumex dentatus</i> (Meisn.) Rech.f.	Polygonaceae	0.7	2.94	20	2.66	1.25	4.25	9.85
32	<i>Silene vulgaris</i> (Moench) Garcke.	Caryophyllaceae	0.85	3.57	35	4.66	1.25	4.25	12.48
33	<i>Sisymbrium irio</i> L	Brassicaceae	1	4.21	20	2.66	1.55	5.27	12.14
34	<i>Trigonella crassipes</i> Boiss.	Papilionaceae	1.15	4.84	35	4.66	1.75	5.96	15.46

During summer, herbs

35	<i>Alhagi maurorum</i> Medic.	Papilionaceae	0.65	5.88	45	10.84	1.15	8.21	24.94
36	<i>Amaranthus viridis</i> L.	Amaranthaceae	0.9	8.14	35	8.43	0.75	5.35	21.92
37	<i>Aristida cynantha</i> L.	Poaceae	0.95	8.59	40	9.63	1.45	10.35	28.57
38	<i>Carthamus persicus</i> Willd.	Asteraceae	0.85	7.69	30	7.22	0.75	5.35	20.26
39	<i>Chrozophora plicata</i> (Vahl) A. Juss. Ex Spreng	Euphorbiaceae	0.75	6.78	25	6.02	0.8	5.71	18.51
40	<i>Citrullus colocynthis</i> (L.) Shred.	Cucurbitaceae	0.5	4.52	25	6.02	0.99	7.07	17.61
41	<i>Cynodon dactylon</i> (L.) Pers.	Poaceae	1.4	12.66	30	7.22	1.85	13.21	35.09
42	<i>Cyperus rotundus</i> L.	Cyperaceae	0.75	6.78	25	6.02	0.85	6.07	18.87
43	<i>Eragrostis pilosa</i> (L.)P. Beauv.	Poaceae	1.05	9.50	30	7.22	1.4	10	26.72
44	<i>Eragrostis minor</i> Host.	Poaceae	0.85	7.69	30	7.22	0.85	6.07	20.98

45	<i>Euphorbia prostrata</i> Ait.	Euphorbiaceae	0.6	5.42	25	6.02	0.95	6.78	18.22
46	<i>Fagonia indica</i> L.	Zygophyllaceae	0.75	6.78	30	7.22	1.11	7.92	21.92
47	<i>Plantago ovata</i> Frossk.	Plantaginaceae	0.55	4.97	25	6.02	0.45	3.21	14.2
48	<i>Portulaca oleraceae</i> Linn.	Aizoaceae	0.5	4.52	20	4.81	0.65	4.64	13.97

During autumn, herbs

49	<i>Cenchrus bifolrus</i> Roxb.	Poaceae	0.75	22.05	25	21.73	1.2	29.62	73.4
50	<i>Chenopodium murale</i> L.	Chenopodiaceae	0.9	26.47	30	26.08	1.35	33.33	85.88
51	<i>Cynodon dactylon</i> (L.) Pers.	Poaceae	1.05	30.88	35	30.43	0.95	23.45	84.77
52	<i>Cyperus rotundus</i> L.	Cyperaceae	0.7	20.58	25	21.73	0.55	13.58	55.90

During winter, herbs

53	<i>Asphadelus tunifolius</i> Caven.	Asphodelaceae	1.05	20.19	40	14.28	1.2	9.44	43.91
54	<i>Aristida adscensionis</i> L.	Poaceae	0.8	20.19	25	8.92	1.35	9.05	38.16
55	<i>Chenopodium album</i> L.	Chenopodiaceae	1.05	15.38	25	8.92	1.15	10.62	34.94
56	<i>Cynodon dactylon</i> (L.) Pers.	Poaceae	0.55	7.28	20	14.28	1.1	29.52	51.49
57	<i>Cyperus rotundus</i> L.	Cyperaceae	0.6	10.57	30	7.14	0.65	8.66	26.37
58	<i>Dichanthium annulatum</i> Frossk	Poaceae	0.45	5.76	70	10.71	0.65	22.44	38.91
59	<i>Launaea angustifolia</i> (Desf.) Kuntze	Asteraceae	0.4	11.53	40	10.71	3.75	5.11	27.35
60	<i>Malva neglecta</i> Wallr.	Malvaceae	0.3	8.65	30	25	2.85	5.11	38.76

Appendix 3. Phytosociological attributes of plant community at Site II

S.No	Name of plants	Family	Density	R/Density	Frequency	R/Frequency	Cover	R/Cover	Importance value
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During spring, trees

1	<i>Acacia modesta</i> Wall.	Mimosaceae	0.7	10.68	45	14.28	4.25	12.89	37.87
2	<i>Acacia nilotica</i> (L.) Wild.ex Delile	Mimosaceae	0.55	8.39	50	15.87	5.75	17.45	41.72
3	<i>Phoenix dactylifera</i> L.	Araceae	1.25	19.08	60	19.04	4.75	14.41	52.55
4	<i>Prosopis cineraria</i> L.	Mimosaceae	1.35	20.61	60	19.05	5.8	17.60	57.26
5	<i>Tamarix aphylla</i> (L.) Karst	Tamaricaceae	2	30.53	55	17.46	6.25	18.97	66.96
6	<i>Ziziphus jujube</i> Mill.	Rhamnaceae	0.7	10.68	45	14.28	6.15	68.66	43.64

During spring, shrubs

7	<i>Aerva javanica</i> (Burm. F.) Juss.	Amaranthaceae	0.95	11.18	55	16.67	0.65	4.21	32.05
8	<i>Calotropis procera</i> (Willd.) R. Br.	Asclepiadaceae	0.65	7.65	40	12.12	1.85	11.97	31.74
9	<i>Cistanche tubulosa</i> (Shehenk.)	Orobanchaceae	1.15	13.53	30	9.09	0.95	6.15	28.77
10	<i>Prosopis juliflora</i> Swartz.	Mimosaceae	1.45	17.05	60	18.18	5.25	33.98	69.22
11	<i>Rhazya stricta</i> Decne.	Apocynaceae	0.85	10	35	10.60	2.2	14.24	34.84
12	<i>Tamarix dioica</i> Roxb. Ex Roth.	Tamaricaceae	2	23.53	35	10.60	1.65	10.68	44.81
13	<i>Vitex negundo</i> L.	Verbenaceae	0.6	7.06	30	9.09	1.25	8.09	24.24
14	<i>Withania coagulans</i> Dunal.	Solanaceae	0.85	10	45	13.63	1.65	10.67	34.31

During spring, herbs

15	<i>Anagallis arvensis</i> L.	Primulaceae	1.25	5.34	50	6.09	0.75	2.65	14.08
16	<i>Avena fatua</i> L.	Poaceae	0.6	2.56	50	6.09	0.45	1.59	10.24
17	<i>Calendula officinalis</i> L.	Asteraceae	0.65	2.77	40	4.87	0.85	3.00	10.64
18	<i>Carthamus persicus</i> Willd.	Asteraceae	1	4.27	30	3.65	1.15	4.06	11.98
19	<i>Cenchrus ciliaris</i> L.	Poaceae	2.25	9.61	40	4.87	1.75	6.18	20.66
20	<i>Chenopodium album</i> L.	Chenopodiaceae	1.15	4.91	45	5.48	2.15	7.59	17.98
21	<i>Convolvulus arvensis</i> L.	Convolvulaceae	0.75	3.20	30	3.65	0.95	3.35	10.22
22	<i>Cymbopogon distanse</i> Schutt.	Poaceae	1.3	5.55	65	7.92	5.15	18.19	31.66
23	<i>Cynodon dactylon</i> (L.) Pers.	Poaceae	1.85	7.90	60	7.31	2.65	9.36	24.57
24	<i>Datura alba</i> Nees.	Solanaceae	0.95	4.059	40	4.87	1.25	4.41	13.33
25	<i>Euphorbia helioscopia</i> L.	Euphorbiaceae	0.55	2.35	30	3.65	0.95	3.35	9.35
26	<i>Heliotropium europaeum</i> (F. & M.) Kazmi	Boraginaceae	0.65	2.77	30	3.65	1.25	4.41	10.83
27	<i>Malcolmia Africana</i> (L.) R.Br.	Malvaceae	2.25	9.61	55	6.70	1.15	4.06	20.37
28	<i>Oligomeris linifolia</i> (vahl) Macbride	Resedaceae	0.6	2.56	35	4.26	0.65	2.29	9.12
29	<i>Pegnum harmala</i> L.	Zygophyllaceae	1	4.27	45	5.48	1.85	6.53	16.26
30	<i>Polygonum plebejum</i> R.Br	Polygonaceae	0.75	3.20	25	3.04	0.65	2.29	8.83
31	<i>Rumex dentatus</i> (Meisn.) Rech.f.	Polygonaceae	1.05	4.48	35	4.26	1.25	4.41	13.15
32	<i>Sisymbrium irio</i> L	Brassicaceae	1.45	6.19	30	3.65	1.3	4.59	14.43
33	<i>Sonchus asper</i> (L.) Hill.	Asteraceae	1.45	6.19	35	4.26	0.65	2.29	12.74

34	<i>Spergula fallax</i> (Lowe) E.H.L. Krause	Caryophyllaceae	0.35	1.49	20	2.43	0.35	1.23	5.15
35	<i>Taraxacum officinale</i> F.H. Wiggers	Asteraceae	1.55	6.62	30	3.65	1.15	4.06	14.33

During summer, herbs

36	<i>Alhagi maurorum</i> Medic.	Papilionaceae	0.95	7.6	50	9.90	1.45	7.83	25.33
37	<i>Avena fatua</i> L.	Poaceae	0.6	4.8	35	6.93	0.45	2.43	14.16
38	<i>Bromus pectinatus</i> Thunb.	Poaceae	0.95	9.6	30	10.89	0.95	8.91	29.4
39	<i>Carthamus persicus</i> Willd.	Asteraceae	1.15	7.6	40	5.94	1.15	5.13	18.67
40	<i>Cenchrus biflorus</i> Roxb.	Poaceae	1.55	9.2	45	7.92	1.25	6.21	23.33
41	<i>Cynodon dactylon</i> (L.) Pers.	Poaceae	0.55	12.4	25	8.91	0.65	6.75	28.06
42	<i>Cyperus rotundus</i> L.	Cyperaceae	1.2	4.4	55	4.95	1.65	3.51	12.86
43	<i>Eleusine indica</i> (L.) Gaertn.	Poaceae	0.6	4.4	20	9.90	0.55	17.02	31.32
44	<i>Fagonia cretica</i> L.	Zygophyllaceae	0.95	4.8	45	3.96	1.65	2.97	11.73
45	<i>Pegnum harmala</i> L.	Zygophyllaceae	1.45	7.6	45	8.91	0.55	8.91	25.42
46	<i>Poa annua</i> L.	Poaceae	0.95	11.6	35	8.91	1.2	2.97	23.48
47	<i>Rumex dentatus</i> (Meisn.) Rech.f.	Polygonaceae	0.55	7.6	50	6.93	3.15	6.48	21.01
48	<i>Taraxacum officinale</i> F.H. Wiggers	Asteraceae	1.05	8.4	30	5.94	1.15	6.21	20.55

During autumn, herbs

49	<i>Achyranthes aspera</i> L.	Amaranthaceae	0.85	12.68	45	14.51	0.75	7.28	34.47
50	<i>Amaranthus viridis</i> L.	Amaranthaceae	0.7	10.44	35	11.29	0.65	6.31	28.04
51	<i>Boerhavia procumbens</i> Banks ex Roxb	Nyctaginaceae	0.75	11.19	25	8.06	0.95	9.22	28.47
52	<i>Bromus pectinatus</i> thumb.	Poaceae	0.85	5.22	30	9.67	0.75	25.72	40.61
53	<i>Chenopodium murale</i> L.	Chenopodiaceae	0.55	12.68	35	9.67	1.55	7.28	29.63
54	<i>Citrullus colocynthis</i> (L.) Shred.	Cucurbitaceae	1.25	8.20	50	11.29	1.2	15.04	34.53
55	<i>Cynodon dactylon</i> (L.) Pers.	Poaceae	0.85	18.65	35	16.12	0.65	11.65	46.42
56	<i>Cyperus rotundus</i> L.	Cyperaceae	0.35	12.68	30	11.29	2.65	6.31	30.28
57	<i>Solanum surattense</i> Burm.f.	Solanaceae	0.55	8.20	25	8.06	1.15	11.16	27.42

During winter, herbs

58	<i>Aristida adscensionis</i> L.	Poaceae	0.55	8.94	35	13.46	0.55	11.45	33.85
59	<i>Chenopodium album</i> L.	Chenopodiaceae	0.75	12.19	40	15.38	1.15	23.95	51.52
60	<i>Convolvulus arvensis</i> L.	Convolvulaceae	0.55	8.94	25	9.61	0.75	15.62	34.17
61	<i>Cynodon dactylon</i> (L.) Pers.	Poaceae	0.95	15.44	40	15.38	0.55	11.45	42.27
62	<i>Dichanthium annulatum</i> Forssk.	Poaceae	0.65	10.56	30	11.53	0.5	10.41	32.5
63	<i>Poa annua</i> L.	Poaceae	1.05	17.07	35	13.46	0.45	9.375	39.8
64	<i>Polygonum plebejum</i> R.Br	Polygonaceae	0.6	9.75	20	7.69	0.4	8.33	25.77
65	<i>Sonchus asper</i> (L.) Hill.	Asteraceae	1.05	17.07	35	13.46	0.45	9.37	39.9

Appendix 4. Phytosociological attributes of plant community at Site III

S.No	Name of Plants	Family	Density	R/Density	Frequency	R/Frequency	Cover	R/Cover	Importance value
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During spring, trees

1	<i>Acacia modesta</i> Wall.	Mimosaceae	0.85	20.98	55	22	4.25	18.44	61.42
2	<i>Acacia nilotica</i> (L.) Wild.ex Delile	Mimosaceae	1.05	25.92	60	24	6.15	26.68	76.60
3	<i>Tamarix aphylla</i> (L.) Karst	Tamariaceae	1.4	34.57	65	26	4.75	20.60	81.17
4	<i>Ziziphus jujuba</i> Mill.	Rhamnaceae	0.5	12.34	45	18	5.75	24.94	55.29
5	<i>Prosopis cineraria</i> L.	Mimosaceae	0.25	6.17	25	10	2.15	9.33	25.50

During spring, shrubs

6	<i>Aerva javanica</i> (Burm. F.) Juss.	Amaranthaceae	1.2	21.24	60	21.05	1.15	8.84	51.14
7	<i>Calotropis procera</i> (willd.) R. Br.	Capparidaceae	0.75	13.27	55	19.29	2	15.38	47.96
8	<i>Prosopis juliflora</i> Swartz.	Mimosaceae	1.75	30.97	70	26.56	6.25	48.08	103.61
9	<i>Rhazya stricta</i> Decne.	Apocynaceae	0.8	14.16	40	14.03	1.75	13.46	41.65
10	<i>Withania coagulans</i> Dunal.	Solanaceae	1.15	20.35	60	21.05	1.85	14.23	55.65

During spring, herbs

11	<i>Alopecurus nepalensis</i> Trin.Ex Steud.	Poaceae	1.05	2.10	30	1.84	0.55	1.51	5.45
12	<i>Anagallis arvensis</i> L.	Primulaceae	1.5	3.00	60	3.69	0.85	2.34	9.03
13	<i>Atriplex stocksii</i> Boiss	Chenopodiaceae	0.85	1.70	40	2.46	0.85	2.34	6.5
14	<i>Calendula officinalis</i> L.	Asteraceae	1.45	2.90	60	3.69	1.25	3.45	10.04
15	<i>Carduus argentatus</i> L.	Asteraceae	0.75	1.50	30	1.84	0.75	2.07	5.41

16	<i>Cirsium arvense</i> (L.) Scop.	Asteraceae	1.15	2.30	40	2.46	0.65	1.79	6.55
17	<i>Convolvulus arvensis</i> L.	Convolvulaceae	1.75	3.51	50	3.07	1.15	3.17	9.75
18	<i>Conyza bonariensis</i> (L.) Cronquist	Asteraceae	0.95	1.90	30	1.84	0.55	1.51	5.25
19	<i>Cymbopogon distanse</i> Schutt.	Poaceae	0.65	1.30	45	2.76	1.45	4.00	8.06
20	<i>Cynodon dactylon</i> (L.) Pers.	Poaceae	2.25	4.51	65	4	3.15	8.70	17.21
21	<i>Datura alba</i> Nees.	Solanaceae	1.05	2.10	30	1.84	0.75	2.07	6.01
22	<i>Dinebra retroflexa</i> (Vahl) Panzer.	Poaceae	0.45	0.90	30	1.84	0.25	0.69	3.43
23	<i>Echinochloa crus-galli</i> (L.) P. Beauv.	Poaceae	0.7	1.40	35	2.15	0.3	0.82	4.37
24	<i>Euphorbia helioscopia</i> L.	Euphorbiaceae	2.8	5.61	60	3.69	2.15	5.94	15.24
25	<i>Euphorbia prostrata</i> Ait.	Euphorbiaceae	1.55	3.10	30	1.84	1.14	3.15	8.09
26	<i>Fagonia indica</i> L.	Zygophyllaceae	1.35	2.70	35	2.15	1.15	3.17	8.02
27	<i>Filago pyramidata</i> L.	Asteraceae	0.45	0.90	25	1.53	0.35	0.96	3.39
28	<i>Fumeria indica</i> Hausskn.	Fumariaceae	1.45	2.90	40	2.46	1.35	3.73	9.09
29	<i>Heliotropium crispum</i> Desf.	Boraginaceae	0.65	1.30	30	1.84	0.25	0.69	3.83
30	<i>Lactuca serriola</i> L.	Asteraceae	0.95	1.90	35	2.15	0.45	1.24	5.29
31	<i>Lathyrus aphaca</i> L.	Papilionaceae	0.7	1.40	25	1.53	0.2	0.55	3.89
32	<i>Launaea procumbens</i> Pravin Kawale	Asteraceae	0.55	1.10	25	1.53	0.35	0.96	3.18
33	<i>Leptochloa panacea</i> Retz	Poaceae	0.85	1.70	35	2.15	0.2	0.55	4.4
34	<i>Malva neglecta</i> Wallr.	Malvaceae	0.75	1.50	25	1.53	0.3	0.82	3.85
35	<i>Medicago polymorpha</i> L.	Papilionaceae	1.2	2.40	40	2.46	0.75	2.07	6.93
36	<i>Melilotus alba</i> Desr.	Papilionaceae	0.65	1.30	25	1.53	0.25	0.69	3.52

37	<i>Melilotus indica</i> (L.) All.	Papilionaceae	1.15	2.30	35	2.15	0.35	0.96	5.41
38	<i>Neslia apiculata</i> Fisch.	Brassicaceae	0.55	1.10	20	1.23	0.4	1.10	3.43
39	<i>Nicotiana plumbaginifolia</i> Viv.	Solanaceae	0.75	1.50	25	1.53	0.35	0.96	4.01
40	<i>Oxalis corniculata</i> L.	Oxalidaceae	1.15	2.30	30	1.84	0.2	0.55	4.69
41	<i>Phalaris minor</i> Retz.	Poaceae	0.9	1.80	30	1.84	0.35	0.96	4.6
42	<i>Plantago lanceolata</i> L.	Plantaginaceae	1.5	3.00	45	2.76	0.55	1.51	7.27
43	<i>Poa annua</i> L.	Poaceae	2.35	4.71	60	3.69	1.65	4.55	12.95
44	<i>Poa botryoides</i> (Trin. Ex Griseb.) Kom.	Poaceae	1.05	2.10	30	1.84	0.45	1.24	5.18
45	<i>Polygonum plebejum</i> R.Br	Polygonaceae	0.55	1.10	25	1.53	0.75	2.07	4.7
46	<i>Ranunculus sceleratus</i> L.	Ranunculaceae	0.65	1.30	25	1.53	0.35	0.96	3.79
47	<i>Rumex dentatus</i> (Meisn.) Rech.f.	Polygonaceae	0.55	1.10	20	1.23	0.65	1.79	4.12
48	<i>Polypogon monspeliensis</i> (L.) Desf.	Poaceae	0.5	1.00	40	2.46	2.15	5.94	9.4
49	<i>Sisymbrium irio</i> L	Brassicaceae	1.55	3.10	35	2.15	1.15	3.17	8.42
50	<i>Sonchus asper</i> (L.) Hill.	Asteraceae	1.45	2.90	50	3.07	0.7	1.93	7.9
51	<i>Solanum nigrum</i> L.	Solanaceae	0.5	1.00	30	1.84	0.35	0.96	3.8
52	<i>Taraxacum officinale</i> F.H. Wiggers	Asteraceae	1.75	3.51	35	2.15	1.2	3.31	8.97
53	<i>Torilis nodosa</i> (L.) Gaertn.	Apiaceae	1.15	2.30	25	1.53	0.75	2.07	5.9
54	<i>Trigonella crassipes</i> Boiss.	Papilionaceae	1.55	3.10	35	2.15	0.75	2.07	7.32
55	<i>Verbena officinalis</i> L.	Verbenaceae	0.85	1.70	30	1.84	0.55	1.51	5.05
56	<i>Xanthium strumarium</i> L.	Asteraceae	0.95	1.90	25	1.53	1.15	3.17	6.6

During summer, herbs

57	<i>Alhagi maurorum</i> Medic.	Papilionaceae	1.35	17.1	55	15.94	1.75	19.02	52.15
58	<i>Aristida cyanantha</i> Nees ex Steud.	Poaceae	0.55	7.00	30	8.69	0.65	7.06	22.75
59	<i>Cenchrus ciliaris</i> L.	Poaceae	0.85	10.82	45	13.04	0.55	5.97	29.83
60	<i>Conyza bonariensis</i> (L.) Cronquist	Asteraceae	0.75	9.55	35	10.14	0.6	6.52	26.21
61	<i>Cynodon dactylon</i> (L.) Pers.	Poaceae	1.35	17.19	50	14.49	1.75	19.02	50.7
62	<i>Cyperus rotundus</i> L.	Cyperaceae	0.95	12.10	35	10.14	0.75	8.15	30.39
63	<i>Fagonia cretica</i> L.	Zygophyllaceae	0.95	12.10	30	8.69	0.65	7.06	27.85
64	<i>Heliotropium strigosum</i> Wild	Boraginaceae	0.6	7.64	25	7.24	0.35	3.80	18.68
65	<i>Polypogon monspeliensis</i> (L.) Desf.	Poaceae	0.5	6.36	40	11.59	2.15	23.36	41.31

During autumn, herbs

66	<i>Achyranthes aspera</i> L.	Amaranthaceae	1.15	13.60	50	12.65	1.1	11.82	38.07
67	<i>Amaranthus viridis</i> L.	Amaranthaceae	1.2	14.20	50	12.65	1.15	12.36	39.21
68	<i>Boerhavia procumbens</i> Banks ex Roxb	Nyctaginaceae	0.65	7.69	30	7.59	0.55	5.91	21.19
69	<i>Chenopodium murale</i> L.	Chenopodiaceae	1.25	14.79	55	13.92	1.35	14.51	43.22
70	<i>Corchorus depressus</i> (L.)	Tiliaceae	0.5	5.91	25	6.32	0.45	4.83	17.06
71	<i>Cynodon dactylon</i> (L.) Pers.	Poaceae	1.05	12.42	45	11.39	1.3	13.97	37.78
72	<i>Cyperus rotundus</i> L.	Cyperaceae	0.8	9.46	35	8.86	0.45	4.83	23.15
73	<i>Polypogon monspeliensis</i> (L.)	Poaceae	0.5	5.91	40	10.12	2.15	23.11	39.14

	Desf.								
74	<i>Solanum surattense</i> Burm.f.	Solanaceae	0.7	8.28	30	7.59	0.45	4.83	20.7
75	<i>Tribulus terrestris</i> L.	Zygophyllaceae	0.65	7.69	35	8.86	0.35	3.76	20.31

During winter, herbs

76	<i>Avena fatua</i> L.	Poaceae	0.85	7.98	40	10.81	0.35	5.18	23.97
77	<i>Convolvulus arvensis</i> L.	Convolvulaceae	1.25	11.73	35	9.45	0.55	8.14	29.32
78	<i>Cynodon dactylon</i> (L.) Pers.	Poaceae	1.25	11.73	45	12.16	1.45	21.48	45.37
79	<i>Dichanthium annulatum</i> Forssk.	Poaceae	1.05	9.85	40	10.81	1.25	18.51	39.17
80	<i>Euphorbia helioscopia</i> L.	Euphorbiaceae	1.75	16.43	60	16.21	1.35	20	52.64
81	<i>Leptochloa panacea</i> Retz	Poaceae	0.85	7.98	35	9.45	0.2	2.96	20.39
82	<i>Melilotus alba</i> Desr.	Papilionaceae	0.65	6.10	25	6.75	0.25	3.70	16.55
83	<i>Melilotus indica</i> (L.) All.	Papilionaceae	1.15	10.79	35	9.45	0.35	5.18	25.42
84	<i>Poa botryoides</i> (Trin. Ex Griseb.) Kom.	Poaceae	1.05	9.85	30	8.10	0.45	6.66	24.61
85	<i>Setaria pumila</i> (Poir.) Roem.	Poaceae	0.8	7.51	25	6.75	0.55	8.14	22.4