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Ethnobotanical Survey of the Flora of Tehsil Balakot, District Mansehra, Khyber Pakhtunkhwa, Pakistan

Muhammad Irfan[1, 2], Nabeela[1], Imran Khan[1], Mohammad Kamil[1], Saif Ullah[1], Siraj Khan[1], Muzammil Shah[3], Ashfaq Ali[4], Saif Ur Rehman[4], Rashid Khan[4], Danish Ali[5], Rukhsana Kausar[6], Gul Jan[1] & Waheed Murad[1]

[1]Department of Botany, Abdulwalikhan University, Mardan, Pakistan
[2]Department of Botany, University of Swabi – Swabi, Pakistan
[3]Department of Biological Sciences, King Abdulaziz University, Jeddah, Saudi Arabia
[4]Department of Botany, Hazara University, Mansehra, Pakistan
[5]Department of Botany, Government Post Graduate College, Mansehra, Pakistan
[6]Department of Environmental Sciences, International Islamic University, Islamabad, Pakistan

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ABSTRACT

The inhabitants of tehsil Balakot, district Mansehra, Khyber Pakhtunkhwa, Pakistan were using eighty eight different taxa belonging to seventy one genera and forty six families. Amongst the part used results showed that mostly whole plant viz. thirty two, leaves of twenty seven, stem of twelve and fruits of nine taxa were used for different purposes. The governing families of the study area were Family Rosaceae consists of thirteen taxa, solanaceae having five taxa, Buxaceae, Verbenaceae, Lamiaceae, Acanthaceae having three taxa each, Papilionaceae, Berberidaceae, Buddlejaceae, Anacardiaceae, Thymelaceae, Sapindaceae, Araliaceae, Guttiferae, Oleaceae, Cupressaceae, Euphorbiaceae, Poaceae, Rhamnaceae, Rutaceae, Caprifoliaceae keeps two taxa and rest of all the families contains one taxa each were recorded in the study area.
KEY WORDS: Ethnobotanical, Medicinal, Balakot, Mansehra, Khyber Pakhtunkhwa, Pakistan

INTRODUCTION

Balakot is located between 34°33′N 73°21′E latitude and 34°33′N 73°21′E longitude near to Kaghan valley located in the Northern part of Pakistan. It is a historical place and famous tourism site of the region and the gateway to Kaghan valley of Khyber Pakhtunkhwa, Pakistan. The famous river of Balakot is Kunhar, originating from Lulusar lake and merge with River Jehlum just outside Muzaffarabad in Azad Kashmir. Balakot has a humid subtropical climate with hot summers and cool winters. Rainfall in Balakot is much higher than in most other parts of Pakistan. The heaviest rainfall occurs in late winter in the months of February and March and in the monsoon season in the months of July and August however all the time there we meet with pleasant rainfall [1]. Tehsil Balakot comprises eleven union councils viz. Garhi Habibullah, Garlat, Ghanool, Hangrai, Kaghan, Kund, Mahandari, Sathbani, Shohal Mazullah and Talhata. Till now there is no documentation of traditional knowledge of their flora. The most common taxa of gymnosperms found there are *Picea smithiana, Cedrus deodara, Taxus baccata, Pinus wallichiana* and *Pinus roxburghii.* While the most common angiosperm taxa are *Fragaria duchesnia, Ranunculus muricatus, Zanthoxylum aramatum* and *Datura alba*. The important wild and cultivated fruits are *Ziziphus nummularia, Ziziphus oxyphylla, Phoenix dactylifera, Viburnum grandiflorum, Rubus ulmifolius, Berberis lyceum* and *Diospyros lotus*. The key crops grown are *Allium cepa, Oryza sativa, Zea mays,* and *Triticum aestivum, Hordeum vulgare, Solanum tuberosum, Brassica campestris, Avena sativa, Lycopersicon esculentum, solanum melongena, cucurbita pepo, Cucumus sativa* and *Pisum sativum.* New plants have been adding to the flora of Pakistan which has great medicinal importance [2]. Residents of the study area are using different kinds of plants hormones for increasing the yield of crops [3], [4], [5].

Ethnobotany deals with the traditional knowledge and relationship that exists between plants, animals and humans. The delivery of the traditional knowledge traced back to China about five thousand years ago. Approximately eighty percent of the total human population still depends upon traditional uses of plants [6]. According to the report of World Health Organization three-fourth of human world population is not able to afford modern medicines. These folks still use traditional plants and poultices of traditional weeds for treatment of different remedies. About 422000 flowering plants have been reported from the world and amongst them 50000 have been used for medicinal

***Corresponding Author:** Muhammad Irfan, Department of Botany, Abdulwalikhan University, Mardan, Pakistan.
Email: Mirfan310@yahoo.com

purposes. About 6000 flowering plant taxa have been documented in Pakistan and so far amongst them there are 600 medicinal plants [7].

MATERIALS AND METHOD

First of all available literature was studied and plants were collected in the respective localities having field notebook, questionnaire, pencil, plant presser, blotting papers, polythene bags, newspapers, knife, towel, gloves, twig cutter and stick. Frequently field visits were carried out during January to December 2017 in different seasons of the year. A questionnaire was used to collect all information regarding plants traditional uses. Each specimen was tagged, pressed, poisoned with mercuric chloride and absolute alcohol then mounted on standard herbarium sheets. All the data viz. scientific name, vernacular name, family, habit, habitat, locality, parts used, medicinal use, folk recipe uses were documented in the field note book and then transferred to herbarium slip which is posted on the right foot corner of herbarium sheet. Plant taxa were identified with the help of available literature viz. flora of Pakistan [8]. Finally the collected plant taxa were deposited in the herbarium of Government Post Graduate College, Mansehra, Khyber Pakhtunkhwa, Pakistan.

RESULTS AND DISCUSSION

A total of three hundred and forty five persons were investigated regarding the distribution on the basis of age and gender of informants. Out of three hundred and forty five informants there we find two hundred males and one hundred forty five females. The consequences open that males were mostly aged informants about the traditional knowledge than young generation in target survey area. In the study area a total of 88 taxa belonging to 71 genera and 46 families [fig.1] were recorded during the first exploration of tehsil Balakot, district Mansehra, Khyber Pakhtunkhwa, Pakistan. The dominant families of the study area were Rosaceae consists of thirteen taxa, solanaceae having five taxa, Buxaceae, Verbenaceae, Lamiaceae, Acanthaceae having three taxa each while family Papilionaceae, Berberidaceae, Buddlejaceae, Anacardiaceae, Thymelaceae, Sapindaceae, Araliaceae, Guttiferae, Oleaceae, Cupressaceae, Euphorbiaceae, Poaceae, Rhamnaceae, Rutaceae, Caprifoliaceae keeps two taxa each while the rest of all families contains one taxa each recorded in the study area. Amongst these plant taxa seventy one taxa were wild while eighteen taxa were cultivated in the study area. Most of the taxa were reported to be quite successful remedies for different disorders viz. diarrhea, Vomiting, stomach problem, diabetes, headache, blood pressure, backache, bronchitis, kidney problems, edema, pulmonary diseases, blood clotting, wounds healing, influenza, jaundice and cancer. These taxa were mostly used by hakims, local wound healers and old women as well. The plant taxa were mostly used as a source of fuel, fodder, vegetable, medicinal and ornamental purposes. The highest percentage of the plants part used were whole plant viz. thirty six percent, leaves were used viz. thirty percent, stem were used viz. thirteen percent, fruits were used viz. ten percent and Roots were used viz. eight percent while remaining parts were used viz. three percent only. The study area was having maximum diversity of wild flora viz. eighty percent and rarely cultivated viz. twenty percent. The taxa wise investigation showed that twenty six taxa were used as a source of fuel, eleven taxa were used as a fodder, eleven taxa were used as an ornamental purpose, eleven taxa were edible fruits, seven taxa were used against jaundice, five taxa were used against Stomach problems, four taxa were used against Fever, three taxa were used against vomiting, three taxa were used for ear and nose pain, three taxa were used against Backache, three taxa were used against Asthama, three taxa were used against Earache, two taxa were used against influenza, two taxa were used against Diarrhea, two taxa were used for cleaning teeth, two taxa were used for the relief of menstrual cycle, two taxa were used for Blood purification, two taxa were used against Arthiritis, two taxa were used against Pulmonary disorders, two taxa were used against Skin infections, two taxa were used for Stick walk by aged peoples, two taxa were used against Headache, one taxa was used as a vegetable, one taxa was used against Dyspepsia, one taxa was used against Diabetes, one taxa was used against Typhoid, one taxa was used for rope making, one taxa having spiritual value, one taxa was used against Constipation, one taxa was used against Piles, one taxa was used against Kidney stones, one taxa was used against ring worm and foot athletes, one taxa was used as an Analgesic, one taxa was used against Bronchitis, one taxa is Attractive for honey making, one taxa was Anticancer, one taxa was used for Healing of wounds, one taxa was used as Antilice, one taxa was used for making baskets, one taxa was used for house fencing.
Our result was in close union with a variety of other researchers who has previously conducted their study in different parts of Pakistan viz from Chapursan valley, Gojal, Gilgit Baltistan, Pakistan [9], from Shawer Valley, District; Swat, Khyber Pakhtunkhwa, Pakistan [10], from Dir valley, Khyber Pakhtunkhwa, Pakistan [11], from Dir Kohistan valley, Khyber Pakhtunkhwa, Pakistan [12], from Kahuta, District Rawalpidni, Punjab, Pakistan [13], from Wari, district Upper Dir, Khyber Pakhtunkhwa, Pakistan [14], from tehsil Kabal, Swat District, Khyber

Pakhtunkhwa, Pakistan [15], from Neelum valley, Azad Jammu & Kashmir, Pakistan [16], from Hazar Nao Forest, Malakand District, Khyber Pakhtunkhwa, Pakistan [17], from Chitral Valley, Khyber Pakhtunkhwa, Pakistan [18], from Samar Bagh Valley, Lower Dir district, Khyber Pakhtunkhwa, Pakistan [19], from district Lower Dir, Khyber Pakhtunkhwa, Pakistan [20], from district Mansehra, Khyber Pukhtunkhwa, Pakistan [21], from southern Himalayan regions of Khyber Pakhtunkhwa, Pakistan [22], from Siran Valley, district Mansehra, Khyber Pakhtunkhwa, Pakistan [23], from Malam Jabba, district Swat, Khyber Pakhtunkhwa, Pakistan [24], from Dir Kohistan valley, district Dir upper, Khyber Pukhtunkhwa, Pakistan [25], from Charkotli Hills, Batkhela District, Malakand, Khyber Pakhtunkhwa, Pakistan [26], from Mastuj, District Chitral, Khyber Pakhtunkhwa, Pakistan [27], from Maidan Valley, Lower Dir District, Khyber Pakhtunkhwa, Pakistan [28], from Dilbori, District Mansehra, Khyber Pakhtunkhwa, Pakistan [29], from Upper Tanawal, District Mansehra, Khyber Pakhtunkhwa, Pakistan [30], from District Tor Ghar, Khyber Pakhtunkhwa, Pakistan [31], from tehsil Laalqilla District Lower Dir, Khyber Pakhtunkhwa, Pakistan [32] and also from Kaghan Valley, district Mansehra, Khyber Pakhtunkhwa, Pakistan [33].

Table 1: Ethnobotanical uses of the plants of tehsil Balakot, district Mansehra, Khyber Pakhtunkhwa, Pakistan

Sr. No.	Botanical name	Local name	Family	Part/s used	Ethnobotanical uses
1	*Andrachne cardifolia* L.	Karukani	Phyllanthaceae	Leaves & stem	Leaves and stem used as a fuel.
2	*Astragalus psilocentros* Fish	Pei botil	Papilionaceae	Leaves	Leaves used as a fodder & fuel. Decoction of leaves used against cough & influenza.
3	*Berberis lyceum* Royle	Sunmbal	Berberidaceae	Whole plant	Extract of young stem & leaves used in Jaundice, diarrhea and Dyspepsia. Bark of root used with water against diabetes, vomiting, wound healing and cancer. Fruits are edible & used for blood purification.
4	*Berberis vulgaris*	Jangalli Sunmbal	Berberidaceae	Whole plant	Fruits are edible. Stems used as a fuel. Root & Bark used in blood clotting.
5	*Buxus wallichiana* Bill	Kutay lal	Buxaceae	Leaves & stem	Extract of leaves used against edema & Stem is used as a fuel.
6	*Buddleja asiatica* Lour	Chiti boti	Buddlejaceae	Leaves & stem	Stem and leaves are used as a fuel & in Blood clotting.
7	*Buddleja Crispa* Bth	Chiita kao	Buddlejaceae	Whole plant	Whole plant is used as a fuel and in making sticks.
8	*Bougainvillea glabra* Choisy	Bengi boti	Nyctaginaceae	Whole plant	Ornamental purpose
9	*Calotropis procera* Ail	Rubber bush	Apocynaceae	Whole plant	Whole plant used against Diarrhea, vomiting and skin problems.
10	*Caesalpinia decapitala* Alston	Jarra	Caesalpinaceae	Stem & leaves	Leaves having ornamental value and stem used as a fuel.
11	*Cotinus coggyria* Scop	Sagrati jhari	Anacardiaceae	Leaves	Leaves used as a fodder and decoction of leaves used in Bronchitis
12	*Carissa opaca* L	Jugnu	Apocynaceae	Stem	Stem used in making furniture
13	*Caryopteris odorata* D. Don	Safedii	Verbenaceae	Whole plant	Whole plant used as a fuel and fodder
14	*Cassia occidentalis* L.	Path jarri	Caesalpiniaceae	Root	Roots used in stomach ulcer
15	*Cotoneaster bacillaris* Wall ex. Lindle	Loon	Rosaceae	Stem	Stem used in making sticks
16	*Cotoneaster microphylla* Wall ex. Lindle	Lani	Rosaceae	Leaves	Blood clotting
17	*Cotoneaster nummularia* Fish	Karwa	Rosaceae	Whole plant	Whole plant used as a fuel
18	*Cycus revoluta*	Sago palm	Cycadaceae	Whole plant	Ornamental value
19	*Cestrum nocturnum* L.	Rat ki Rani	Solanaceae	Whole plant	Pleasant smell used as ornamental
20	*Campsis radicans* (L.) Seem	Cow vine	Bignoniaceae	Leaves	Leaves used in headache and ear pain
21	*Colebrookea oppositifolia* Smith	Balli	Labiatae	Stem	Stem used in asthma
22	*Cotonus coggyria* Scope	Paan	Anacardiaceae	Whole plant	Whole plant used as a fuel and making baskets
23	*Datura alba* MILL	Tatura	Solanaceae	Seeds	Grinded seeds are used in asthma
24	*Duranta erecta*	Zard bootey	Verbenaceae	Whole plant	Ornamental value

25	*Daphne mucronata* Royle	Kutay lal	Thymelaceae	Whole plant	Extract of leaves used to kill lice on animals body hairs
26	*Daphne oleoides* Royle	Kutty lal	Thymelaceae	Whole plant	Whole plant used in Jaundice & rheumatism
27	*Datura strumarium* MILL	Tatura	Solanaceae	Leaves	Leaves are Anthelmenthic
28	*Datura innoxia* MILL	Tatura	Solanaceae	Leaves	Leaves used in blood purification
29	*Debregesia salcifolia* (D. Don) Rendle	Chenjal	Urticaceae	Leaves	Leaves used in jaundice .
30	*Isodon rugosus* (Wall. ex benth) Codd.	Chitt bota	Lamiaceae	Leaves.	Leaves used in Jaundice.
31	*Dodonea viscosa* (L) jacq	Sanatha	Sapindaceae	Leaves	Leaves used in diabetes and whole plant used as a fuel
32	*Eranthemum pulchellum* Andrews	Ude gule	Acanthaceae	Leaves	Skin diseases and healing of wounds
33	*Ficus hederacea* Roxb.	Dumur	Moraceae	Leaves	For blood clotting
34	*Ephedra gerardiana* Wall ex.	Samai boti	Ephedraceae	Roots	Roots used in stomach problem and cough
35	*Hedra helix* K. Koch	Parwara	Araliaceae	Leaves	Leaves used in blood clotting
36	*Foeniculum vulgare* Mill	Sounf	Apiaceae	Seeds	Seed used for jaundice
37	*Hedra neoalensis* K. Koch	Berlli	Araliaceae	Roots	Roots have anticancer potentials
38	*Hypericum oblongifolium* Choisy	Shinoo	Guttiferae	Flowers	Flowers are attractive for honey bees
39	*Grewia tenax* (Forsk) Fiori	Tambar	Tilliaceae	Fruits	Fruits used in stomach ulcer.
40	*Gymnosporea royleana* Wall. ex. Brand	Selti	Celastraceae	Whole plant	Whole plant is used as a fodder and fuel
41	*Indigofera heterantha* Wall. ex Brandis	Kainthi	Papilionaceae	Whole plant	Stem used in making baskets, as a fodder, blood clotting and in jaundice
42	*Isodon rugosus (*Wall. ex Benth} Codd	Chitt bota	Lamiaceae	Leaves	Leaves used in Jaundice and in pulmonary disorders
43	*Justicia adhatoda* Linn.	Baikar	Acanthaceae	Leaves	Decoction of leaves used in bronchitis and cough
44	*Jasminum nudiflorum* Lindl	Safedi	Oleaceae	Whole plant	Having ornamental value
45	*Jasminum humile* L.	Kangarru	Oleaceae	Flowers	Flowers extract used for the removal kidney stone
46	*Juniperus communis* L	Barari	Cupressaceae	Whole plant	Asthama, joints pain and rest of plaant body is used as fuel
47	*Justica adhatoda* L.	Baikar	Acanthaceae	Leaves & roots	Leaves and roots used in diabetes and vomiting
48	*Maytenus royleanus* (Wall ex. Lawson) Cuf	Patakha	Celastraceae	Leaves	Leaves used as a fodder & fuel
49	*Lespedeza hirta* (L.) Hornem.	Budii khantii	Fabaceae	Leaves.	Leaves extract is applied on wounds for blood clotting
50	*Lantana camara* L.	Nagh phool	Verbenaceae	Leaves & stem	Leaves are Analgesic and stem used as a fuel
51	*Mallotus philippensis* (Lam.) Muess	Kambeela	Euphorbiaceae	whole plant	Fruits used in fungal infections & whole plant used as a fuel
52	*Myrsine africana* L.	Gori boti	Myrsinaceae	Roots	Root extract used for the removal of kidney stones
53	*Nerium oleander* L.	Gandeeri	Apocynaceae	whole plant	Flowers used for piles & whole plant used as a fuel
54	*Otostegia limbata (*Benth) Boiss	Koray	Lamiaceae	Whole plant	Whole plant used as a fodder & fuel.
55	*Periploca aphylla* Dcne.	Kutti kid um wali boti	Asclepiadaceae	Whole plant	Whole plant used in stomach problems & fever.
56	*Prinsipia utilis*	Desi sunbal	Rosaceae	Fruits	Fruit used stomach, intestinal and urinary

	Royle				problems.
57	*Reinwardtia trigyra* (Roxb.) Planch	Zard gule bootey	Linaceae	Leaves	Leaves used for blood clotting
58	*Ricinus communis* L.	Kashtrail	Euphorbiacae	Root & Bark	Roots & bark used in Arthritis, swelling & backache.
59	*Rosa indica*	Rata gulab	Rosaceae	Flowers	Flowers extract used in eyes infections.
60	*Rosa alba*	Chitta gulab	Rosaceae	Whole plant	Having ornamental value
61	*Rosa moschata* J. Herm	Gulabi rose	Rosaceae	Whole plant	Having ornamental value
62	*Rosa damascene* Miller.	Gulab	Rosaceae	Flowers	Flowers used in constipation for cattle's
63	*Rubus ellipticus* Smith	Pogana	Rosaceae	Whole plant	Having ornamental value
64	*Rubus fruticosus* Hook	Karwara	Rosaceae	Fruits & leaves	Fruits used for blood purification & leaves for blood clotting.
65	*Rubus niveus* Thanb-non Wall.	Pogana	Rosaceae.	Roots	Roots used in excessive menstrual cycle.
66	*Rubus Ulmifolius* Schoot.	Phalwari	Rosaceae	Leaves & fruits	Leaves used as a fodder and fruits are edible.
67	*Senna tora* L	Ban khenthi	Caesalpianiaceae	Leaves	Leaves decoction used in jaundice
68	*Saccharum spontaneum* L	Jharoo	Poaceae	Whole plant	Whole plant used in making brooms
69	*Spirea japonica*	Speen gule	Rosaceae	Whole plant	Whole plant used as a fuel
70	*Thuja orientalise* L.	Cheelai	Cupressaceae.	Leaves	Leaves used in excessive menstrual cycle.
71	*Segeretia thea* (Osbeck) M.C.Jhonston	Kandula	Rhamnaceae	Leaves	Leaves used as a fodder
72	*Sarcococa saligna* (D. Don) Muell	Neka Sanatha	Buxaceae	Leaves	Leaves used in jaundice.
73	*Skimmia laureola* Dc	Nehra	Rutaceae	Leaves	Leaves used as evils repellent having spiritual value
74	*Saccharum grifthi* L	Jharro	Poaceae	Whole plant	Whole plant used for soil bonding
75	*Typha latifolia*	Sag wali rassi	Typhaceae	Leaves	Leaves used to make ropes and baskets
76	*Vitex negundo* L.	Marvandi	Lamiaceae	Leaves and stem	Leaves used for watering in mouth and stem used as fuel and tooth brush
77	*Vitis vinifera L*	Angoor	Vitaceae	Fruits and stem	Fruits are edible extract from stem used for jaundice
78	*Viburnum cotinifolium* D. Don.	Ghuch	Caprifoliaceae	Leaves & fruits	Leaves used as a Fodder and fruits are edible
79	*Viburnum grandiflorum* D. Don.	Uklun	Caprifoliaceae	Whole plant	Fruits are edible, leaves used as a fodder & rest of the parts are used as a fuel
80	*Segeretia thea* Var	Gutka	Rhamnaceae	Whole plant	Used as fuels leaves for fodder
81	*Woodforbia fruiticosa* (L.) S, Kurz	Thahawa	Lythraceae	Leaves	Leaves are used as a fodder
82	*Phoenix dactylifera* L	Khajor	Arecaceae	Fruits	Fruits are edible having proteins and minerals
83	*Withania somnifera* (L.) Dunal	Patakha	Solanaceae	Fruits	Young fruits extract used one cup with milk in morning in typhoid
84	*Yucca aloifolia* L	Azge Botey	Agvaceae	Whole plant	Having ornamental value
85	*Ziziphus nummularia* Burn. F	Kanda	Rhamnaceae	Whole plant	Leady used spine in nose and ear. Fruits are edible. Stem used as a fuel.
86	*Ziziphus oxyphylla* Edgew	Elani	Rhamnaceae	Fruit leaves & stem	Fruits are edible. Leaves used as a fodder. Stem used as a fuel.
87	*Zanthoxylum aramatum* Dc	Timbar	Rutaceae	Leaves & stem	Leaves used for making chatni and stem used for cleaning teeth
88	*Hypericum perforatum*	Ban chahy	Hypericaceae	Leaves	Decoction of leaves used in influenza

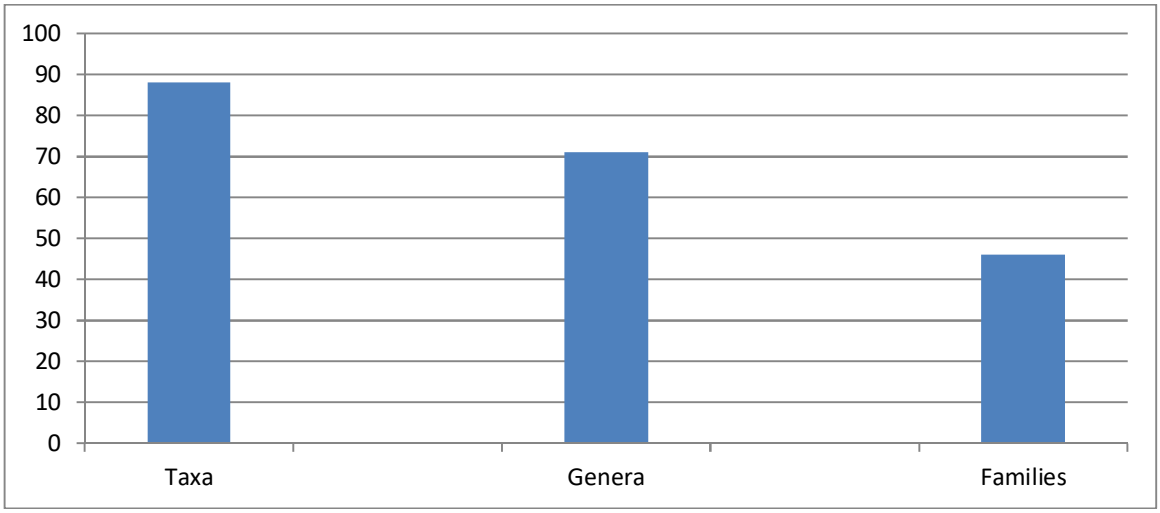

Fig 1: Representation of the number of taxa, genera and families used ethnobotanically in tehsil Balakot, District Mansehra, Khyber Pakhtunkhwa, Pakistan

CONCLUSION

Mostly the plant taxa were collected, cleaned, dried, grinded and then decoction was used twice a day orally against Diarrhea, vomiting, cough, asthma, urinary, intestinal, skin disorders. The consequences of using different plant taxa were different because inhabitants of tehsil Balakot, district Mansehra, Khyber Pakhtunkhwa, Pakistan were mostly unaware about modern facilities and mostly depend upon traditional knowledge and ancestor's instructions because due to the expensive prices of modern medicines and poverty of inhabitants their native home-made remedies and medicines were used commonly.

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We are really thankful to the inhbitants of tehsil Balakot, District Mansehra, Khyber Pakhtunkhwa, Pakistan for sharing their valuable knowledge with us.

Conflict of Interest
The authors declare that there is no conflict of interest amongst them.

Authors' contribution
MI, N, MS & SU conducted the experiment and SR, AA, RA & DA carried out the statistical analysis, IK, GJ, WM designed the experiment and RK & MK structured and wrote the manuscript

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Amelioration of Salt Stress in Cowpea (*Vigna unguiculata* L.) through Potassium Nitrate Application

Humaira Gul*, Mamoona Arif, Husna, Maria Farman, Sadaf Pervez and Sehrish

Department of Botany, Abdul Wali Khan University, Mardan, Khyber Pukhtunkhuwa, Pakistan

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ABSTRACT

Presence of salt in water and soil considered as an important stress factor of environment that severely reduced development of plant and its growth. When plants grow under such stress condition, adequate and appropriate fertilizers and good application methods can minimize such hazardous effects of stress and increased productivity of plants. Keeping such consequences in mind field trial has been taken and pot experiment was designed to examine the potassium nitrate effects (foliar) on the response of cowpea (*Vigna unguiculata* L.) grown under different levels of salts. Three levels of irrigation water salinity (0, 2.5 dS/m and 5 dS/m seasalt irrigation) and three levels of potassium nitrate (0, 250 ppm and 500 ppm) were applied in complete randomized block design with three replicates. Results exhibited reduction effect of salinity on growth (plant height, root length, fresh and dry biomass) and biochemical parameters (Chlorophyll a, b total chlorophyll, and protein) and relative water content and potassium ion concentration in different plant parts while carbohydrate and potassium ion concentration showed increase as seasalt salinity increase in irrigation water. Potassium nitrate application significantly improved abovementioned growth and biochemical parameters, thus helps in alleviation of stress condition.
KEYWORDS: Salinity, Potassium, Chlorophyll, Proteins, carbohydrates.

INTRODUCTION

Plant expose to different stresses in the environment and salt stress either it is present in soil or in water is the major form that cause reduction in plant development and growth all over the world [1, 2]. Sodicity and salinity cause billions of financial loss and reduced in crop yield every year. In the field of agriculture presence of soluble salts in high concentration in the soil moisture of root zone is known as soil salinity. One of the major causes in the increase in soil salinity is usage of contaminated and poor quality water which then results in reduction in the yield of salt sensitive crops [3]. Presence of high amount of soluble salts in saline water/soil produced high osmotic pressure which ultimately restricted the uptake of water through roots and results in reduction of plant growth. High concentration of salt in soil solution also disturbed the balanced absorption of essential elements/nutritional ions by plants [4]. When we compared normal soil conditions with stressed ones absorption of toxic ions in higher concentration under high salt level results in the increased ions level in the tissue inside, ultimately more negative osmotic potential was observed in the tissue and cause reduced development and growth of plant [5]. Presence of high NaCl concentration results in nutritional imbalance in plants and it also reduces the ionic concentration of magnesium, calcium and potassium [6, 7].

Rate of photosynthesis had great effect on plant growth and development. This phenomenon was influenced negatively under different abiotic stresses and ultimately reduced plant development and growth of plant occur [7]. Soil and water salinity had more severe effect on plants during vegetative stage, so this stage considered more sensitive [8]. When we applied salt to any plant it either showed quick response and within few minutes it showed reduction (when plants in first growth phase) or it showed its effect within few days or weeks (second phase of growth) [7]. Many researchers concluded and stated that salt presence exhibited reduction in total dry biomass, root length and shoot length of different plants [9]. Presence of salt disturbed water potential and caused ionic imbalance in soil and cell which resulted in reduced developmental growth and productivity of most agricultural crops. Growth of plant and its yield depends on the presence different levels of salinity and its severity [10].

Potassium is very essential and abundant cation present in plants and its concentration in the cytoplasm was found between 100 and 200 mM [11] and in apoplastic region it may vary between 10-200 and sometimes reached upto 500 mM [12]. This nutrient had played an essential role in Osmoregulation, photosynthesis, phloem transport, stress

***Corresponding Author:** Humaira Gul, Department of Botany, Abdul Wali Khan University, Mardan, Khyber Pukhtunkhuwa, Pakistan. Email: gulhumaira@awkum.edu.pk

resistance, enzyme activation, protein synthesis, energy transfer, stomatal movements and cation-anion balance [13]. Potassium is also required for different physiological processes such as tropism, regulation of osmotic pressure in cell and maintenance of cell membrane turgor and potential [14]. Efficient use of iron depends on adequate supply of potassium as application of higher concentration of potassium cause its competition with iron [15]. Present experiment was designed with the hypothesis whether potassium in the form of potassium nitrate had any beneficial and significant effect on the growth, biochemistry and elemental status of cowpea grown under different levels of root zone salinity.

MATERIAL AND METHODS

Plant biomass and growth parameters:

Vigna unguiculata L. seeds were purchased from Dubai International Bio-salt Agriculture Center. In this experiment 36 pots were used and divided into three groups (12pots/treatment). The three treatments were irrigated with water (control), 2.5 dS/m and 5dS/m in seawater and potassium nitrate was used as:

1st treatment: Without potassium nitrate.

2nd treatment: Potassium provided as potassium nitrate @ 250 ppm.

3rd treatment: Potassium provided as potassium nitrate @ 500 ppm.

The sandy loam soil was thoroughly washed and each pot having basal out let was approximately filled with 3 Kg of sandy loam. Full strength Hoagland's solution was used to fully saturate the soil. Healthy seeds were surface sterilized with mercuric chloride (0.1%) for 1 minute and then washed thrice with autoclaved distilled water. In each pot 5 seeds were sown and were irrigated with tap water i.e., 150 ml everyday. At three leaves stage the plants were thinned and only one plant was left in each pot. All the pots were arranged in a completely randomized design (CRD) in the Department of Botany, University of Karachi, Karachi. Sea salt treatment begins at this stage and irrigation with 1.5L tap water/Sea salt solution is done twice a week for each pot. Different concentrations of copper sulphate, molybdenum oxide and zinc sulphate were foliar applied at different concentrations when salinity was maintained in the pot. At termination of experiment, root length, number of leaves and branches, fresh and dried biomass, and number of pods per plant were recorded in harvested plants. Leaf samples were collected for biochemical analysis and relative water content during their splendid growth season.

Relative water content: (RWC)

To analyze the relative water contents method developed by [16]. The fresh weight (FW) of the leaves was measured and the leaves were then allowing to rehydrate in distilled water for two hours and their turgor weight (TW) was measured. To obtain dry mass (DM) leaf samples were placed in a pre-heated oven at 80°C for 48 hrs. The relative water content (RWC) were measured while using the following formula

Relative Water Contents (%) = (Fresh Weight-Dry Weight)/ (Total Weight-Dry Weight) *100

Chlorophyll content:

Chlorophyll contents (Chl) was measured in fresh leaves according to the protocol of [17].

Estimation of total Carbohydrate Content:

Carbohydrate estimation was performed in plant extracts by the method of [18] using an Anthrone reagent.

Estimation of total Protein contents:

Total protein contents were extracted and analyzed by the Bradford reagent method [19].

Mineral Estimation of Vegetative Parts

Samples of root, shoot and leaves were taken for analysis of different cations (Na + and K +) during their grand growth period. The sample was dried and the weight of ash of 0.5 grams of each dry sample were taken. The ash solution was then prepared in 50 ml of deionized water and then diluted in deionized water for mineral analysis. The PFP1 flame photometer was used to measure the concentration of cations in the sample.

Experimental design and data analysis

The completely randomized design (CRD) was used for experimental purposes with three salt concentration and three replicas. Statistical analysis using SPSS software for analysis of variance (ANOVA), Duncan's multiple comparison using mean ($P < 0.05$).

RESULTS AND DISCUSSION

Growth

Data for different growth parameters (root length, plant height and fresh and dry biomass) presented in figures 1-4 revealed that plants treated with salinity exhibited significant (P<0.001) reduction in these parameters. Salt stress produced negative effects on growth of plants and this is a common phenomenon and serious problem which was reported by different workers [20, 4]. Main factors that affect growth of plant in salt stressed condition are imbalanced nutrition and specific ion toxicity. Plant exhibited reduction in leaf growth as most earlier and common salt stress response [21, 22]. At highest salinity level (0.6% sea salt solution) increase in dead leaves and leaf growth reduction both occur which further cause leaf area reduction in plant. When plant expose to salt stress, reduction in growth mainly caused due to the accumulation of different ions in young and especially in old leaves [20].

Potassium performs major role in balancing different ions in plants and this phenomenon is reflected in metabolism of nitrogen [23]. Foliar application of different potassium nitrate concentrations showed significant (P<0.0001) improvement in above mentioned growth parameters in saline as well as non-saline environment. Foliar application of potassium nitrate to salt treated cause improvement in the status of N and K and also cause reduction in uptake of toxic ions. Application of potassium caused an increase in leaf potassium content which followed by RuBP carboxylase activity, photorespiration and photosynthesis. In present investigation considerable improvement can be seen even under salinity stress condition. [24] investigated that when NaCl grown guava seedling supplemented with 10 mM calcium nitrate it exhibited beneficial effect on metabolism and growth. [25] grown sunflower under salt concentration (150 mM NaCl) and beneficial effect was observed when same plants were foliarly applied with 1.25% potassium nitrate and potassium sulfate. When vegetable crops grown and irrigated with saline water, this act lead to gradual increase of salinity stress in plant root zone. Increase in salinity cause decrease in phosphorus uptake and also cause reduction in its availability to plants [26] and it happens to Calcium and potassium as well [27], which results in reduced growth of roots and plants, while foliar application of potassium results in obtaining the desirable K/Na ratio [28].

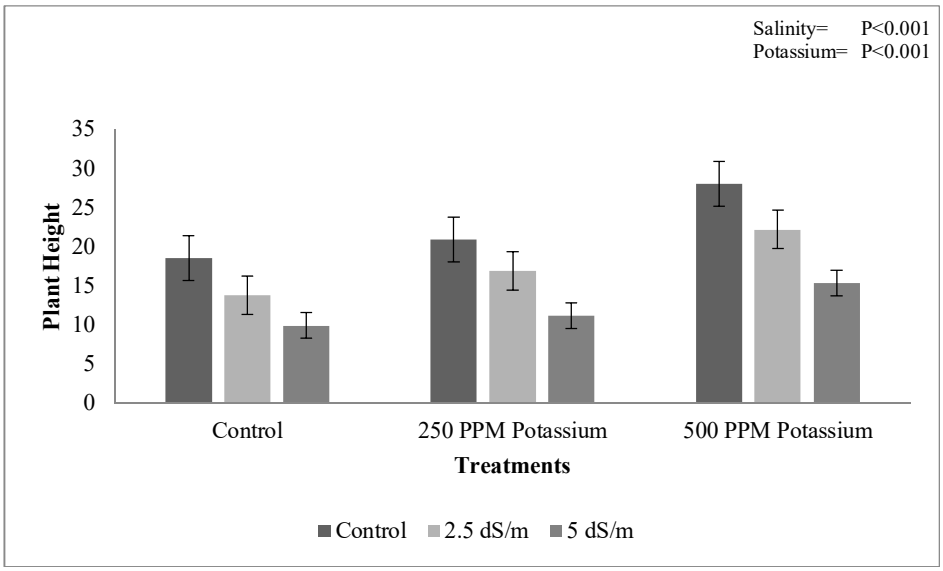

Figure 1. Influence of foliar application of potassium nitrate on plant height (cms) on *Vigna unguiculata* grown under seasalt stress.

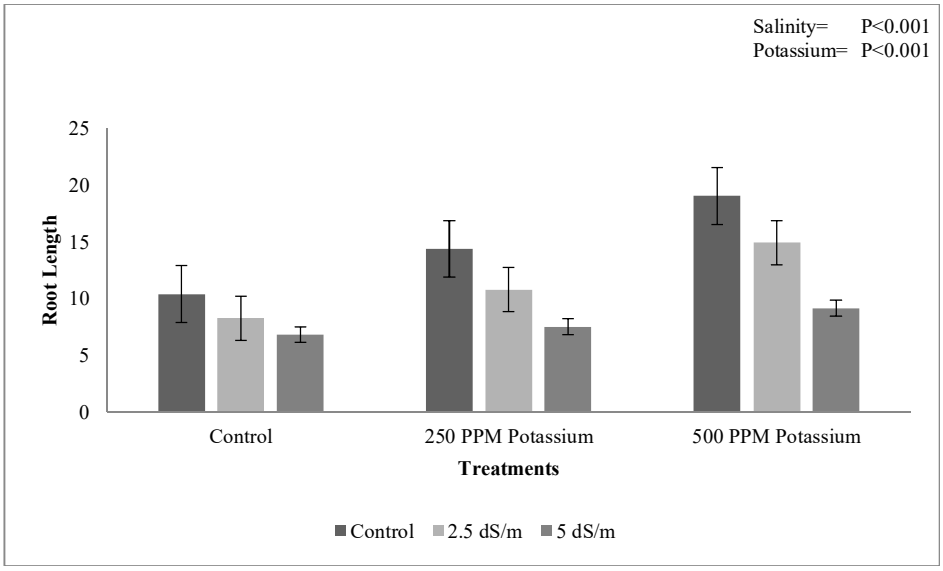

Figure 2. Influence of foliar application of potassium nitrate on root length (cms) on *Vigna unguiculata* grown under seasalt stress.

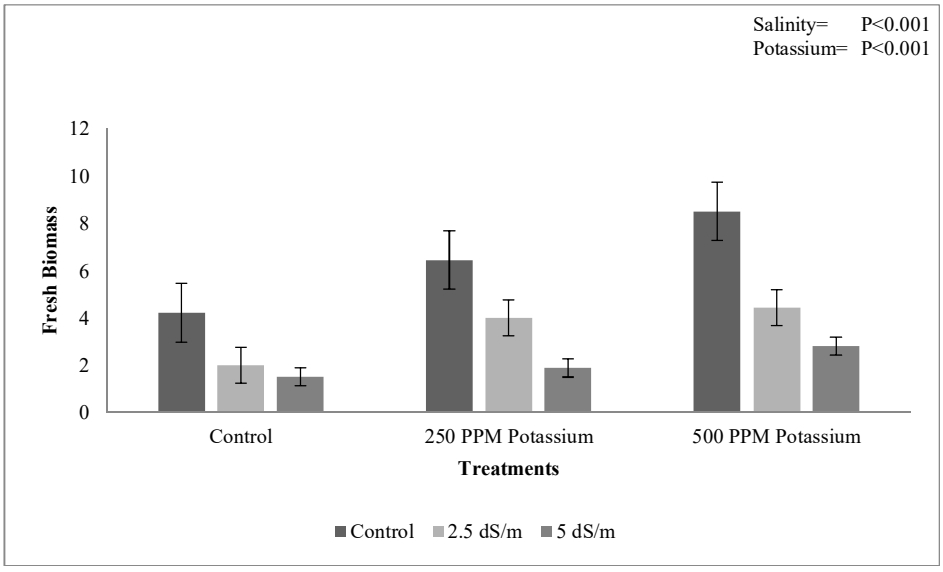

Figure 3. Influence of foliar application of potassium nitrate on fresh biomass (gms) on *Vigna unguiculata* grown under seasalt stress.

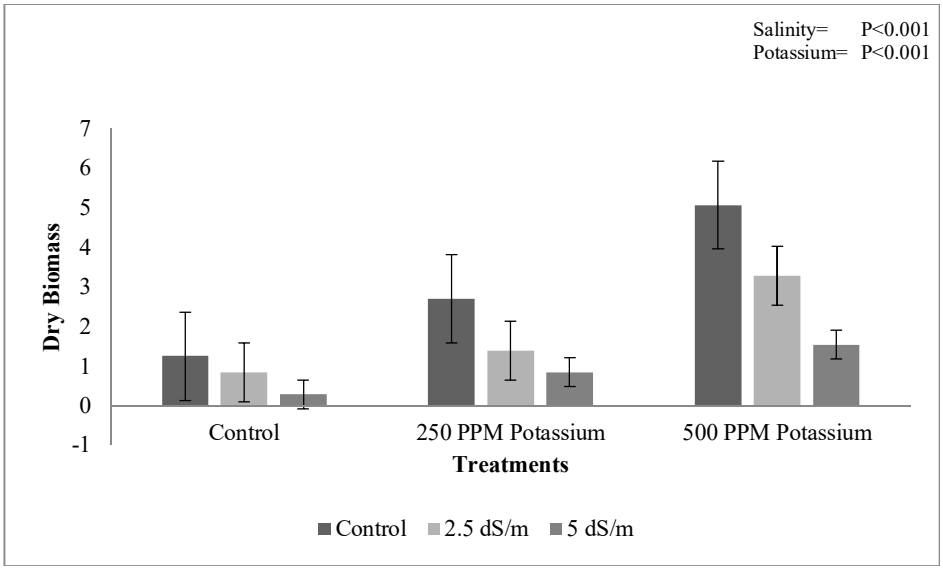

Figure 4. Influence of foliar application of potassium nitrate on dry biomass (gms) on *Vigna unguiculata* grown under seasalt stress.

Relative Water Content

Leaf's relative water content significantly (P<0.001) reduced at the highest level of salinity (Fig. 5). [29] grown sorghum plants under sodium chloride stress and studied their water relation, he observed significant reduction in osmotic potential of leaf, water pressure of leaf and relative water content. This reduction in water relation was basically due to restricted availability of water to cells which ultimately cause reduction of turgor in cell. Relative water content of increased Ca2+ level was almost constant at high salt level, and it showed advanced level and ability for osmotic adjustment of cell. Foliar application of potassium showed significant (P<0.0001) improvement in relative water content. [30] studied red beat with potassium application and observed significant reduction in relative water content at low potassium level. When maize [31] and *Vigna radiata* [32] plants grown under water stressed conditions and foliarly supplemented with potassium then increase in relative water content and leaf turgor was observed.

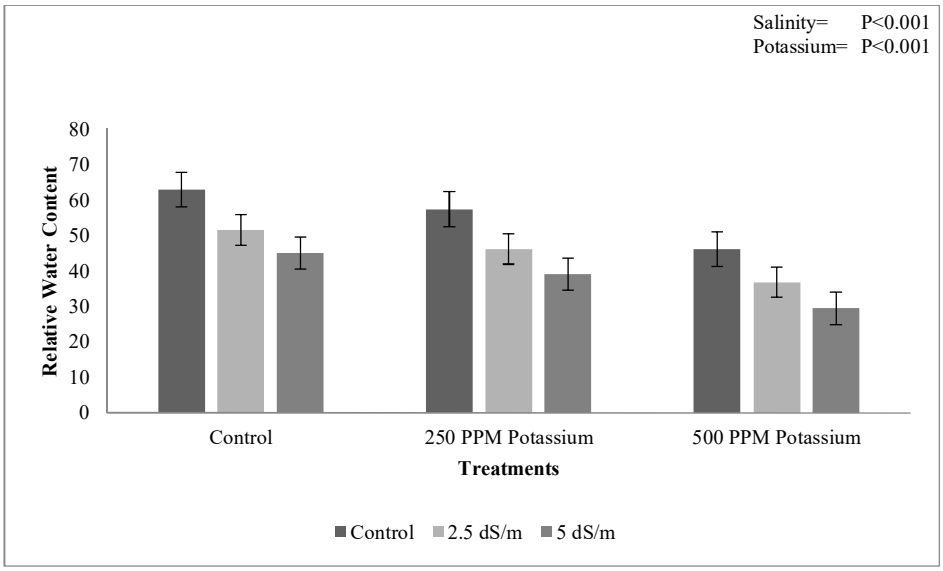

Figure 5. Influence of foliar application of potassium nitrate on relative water content on *Vigna unguiculata* grown under seasalt stress.

Chlorophyll Content

In the present study, saline stress led to significant (P<0.001) decrease in the chlorophyll b, *a* and total chlorophyll (Figures 6-9). Exogenous spraying of KNO_3 causes beneficial effect and salt stress grown plants showed ameliorative effect in leaf chlorophyll content. Abiotic stressed conditions cause decrease in gas exchange and Rubisco activity which ultimately result in limited and decrease photosynthesis [33]. [34] studied barley plants that grown under salt stress and foliarly applied with potassium nitrate and salicylic acid. Results showed that photosynthetic pigments showed improvement after application of salicylic acid and potassium nitrate. It is also observed in barley plants under stress conditions that decreased sodium and increased potassium concentrations after application of potassium nitrate gives positive response and may be responsible for maintenance of photosynthesis. [35] stated that potassium application cause promotion in photosynthetic activity.

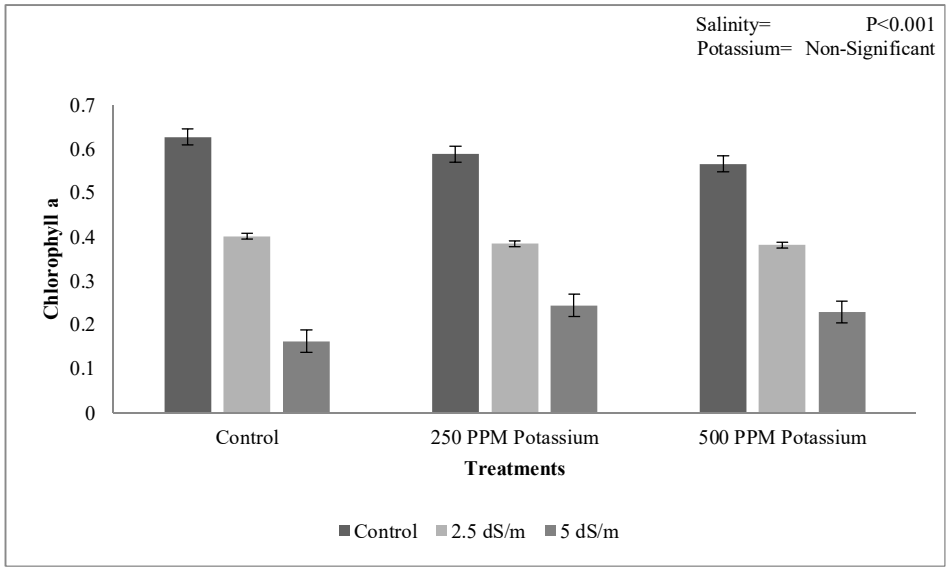

Figure 6. Influence of foliar application of potassium nitrate on chlorophyll a (mg/gm fr. wt.) on *Vigna unguiculata* grown under seasalt stress.

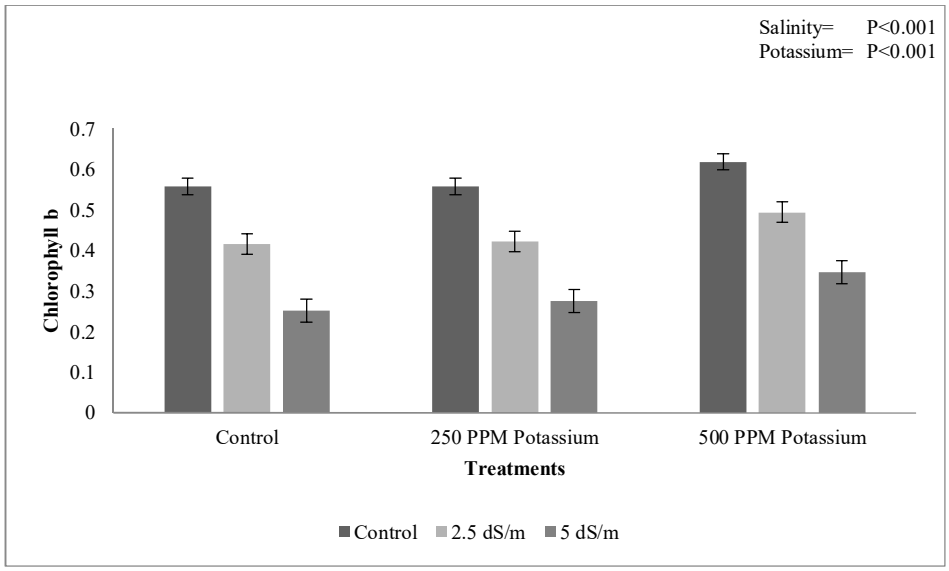

Figure 7. Influence of foliar application of potassium nitrate on chlorophyll b (mg/gm fr. wt.) on *Vigna unguiculata* grown under seasalt stress.

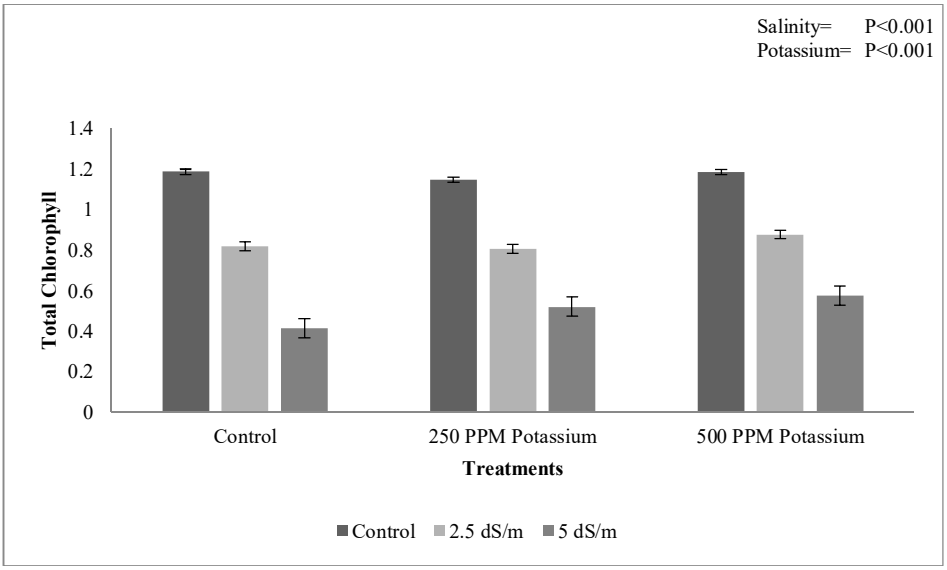

Figure 8. Influence of foliar application of potassium nitrate on total chlorophyll on *Vigna unguiculata* grown under seasalt stress.

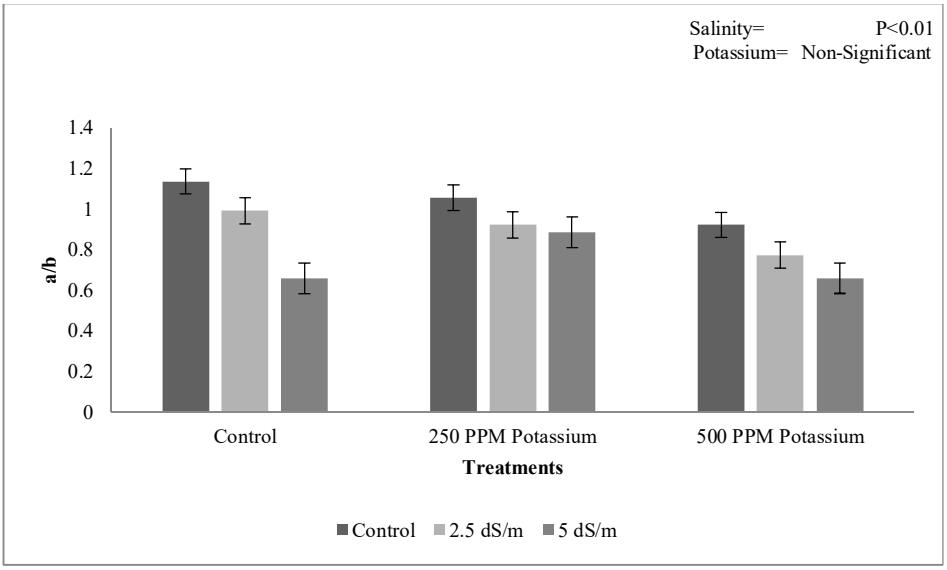

Figure 9. Influence of foliar application of potassium nitrate on chlorophyll a b ratio (a/b) on *Vigna unguiculata* grown under seasalt stress.

Total Carbohydrates

Data presented in figure 10 exhibited that plants irrigated with salt solutions showed significant (P<0.001) increase in total carbohydrates. When barley leaves were exposed to salinity then leaves showed increased contents of soluble carbohydrates [36]. Increase in salt concentrations soluble carbohydrate contents were also increased which indicate its importance and key role in adjustments of osmotic potential of cell. It was also assumed that under salinity stress conditions different sugars that accumulate in plants take part in osmotic adjustment [37, 38]. Interestingly, foliar application of KNO_3 to salt stressed plants exhibited decreased soluble carbohydrate. This reduction in total carbohydrate (soluble) was associated with increase in potassium and decrease in sodium ions concentrations. Potassium has important role in maintaining balance of different ions in cell and this element ionically bound to pyruvate kinase enzyme that is essential for carbohydrate metabolism and had a vital role in respiration [39]. When sugar beet plant studied under salt stressed condition this element cause improvement in salt tolerance which is due to increased plant metabolic activity and this element has important role in nitrogen and carbohydrate metabolism, transpiration and water absorption of plant [40].

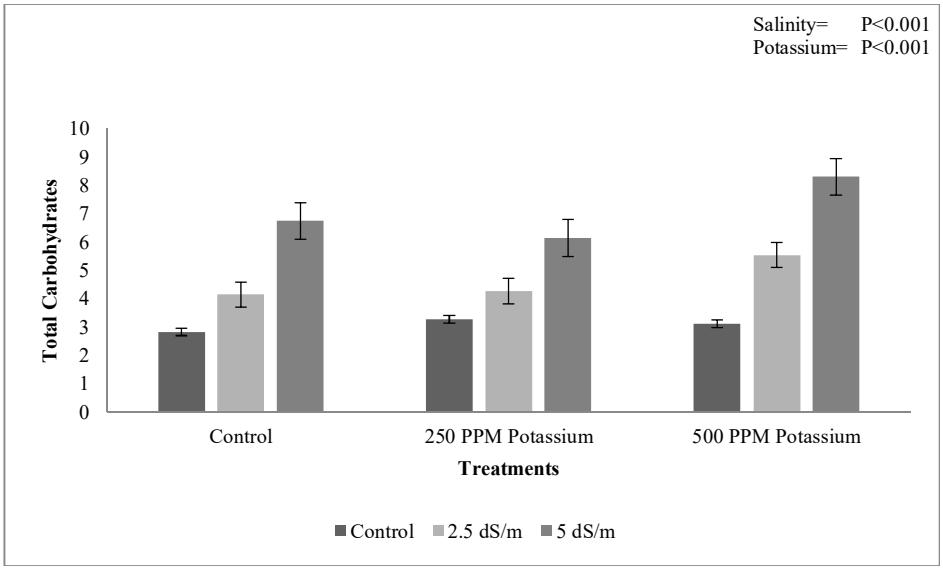

Figure 10. Influence of foliar application of potassium nitrate on total carbohydrates on *Vigna unguiculata* grown under seasalt stress.

Total Proteins

Data presented in figure 11 showed that plants irrigated with different doses of showed significant (P<0.0001) reduction in proteins (total). Proteins are generally formed from NO3-assimilation [41]. In safflower and sunflower leaves concentration of soluble proteins decrease when treated with salt, may be due to change in balance between proteins and soluble amino acids or high salt concentration may increase proteolytic process which results in high protein breakdown. Many workers also reported reduction in total proteins in plants when treated with salinity irrespective of their salt tolerance [42, 43, 44, 45]. Total protein concentration of plant enhanced after application of KNO_3 in the leaves while plants grown under normal and salt stressed conditions. The enhancement effect in plants may be the result of direct involvement of potassium ion when ribosome and tRNA bind with one another and different steps of translation process [46]. Foliar supply of potassium nitrate exhibited enhanced NO3- absorption, nitrate reduction and nitrogen assimilation in plants [47].

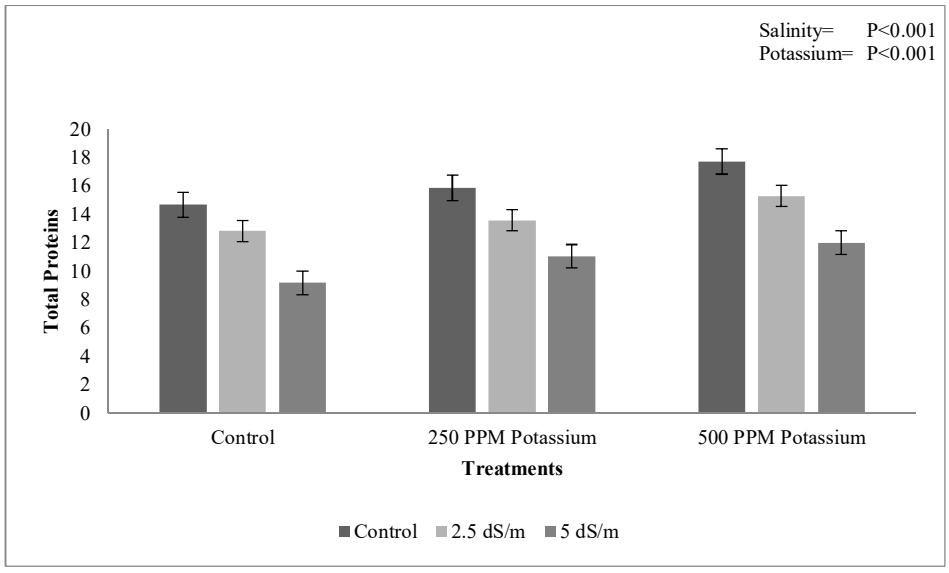

Figure 11. Influence of foliar application of potassium nitrate on total proteins on *Vigna unguiculata* grown under seasalt stress.

Ionic Composition of different plant parts

Different concentration of salt results in significant (P<0.001) enhancement in sodium contents and reduction in potassium contents which showed significant improvement in sodium potassium ratio (Na^+/K^+) (Figures 12-14). [36] studied barley leaves as applied with different doses of sodium chloride and concluded that sodium concentration was decreased as NaCl increased. [48] concluded that high sodium ions as a result of high NaCl concentration cause decrease in potassium concentration. [49] reported that the toxic levels of Na^+ in the plant reduced its growth as well as increase sodium potassium ratio (Na^+/K^+), while at the cell level potassium ions exchange by sodium also negatively affects plasma membrane H^+-ATPase activity. After application of potassium to salt stressed plants reduced sodium ions concentration and enhance potassium ions concentration in the leaves. At the same time sodium potassium ratio (Na^+/K^+) also exhibited improvement when salt doses increase in the medium. When barley leaves grown under salt stress and then applied with different potassium nitrate concentration it showed improvement in plant growth after improvement in sodium potassium ratio (Na^+/K^+). [50] studied sugar beet leaves under salt stress and reported main solutes for osmotic potential adjustments are sodium and potassium, so these inorganic salts also played important role in this phenomenon in addition to carbohydrates.

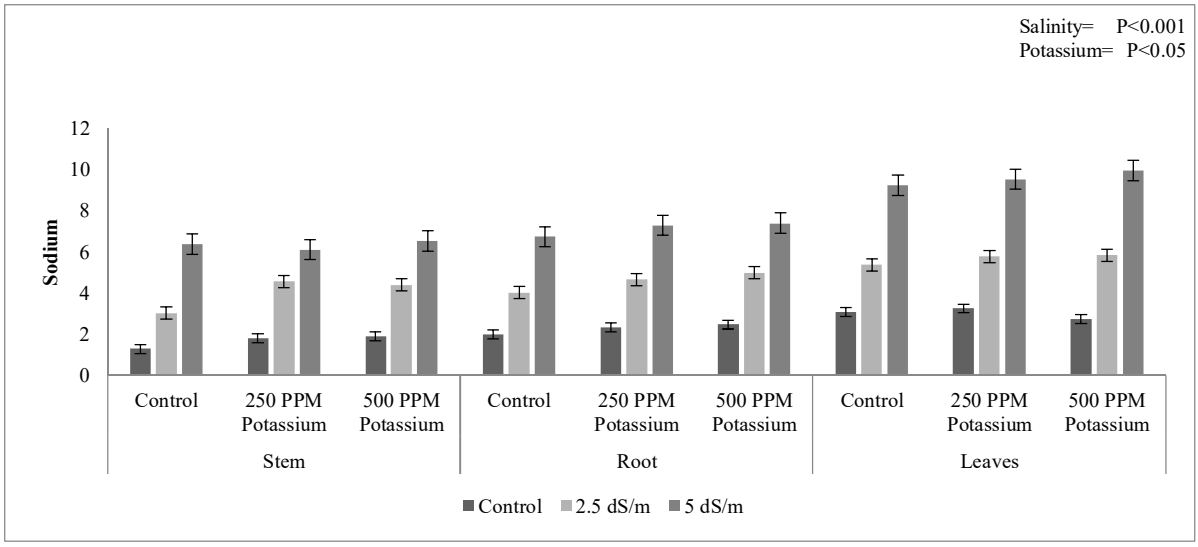

Figure 12. Influence of foliar application of potassium nitrate on sodium ion concentration of different plant parts (stem, root and leaves) on *Vigna unguiculata* grown under seasalt stress.

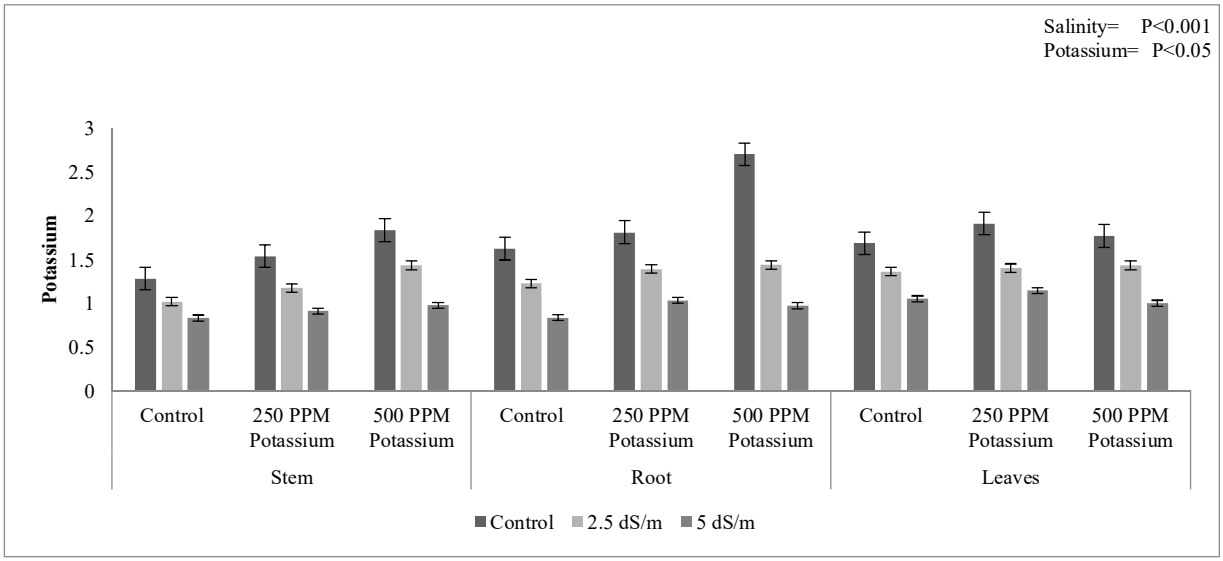

Figure 13. Influence of foliar application of potassium nitrate on potassium ion concentration of different plants parts (stem, root and leaves) on *Vigna unguiculata* grown under seasalt stress.

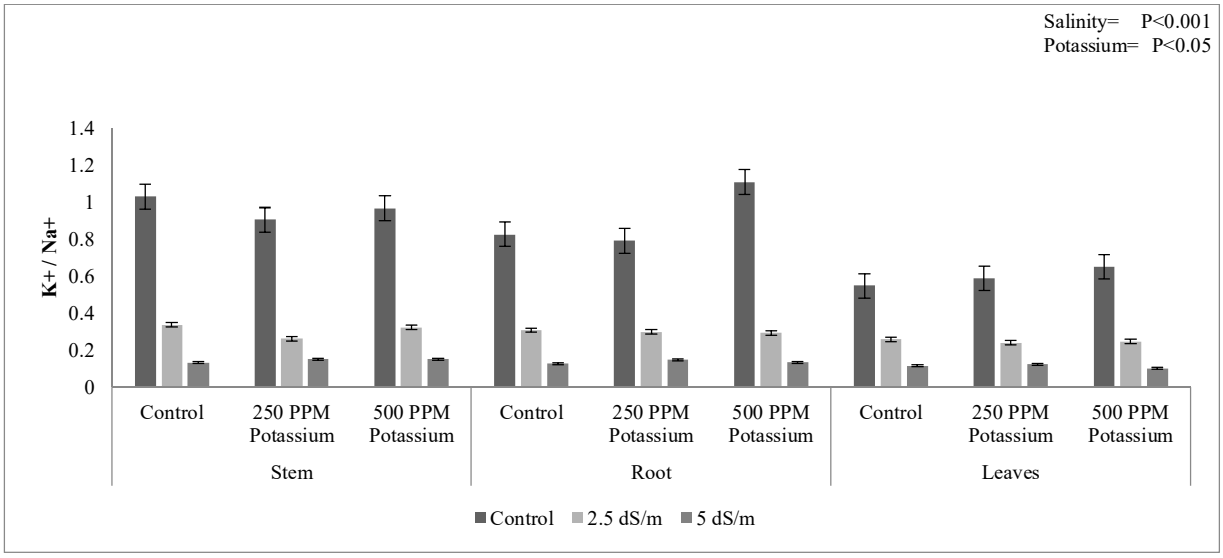

Figure 14. Influence of foliar application of potassium nitrate on potassium sodium ratio (K+/Na+) of different plant parts (stem, root and leaves) on *Vigna unguiculata* grown under seasalt stress.

CONCLUSION

Different doses of salt application significantly reduced different growth parameters, chlorophyll, total proteins and potassium ion concentration in plants while exhibited increase in total carbohydrates, sodium ion concentration and Na+/K+ ratio. Foliar application of potassium in the form of KNO3 exhibited improvement in observed parameters in normal and saline conditions and played its role in mitigating salt stress effects in studied plant.

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Impact of Micronutrients Fertilizer (gillette crop boster) on Growth and Yield of Wheat (*Triticum aestivum* L.)

Muhammad Azeem Malik[1], Habib-Ur-Rehman Memon[1], Waqar Ahmed Khuhro[1], Zohaib Mugheri[3], Majid Ali jamro[2], Jonejo Shahid Ahmad[4], Gaji Bux Bugti[5], Sikandar Ali Jamro*[6]

[1]Department of Agronomy, Sindh Agricultural University, Tando Jam Pakistan.
[2]Department of Plant Breading and Genetics, Shaheed Zulfquar Ali Bhuto Agriculture College, Dokri.
[3]Department of Plant Breading and Genetics, Sindh Agricultural University, Tando Jam Pakistan.
[4]School of tea and food science technology, Anhui Agriculture University, Hefei - 230036, Anhui Province, P.R.China.
[5]Wheat Botanist, Directorate Agriculture Research, Jaffarabad at USTA Mohammad
[6]School of Agronomy, Anhui Agriculture University, Hefei - 230036, Anhui Province, P.R.China.

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ABSTRACT

To assess the response of micronutrients fertilizer (gillette crop boster) on the growth and yield of wheat crop. The application of micronutrients (gillette crop boster) T_3 = NPK (168 + 84 + 60 kg ha^{-1}) + 3 spray of gillette, produced maximum plant height (95 cm), tillers (317 m^{-2}), spike length (13 cm), spikeletes $spike^{-1}$ (23), grains $spike^{-1}$ (61), grains weight $spike^{-1}$ (4 g), seed index (1000-grain weight) (42 g), biological yield (11192 kg ha^{-1}) and grain yield (5775 kg ha^{-1}) followed by plant height (77 cm), tillers (304 m^{-2}), spike length (12 cm), spikeletes $spike^{-1}$ (21), grains spike (56), grains weight $spike^{-1}$ (3 g), seed index (1000-grain weight) (41 g), biological yield (10536 kg ha^{-1}) and grain yield (5522 kg ha^{-1}) was observed under treatment T_4 = NPK (168 + 84 + 60 kg ha^{-1}) + 4 spray of gillette. Whereas as plant height (77 cm), tillers (296 m^{-2}), spike length (11 cm), spikeletes $spike^{-1}$ (19), grains $spike^{-1}$ (53), grains weight $spike^{-1}$ (2 g), seed index (1000-grain weight) (41 g), biological yield (10522 kg ha^{-1}) and grain yield (5149 kg ha^{-1}) was observed under treatment T_2 = NPK (168 + 84 + 60 kg ha^{-1}) + 2 spray of gillette respectively. The results further indicated that minimum plant height (70 cm), tillers (286 m^{-2}), spike length (10 cm), spikeletes $spike^{-1}$ (16), grains $spike^{-1}$ (51), grains weight $spike^{-1}$ (2 g), seed index (1000-grain weight) (38 g), biological yield (9663 kg ha^{-1}) and grain yield (4920 kg ha^{-1}) under treatment T_1 = control (Recommended dose). This was observed that all the treatments of micronutrients (gillette crop boster) showed positively significant impact on growth and yield of wheat. Treatment T_3 application of NPK (168 + 84 + 60 kg ha^{-1}) + 3 spray of gillette produced maximum grain yield (5775 kg ha^{-1}) of wheat variety "Kiran-95" proved most suitable treatment and as recommended for growers.

KEYWORDS: Wheat, Gillette, Micronutrients, Yield

INTRODUCTION

Wheat (*Triticum aestivum* L.) is the most popular food crop of Pakistan and its products are used in a number of ways. Being the staple diet of most of the people, it dominates all crops in acreage and production. Wheat accounts for 9.9 percent of the value added in agriculture and 2.0 percent of GDP of Pakistan during 2015-16, area under wheat cultivation has increased to 9260 thousand hectares from last year's area of 9204 thousand hectares which shows an increase of 0.6 percent. While production of wheat stood at 25.482 million tons during 2015-16, showing an increase of 1.6 percent over the last year's production of 25.086 million tons. The production increased as crop was sown at appropriate time and available moisture particularly in Barani Track supported germination growth and availability and use of inputs remained adequate (GOP, 2016).

Human beings mostly receive food directly from plants. *Gramineae* family is no doubt the most diverse and important family of plant kingdom. The cereal crops belonging to *Gramineae* family producing large edible grains and provides about one half of man's food calories and large part of his nutrients requirements. Wheat *(Triticum aestivum* L.) is foremost among cereals and indeed among all food crops, as direct source of food and energy for human beings [1].

Fertilizers are basic need of crops for enhancing production in crops especially in wheat, increasing use of trace minerals leading to an imbalance of soil elements. Proper use of fertilizes with the macronutrients and micronutrients in the plant nutrition is very beneficial for the high level of production and yield. So there is the need

***Corresponding Author:** Sikandar Ali Jamro, School of Agronomy Anhui Agriculture University Hefei - 230036, Anhui Province, P.R.China. email: sikandarjamro@yahoo.com

of balance used of fertilizers to increase yield of the crop. The role of both nutrients macronutrients and micronutrients is vital in crop nutrition for improved yield [2],Trace nutrients such as Fe and B have essential the vital roles in plant's life cycle and very beneficial for normal growth plants [3;4], Iron (Fe) is the most impotant for the respiration and photosynthesis processes. Iron play basic role in the many plant functions. These functions include the chlorophyll development, energy transfer, Fe an ingredient of enzymes and proteins, and involved in the nitrogen fixation. It plays avital role in the nucleic acid metabolism [5;6;7;8], Boron (B) is a micronutrient essential for all the plant nutrition. B involves at least in 16 functions of plants. These functions are including cell wall formation, membrane integrity, cell wall syntheses, carbohydrate metabolism, calcium uptake, flowering, RNA metabolism, respiration, indole acetic acid, (IAA) metabolism, membranes, root growth, pollination and may help in the translocation of sugar [9; 10; 7; 11] , The foliar fertilization (or the foliar feeding) is a military new and contentious technique of the feeding plants by applying liquid fertilizer directly to the leaves [12], Present research has investigate that small amount of trace elements, particularly B and Fe either solitary or association with the other micronutrients, used by foliar spraying significantly promote growth and increased yield, the yield components and the grain quality of wheat crop[13], reported that Zn, Fe, Mn and Cu fertigation directly increased the grain yield, straw yield, 1000-grain weight, and the number of grains per spikelet. As well as showed that application of Fe significantly increased the concentration and total uptake of Fe in grain, flag leaves grain protein contents as well[14], founded that utilization of trace nutrients increased wheat dry matter, grain yield and the straw yield significantly over an untreated control. Foliar application of trace nutrients (Fe, Mn, Zn, Cu and the B) at various growth stages of wheat increased the plants height, grains per spike, 1000-grain weight, biological yield, harvest index, straw and the grain yield [15;16], Indicate that foliar application of Fe at the various growth stages promote plant height, spike length, 1000-grain weight, grain weight per spike, grain yield, grain protein content and protein yield of the wheat plant in both growing seasons as the compared to control.

[17], showed that the utilization of foliar spray Fe and B directly increased the plant height, no of tillers and root depth as compared to the control treatment (no Fe and B application)[18], revealed that application of foliar spray of (Zn + Fe) produce the highest grain yield of wheat. Foliar application of B and Zn had admired results on the yield and yield components of wheat [19;20;21] , found that the foliar application of B was directly affected on grain yield, number of grains per spike and 1000-grain weight. Aim of the this experiment were to study the effect of foliar application of (Fe + B) at two growth stages.

[22] , found that Zn, Fe, Cu, and Mn contents of wheat grain increased with application of micronutrient fertilizers. More to the point, application methods for macro and trace elements, also, affect the yield. For instance,[23], reported that micronutrients (Cu + Fe + Mn + Zn) produced the highest values of plant height (cm), tillers number (m^{-2}), spikes number (m^{-2}), spike length(cm), number of spikelet $spike^{-1}$, number of grains $spike^{-1}$, 1000-grain weight (g), grain yield (kg ha^{-1}), straw yield (kg ha^{-1}), biological yield (kg ha^{-1}) and harvest index (%), respectively, in both seasons followed by Zn, Mn, Fe and Cu foliar application respectively Further[24], recommended foliar sprays of nutrient solution at tillering ,jointing and booting stage in conjunction with half of the endorsed dose of N and P to growth and yield of wheat, To evaluate the impact of gillette crop boster micronutrients fertilizer on growth and yield of wheat, To assess the proper dose of gillette crop boster micronutrients fertilizer to maximize the wheat production.

MATERIAL AND METHODS

The trial was conducted at the Soil Chemistry Section, (ARI) Agriculture research Institute, Tandojam to assess the impact of micronutrients fertilizer (gillette crop boster) on the growth and yield of wheat. The trial was laid out in the three replicated randomized complete block design (RCBD) having net plot size of 5 m x 5 m (25 m^2) during Rabi, season 2016-17. Sowing was done with the help of single row hand drill at the recommended seed rate of 125 kg ha^{-1} of variety Kiran-95. The details of treatments are as under:

Treatments:

T_1 = Control (Recommended dose)
T_2 = NPK (168 + 84 + 60 kg ha^{-1}) + 2 spray of gillette (30-45 DAS)
T_3 = NPK (168 + 84 + 60 kg ha^{-1}) + 3 spray of gillette (30-45-60 DAS)
T_4 = NPK (168 + 84 + 60 kg ha^{-1}) + 4 spray of gillette (30-45-60-75 DAS)

The foliar application of gillette crop boster (Zn 300 mg), (B 100 mg), (Mn 50 mg), (Fe 500 mg) was applied at 500 ml per acre with 100 liter of water. In all treatments (12.5 mL) of gillette crop boster was applied with 2.5 liters of water at per plot. The recommended dose of NPK fertilizers was applied as usual in all the experimental units.Urea was applied for nitrogen, SSP applied for phosphours and SOP was applied for potassium. All P and K along with 1/3 of N was applied at the time of sowing; while remaining N was divided into two equal splits at 1st and 2nd

irrigation. For recording data, five plants at random was selected and tagged in each plot to measure the following parameters:

RESULT

Plant height (cm)

Result regarding plant hight (cm) of wheat Kiran-95 variety as affected by micronutrients (gillette crop boster) is presented in Table-1 and its analysis of variance as Appendix-I. The analysis of variance suggested that the impact of micronutrients on plant height (cm) was significant ($P<0.05$).

The results revealed that maximum plant height (95 cm) was observed in treatment T_3 = NPK (168 + 84 + 60 kg ha^{-1}) + 3 spray of gillette followed by (77 cm) under treatment T_4 = NPK (168 + 84 + 60 kg ha^{-1}) + 4 spray of gillette respectively. However, treatment T_2 = NPK (168 + 84 + 60 kg ha^{-1}) + 2 spray of gillette were ranked as 3rd with (77 cm). Whereas, the minimum plant height (70 cm) was observed under treatment T_1 = Control (recommended dose)

Table 1. Plant height (cm) of wheat as affected by micronutrients (gillette crop boster) application

Treatments	R-I	R-II	R-III	Mean
T_1 = Control (Recommended dose)	68	70	71	70 C
T_2 = NPK (168 + 84 + 60 kg ha^{-1}) +2 spray of gillette crop boster	76	79	75	77 B
T_3 = NPK (168 + 84 + 60 kg ha^{-1}) +3 spray of gillette crop boster	92	97	95	95 A
T_4 = NPK (168 + 84 + 60 kg ha^{-1}) +4 sprays of gillette crop boster	77	79	76	77 B

S.E ± = 1.1547
LSD 0.05 = 2.8255
CV% = 1.78

Tillers (m^{-2})

The data regarding tillers (m^{-2}) of wheat Kiran-95 variety as affected by micronutrients (gillette crop boster) is presented in Table-2 and its analysis of variance as Appendix-II. The analysis of variance suggested that the impact of micronutrients on tillers (m^{-2}) was significant ($P<0.05$).

The results revealed that maximum tillers (317 m^{-2}) were observed in treatment T_3 = NPK (168 + 84 + 60 kg ha^{-1}) + 3 spray of gillette followed by (304 m^{-2}) under treatment T_4 = NPK (168 + 84 + 60 kg ha^{-1}) + 4 spray of gillette respectively. However, treatment T_2 = NPK (168 + 84 + 60 kg ha^{-1}) + 2 spray of gillette were ranked as 3rd with (296 m^{-2}). Whereas, the minimum tillers (286 m^{-2}) was observed under treatment T_1 = Control (recommended dose).

Table 2. Tillers (m^{-2}) of wheat as affected by micronutrients (gillette crop boster) application

Treatments	R-I	R-II	R-III	Mean
T_1 = Control (Recommended dose)	283	287	289	286 D
T_2 = NPK (168 + 84 + 60 kg ha^{-1}) +2 spray of gillette crop boster	291	297	301	296 C
T_3 = NPK (168 + 84 + 60 kg ha^{-1}) +3 spray of gillette crop boster	311	320	319	317 A
T_4 = NPK (168 + 84 + 60 kg ha^{-1}) +4 spray of gillette crop boster	305	299	308	304 B

S.E ± = 2.7655
LSD 0.05 = 6.7670
CV% = 1.13

Spike length (cm)

The data regarding spike lenght (cm) of wheat variety Kiran-95 as affected by micronutrients (gillette crop boster) is presented in Table-3 and its analysis of variance as Appendix-III. The analysis of variance suggested that the impact of micronutrients on spike lenght (cm) was significant ($P<0.05$).

The results revealed that maximum spike lenght (13 cm) was observed in treatment T_3 = NPK (168 + 84 + 60 kg ha^{-1}) + 3 spray of gillette followed by (12 cm) under treatment T_4 = NPK (168 + 84 + 60 kg ha^{-1}) + 4 spray of gillette

respectively. However, treatment T_2 = NPK (168 + 84 + 60 kg ha^{-1}) + 2 spray of gillette were ranked as 3rd with (11 cm). Whereas, the minimum spike lenght (10 cm) was observed under treatment T_1 = Control (recommended dose).

Table 3. Spike length (cm) of wheat as affected by micronutrients (gillette crop boster) application

Treatments	R-I	R-II	R-III	Mean
T_1 = Control (Recommended dose)	9.5	10.1	9.1	10 D
T_2 = NPK (168 + 84 + 60 kg ha^{-1}) +2 spray of gillette crop boster	10.0	10.5	10.9	11 C
T_3 = NPK (168 + 84 + 60 kg ha^{-1}) +3 spray of gillette crop boster	12.8	12.9	13.0	13 A
T_4 = NPK (168 + 84 + 60 kg ha^{-1}) +4 spray of gillette crop boster	11.9	11.5	12.0	12 B

S.E ± = 0.3277
LSD $_{0.05}$ = 0.8019
CV% = 3.59

Spikeletes $spike^{-1}$

The data regarding spikeletes $spike^{-1}$ of wheat variety Kiran-95 as affected by micronutrients (gillette crop boster) is presented in Table-4 and its analysis of variance as Appendix-IV. The analysis of variance suggested that the impact of micronutrients on spikeletes $spike^{-1}$ was significant ($P<0.05$).

The results revealed that maximum spikeletes $spike^{-1}$ (23) was observed in treatment T_3 = NPK (168 + 84 + 60 kg ha^{-1}) + 3 spray of gillette followed by (21) under treatment T_4 = NPK (168 + 84 + 60 kg ha^{-1}) + 4 spray of gillette respectively. However, treatment T_2 = NPK (168 + 84 + 60 kg ha^{-1}) + 2 spray of gillette were ranked as 3rd with (19). Whereas, the minimum spikeletes $spike^{-1}$ (16) was observed under treatment T_1 = Control (recommended dose).

Table 4. Spikeletes $spike^{-1}$ of wheat as affected by micronutrients (gillette crop boster) application

Treatments	R-I	R-II	R-III	Mean
T_1 = Control (Recommended dose)	15.1	16.8	15.5	16 D
T_2 = NPK (168 + 84 + 60 kg ha^{-1}) +2 spray of gillette crop boster	17.3	19.1	18.5	18 C
T_3 = NPK (168 + 84 + 60 kg ha^{-1}) +3 spray of gillette crop boster	23.7	23.1	22.1	23 A
T_4 = NPK (168 + 84 + 60 kg ha^{-1}) +4 spray of gillette crop boster	19.1	21.5	21.7	21 B

S.E ± = 0.7632
LSD $_{0.05}$ = 1.8674
CV% = 4.80

Grains $spike^{-1}$

The data regarding grains $spike^{-1}$ of wheat variety Kiran-95 as affected by micronutrients (gillette crop boster) is presented in Table-5 and its analysis of variance as Appendix-V. The analysis of variance suggested that the impact of micronutrients on grains $spike^{-1}$ was significant ($P<0.05$).

The results revealed that maximum grains $spike^{-1}$ (61) was observed in treatment T_3 = NPK (168 + 84 + 60 kg ha^{-1}) + 3 spray of gillette followed by (56) under treatment T_4 = NPK (168 + 84 + 60 kg ha^{-1}) + 4 spray of gillette respectively. However, treatment T_2 = NPK (168 + 84 + 60 kg ha^{-1}) + 2 spray of gillette were ranked as 3rd with (53). Whereas, the minimum grains $spike^{-1}$ (51) was observed under treatment T_1 = Control (recommended dose).

Table 5. Grains spike^{-1} of wheat as affected by micronutrients (gillette crop boster) application

Treatments	R-I	R-II	R-III	Mean
T_1 = Control (Recommended dose)	50.1	51.5	50.9	51 C
T_2 = NPK (168 + 84 + 60 kg ha^{-1}) +2 spray of gillette crop boster	54.1	53.2	51.6	53 BC
T_3 = NPK (168 + 84 + 60 kg ha^{-1}) +3 spray of gillette crop boster	58.3	61.5	63.1	61 A
T_4 = NPK (168 + 84 + 60 kg ha^{-1}) +4 spray of gillette crop boster	56.7	56.1	55.3	56 B

S.E ± = 1.3301
LSD $_{0.05}$ = 3.2546
CV% = 2.95

Grains weight spike^{-1} (g)

The data regarding grains weight spike^{-1} (g) of wheat variety Kiran-95 as affected by micronutrients (gillette crop boster) is presented in Table-6 and its analysis of variance as Appendix-VI. The analysis of variance suggested that the impact of micronutrients on grains weight spike^{-1} (g) was significant (P<0.05).

The results revealed that maximum grains weight spike^{-1} (g) (4) was observed in treatment T_3 = NPK (168 + 84 + 60 kg ha^{-1}) + 3 spray of gillette followed by (3) under treatment T_4 = NPK (168 + 84 + 60 kg ha^{-1}) + 4 spray of gillette respectively. However, treatment T_2 = NPK (168 + 84 + 60 kg ha^{-1}) + 2 spray of gillette were ranked as 3rd with (2). Whereas, the minimum grains weight spike^{-1} (g) (2) was observed under treatment T_1 = Control (recommended dose).

Table 6. Grains weight spike^{-1} (g) of wheat as affected by micronutrients (gillette crop boster) application

Treatments	R-I	R-II	R-III	Mean
T_1 = Control (Recommended dose)	1.4	1.5	1.5	2 D
T_2 = NPK (168 + 84 + 60 kg ha^{-1}) +2 spray of gillette crop boster	2.0	2.1	2.5	2 C
T_3 = NPK (168 + 84 + 60 kg ha^{-1}) +3 spray of gillette crop boster	3.1	3.7	3.9	4 A
T_4 = NPK (168 + 84 + 60 kg ha^{-1}) +4 spray of gillette crop boster	2.5	2.9	2.8	3 B

S.E ± = 0.1473
LSD $_{0.05}$ = 0.3605
CV% = 7.24

Seed index (1000-grain weight, g)

The data regarding seed index (1000-grain weight, g) of wheat variety Kiran-95 as affected by micronutrients (gillette crop boster) is presented in Table-7 and its analysis of variance as Appendix-VII. The analysis of variance suggested that the impact of micronutrients on seed index (1000-grain weight, g) was significant (P<0.05).

The results revealed that maximum seed index (1000-grain weight, g) (42) was observed in treatment T_3 = NPK (168 + 84 + 60 kg ha^{-1}) + 3 spray of gillette followed by (41) under treatment T_4 = NPK (168 + 84 + 60 kg ha^{-1}) + 4 spray of gillette respectively. However, treatment T_2 = NPK (168 + 84 + 60 kg ha^{-1}) + 2 spray of gillette were ranked as 3rd with (41). Whereas, the minimum seed index (1000-grain weight, g) (38) was observed under treatment T_1 = Control (recommended dose).

Table 7. Seed index (1000-grain weight, g) of wheat as affected by micronutrients (gillette crop boster) application

Treatments	R-I	R-II	R-III	Mean
T_1 = Control (Recommended dose)	38.1	37.2	38.7	38 C
T_2 = NPK (168 + 84 + 60 kg ha^{-1}) +2 spray of gillette crop boster	40.1	41.2	40.5	41 B
T_3 = NPK (168 + 84 + 60 kg ha^{-1}) +3 spray of gillette crop boster	42.1	41.5	42.5	42 A
T_4 = NPK (168 + 84 + 60 kg ha^{-1}) +4 spray of gillette crop boster	41.4	40.5	41.7	41 AB

S.E ± = 0.4613
LSD $_{0.05}$ = 1.1287
CV% = 1.40

Citation: Muhammad Azeem Malik, Habib-Ur-Rehman Memon, Waqar Ahmed Khuhro, Zohaib Mugheri, Majid Ali jamro, Jonejo Shahid Ahmad, Gaji Bux Bugti, Sikandar Ali Jamro, 2018, Impact of Micronutrients Fertilizer (gillette crop boster) on Growth and Yield of Wheat (*Triticum aestivum* L.); Journal of Applied Environmental and Biological Sciences, 8(9)21-28.

Biological yield (kg ha^{-1})

The data regarding biological yield (kg ha^{-1}) of wheat variety Kiran-95 as affected by micronutrients (gillette crop boster) is presented in Table-8 and its analysis of variance as Appendix-VIII. The analysis of variance suggested that the impact of micronutrients on biological yield (kg ha^{-1}) was significant (P<0.05).

The results revealed that maximum biological yield (kg ha^{-1}) (11192) was observed in treatment T_3 = NPK (168 + 84 + 60 kg ha^{-1}) + 3 spray of gillette followed by (10536) under treatment T_4 = NPK (168 + 84 + 60 kg ha^{-1}) + 4 spray of gillette respectively. However, treatment T_2 = NPK (168 + 84 + 60 kg ha^{-1}) + 2 spray of gillette were ranked as 3rd with (10522). Whereas, the minimum biological yield (kg ha^{-1}) (9663) was observed under treatment T_1 = Control (recommended dose).

Table 8. Biological yield (kg ha^{-1}) of wheat as affected by micronutrients (gillette crop boster) application

Treatments	R-I	R-II	R-III	Mean
T_1 = Control (Recommended dose)	9850	9400	9740	9663 B
T_2 = NPK (168 + 84 + 60 kg ha^{-1}) +2 spray of gillette crop boster	10225	10660	10680	10522 A
T_3 = NPK (168 + 84 + 60 kg ha^{-1}) +3 spray of gillette crop boster	11385	11200	10990	11192 A
T_4 = NPK (168 + 84 + 60 kg ha^{-1}) +4 spray of gillette crop boster	11233	10245	10131	10536 A

S.E ± = 303.06
LSD $_{0.05}$ = 741.56
CV% = 3.54

Grain yield (kg ha^{-1})

The data regarding grain yield (kg ha^{-1}) of wheat variety Kiran-95 as affected by micronutrients (gillette crop boster) is presented in Table-9 and its analysis of variance as Appendix-IX. The analysis of variance suggested that the impact of micronutrients on grain yield (kg ha^{-1}) was significant (P<0.05).

The results revealed that maximum grain yield (kg ha^{-1}) (5775) was observed in treatment T_3 = NPK (168 + 84 + 60 kg ha^{-1}) + 3 spray of gillette followed by (5522) under treatment T_4 = NPK (168 + 84 + 60 kg ha^{-1}) + 4 spray of gillette respectively. However, treatment T_2 = NPK (168 + 84 + 60 kg ha^{-1}) + 2 spray of gillette were ranked as 3rd with (5149). Whereas, the minimum grain yield (kg ha^{-1}) (4920) was observed under treatment T_1 = Control (recommended dose).

Table 9. Grain yield (kg ha^{-1}) of wheat as affected by micronutrients (gillette crop boster) application

Treatments	R-I	R-II	R-III	Mean
T_1 = Control (Recommended dose)	4925.0	4935.3	4900.1	4920 D
T_2 = NPK (168 + 84 + 60 kg ha^{-1}) +2 spray of gillette crop boster	5129.3	5168.0	5172..6	5149 C
T_3 = NPK (168 + 84 + 60 kg ha^{-1}) +3 spray of gillette crop boster	5767.7	5780.1	5775.9	5775 A
T_4 = NPK (168 + 84 + 60 kg ha^{-1}) +4 spray of gillette crop boster	5520.1	5535.2	5510.4	5522 B

S.E ± = 12.337
LSD $_{0.05}$ = 30.187
CV% = 0.28

DISCUSSION

The use of micronutrients is important because of increasing economic and environmental concerns [25,22] ,reported that Cu, Fe, Mn and Zn contents of grain of wheat increased with application of micro fertilizers. More to the point, application methods for macro and trace elements, also, affect the yield. For instance [23] ,reported that micronutrients (Cu + Fe + Mn + Zn) produced the highest values of plant height (85 and 87.2 cm), number of tillers (m^{-2}), spike length (cm), number of spikeletes spike^{-1}, number of grains spike^{-1}, grains weight spike^{-1} (g), seed index(1000-grain weight, g), biological yield (kg ha^{-1}), straw yield and harvest index, respectively, in both seasons followed by Zn foliar application followed by Mn foliar application followed by Fe foliar application then Cu foliar application. Further [24], recommended foliar sprays of nutrient solution at tilling, jointing and boot stage in

conjunction with half of the endorsed dose of N and P to growth yield and yield quantities of wheat [26] , the finding of the study showed that plant height (cm), tillers (m^{-2}), spike length (cm), spikeletes $spike^{-1}$, grains $spike^{-1}$, grain weight $spike^{-1}$ (g), seed index (1000-grain weight, g), biological yield (kg ha^{-1}) and grain yield (kg ha^{-1}) were significantly ($P<0.05$) effect by different level of micronutrients (gillette crop boster). While the application of integrated application of T_3 = NPK (168 + 84 + 60 kg ha^{-1}) + 3 spray of gillette produced maximum value for growth and yield traits particularly grain yield (5774.6 kg ha^{-1}), followed by T_4 = NPK (168 + 84 + 60 kg ha^{-1}) + 4 spray of gillette (5521.9 kg ha^{-1}) grain yield. Therefore, the none the less growth and yield traits, particularly grain yield (4920.1 kg ha^{-1}) was tape in (control) [27] , reported that boom of 31.6 % in wheat grain yield over manipulate via the addition of five kg ha^{-1} Zn further, the yield parameters like wide variety of spike $plant^{-1}$, spike duration, plant height, biological yield and 1000- grain weight have been increased over control. Moreover, the extent of Zn content material became raised from 15.2 to 37.4 mg kg^{-1} by utility of 10 kg Zn ha^{-1} for that reason, substantial improvement in wheat productiveness may be harvested with simultaneous increased concentration of Zn nutrient in grain for relief of syndrome precipitated because of Zn deficiency across rural and peri-urban communities [26],

CONCLUSION

It is concluded from the results that all the treatments of micronutrients (gillette crop boster) showed positively significant effect on growth and yield of wheat. Application of NPK (168 + 84 + 60 kg ha^{-1}) + 3 spray of gillette produced maximum grain yield (5774.6 kg ha^{-1}) of wheat variety ”Kiran-95” proved most suitable treatment.

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Satisfaction with Health Services in General Hospital in Sumenep Regency

Aryo Wibisono[1*], R. Amilia Destryana[2], Miftahol Arifin[1]

[1]Faculty of Economy and Business, University of Wiraraja, Sumenep, Indonesia
[2]Faculty of Agriculture, University of Wiraraja, Sumenep, Indonesia

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ABSTRACT

Local governments as providers of health services for public should provide good quality services that are in accordance with the standard procedures for each general hospital. Mostly, the general hospitals had a problems with quality and effectiveness in services such as complaints that are often experienced by patients who use health services such as the friendliness of employees, nurses and doctors. This study aims to determine the priority of the health service quality that are concerned in order to meet the satisfaction of the people of Sumenep regency, to determine the public satisfaction index and the pattern of relationships between dimensions of satisfaction to health services in general hospital in Sumenep Regency. This study using a sample of 100 respondents where the sampling technique uses purposive sampling and the respondents were patients who visited for treatment at the general hospital in Sumenep Regency. Result showed that public were prioritized the speed and reliability of nurses and doctors in handling patients and the public satisfaction index is 86.4, means the quality of service is at the value of A, which means the service of the general hospital in Sumenep Regency is very good. The pattern of relationships that affect community satisfaction lies in the emphaty and tangible attributes.
KEYWORDS: satisfaction, health service, general hospical, public satisfaction index

INTRODUCTION

Customer service assessments have been carried out based on the concept of quality of service performed by Patawayati, et al. [1]. Assessment of service quality by customers is assessed from several aspects, namely service company services, customer perceptions and differences between consumer expectations of service and actual performance of the service itself. Public services organized by the local government are one of the public services in the health sector. The general hospital as the organizer should provide services that are in accordance with the standard of service quality procedures that have been determined by each general hospital and that has been determined by the local government. This efforts aims to carry out health services for the community in increasing customer satisfaction.

Some of the main causes of public dissatisfaction with health services include lack of drugs supplies, long waiting times, poor information provision, poorly maintained privacy, a dirty environment, and insufficient visiting hours [2]. Users generally feel dissatisfied with the organization inefficiencies, delays and problems of hospital infrastructure, while they are quite satisfied with the behavior and work of health professionals. To solve this problem, a strategy is needed with the objectives and priorities set, namely by planning actions, monitoring and controlling training without dividing the two service factors above [3]

But in the reality that is in the field all this time, especially poor people tend not to pay attention to their health. This is because of their inability to get expensive services. Many of them, if they experience illness, usually take them to a shaman or are given traditional medicine, which of course is not necessarily safe for consumption by people. One of the reason the patient will return to visit the hospital is the service that provided by the organizing party to the patient according to the procedure and providing effective and efficient services. But, in most general hospitals there are still problems with quality and effectiveness in services such as complaints that are often experienced by patients who use public health services such as the friendliness of employees and nurses and doctors. And also there are still problems such as, inadequate facilities, drug supplies, service delays, medical equipment, health service rates and others. Therefore, this study was conducted to determine how satisfied patients who use health services in the general hospital of Sumenep Regency.

The aim of this study is to determine the priority quality of health services that are prioritized in order to meet the public satisfaction in Sumenep Regency, to determine the public satisfaction index and to determine the pattern of relationships between dimensions of service satisfaction to health services in Sumenep Regency general hospitals.

***Corresponding Author:** Aryo Wibisono, Faculty of Economy and Business, University of Wiraraja, Sumenep, Indonesia. Email: aryo.wibisono45@gmail.com

METHODS

In this study using the population of Sumenep Regency who have used health services in the regional general hospital Sumenep Regency, so the population is not known with certainty, then using sampling techniques [4-7] as follows :

$$n = \left(\frac{Z\alpha/2}{E}\right)^2 => n = \frac{1,96}{0,20} = 96 \text{ participants}$$

Information:

n = Sample size

Zα/2 = Normal standard value with 5% confidence level

E = The level of determination used by suggesting a maximum error of 20%.

This study using a sample of 96 respondents will be rounded to 100 respondents, where the sampling technique uses purposive sampling in which the respondents in this study were patients who visited for treatment at the Sumenep Regency general hospital.

In this study using a measurement tool, where to conduct a satisfaction analysis of the people of Sumenep Regency towards health services, identify the variables as Table 1 follows:

Table 1. Variable atrributes

Responsive
1. The speed and accuracy of the services of doctors and nurses in handling patients
2. Response of doctors and nurses to give services in handling patients
Reliability
1. Knowledge of doctors in diagnosing disease
2. Ease of procedure in service
3. Accuracy of operating hours
4. Discipline of doctors and nurses at work
Emphaty
1. Hospitality when handling patients
2. Nurse friendliness when handling patients
Assurance
1. Accuracy of diagnosis of the disease by a doctor
2. Accuracy of prescriptions given by doctors
3. The cost of checking a doctor is still reasonable
Tangible
1. The facilities in the room are good
2. Completeness of medical equipment
3. The hospital environment is clean
4. Comfort of the waiting room
5. Wear uniforms while on duty for doctors and nurses
6. Using identification on the duty of doctors and nurses

RESULTS AND DISCUSSION

Validity Test and Reliability

Before analyzing the data obtained, the validity test is the initial step to do, aims to know that the questionnaire used in making a statement can measure the public satisfaction as provided in Table 2.

Table 2. Validity Test

Variable Attributes	Importance	Satisfaction	Decision
Responsive			
1. The speed and accuracy of the services of doctors and nurses in handling patients	0.502	0.674	Valid
2. Response of doctors and nurses to give services in handling patients	0.502	0.674	Valid
Reliability			
1. Knowledge of doctors in diagnosing disease	0.450	0.709	Valid
2. Ease of procedure in service	0.536	0.882	Valid
3. Accuracy of operating hours	0.537	0.931	Valid
4. Discipline of doctors and nurses at work	0.562	0.895	Valid
Emphaty			
1. Hospitality when handling patients	0.555	0.443	Valid
2. Nurse friendliness when handling patients	0.555	0.443	Valid

Assurance			
1. Accuracy of diagnosis of the disease by a doctor	0.449	0.411	Valid
2. Accuracy of prescriptions given by doctors	0.411	0.680	Valid
3. The cost of checking a doctor is still reasonable	0.229	0.387	Valid
Tangible	0.484	0.442	Valid
1. The facilities in the room are good	0.590	0.418	Valid
2. Completeness of medical equipment	0.373	0.486	Valid
3. The hospital environment is clean	0.437	0.387	Valid
4. Comfort of the waiting roo	0.437	0.447	Valid
5. Wear uniforms while on duty for doctors and nurses			
6. Using identification on the duty of doctors and nurses	0.505	0.301	Valid

To find out the valid or not value, r-table calculations are performed. The following is how to calculate the r-table, the number of samples 100 (df = n - 2) and α = 5%, then the r-table value is 0.1654. Data from the table above, it is found that r-table < r-count so that all attributes of community satisfaction are declared valid.

After testing the validity, then proceed with the reliability test, this test is done to find out the error of the questionnaire that we have distributed, the questionnaire can be carried out further testing if it meets the requirements. Table 3 showed the value is still above, it can be concluded that the questionnaire data obtained is reliable.

Table 3. Reliability Test

General hospital	Interest	Satisfaction
Responsive	0,668	0,805
Reliability	0,731	0,759
Emphaty	0,714	0,599
Assurance	0,539	0,665
Tangible	0,737	0,682

Priorities in the Quality of Health Services

This analysis is conducted to find out which attributes are most preferred by the community in the process of health services in general hospitals. The following are the priority results of the 17 attributes of community satisfaction determined by respondents.

Table 4. Priority Attributes of General hospital

Priority Attributes of General hospital	Scale
The speed and accuracy of the services of doctors and nurses in handling patients	1
Alertness of doctors and nurses in handling patients	2
The cost of checking a doctor is still reasonable	3
Knowledge of the doctor in diagnosing disease	4
Accuracy of operating hours	5
The discipline of doctors and nurses at work	6
Nurse friendliness when handling patients	7
Hospitality friendliness when handling patients	8
Ease of procedure in service	9
The accuracy of the diagnosis of the disease by a doctor	10
The facilities in the room are good	11
Accuracy of prescriptions given by doctors	12
Completeness of medical devices	13
The hospital environment is clean	14
Comfortable waiting room	15
Wear uniforms while on duty for doctors and nurses	16
Use identification on the duty of doctors and nurses	17

Table 4 showed that the most important priority for the community is the first order "speed and accuracy of the services of doctors and nurses in handling patients". Public considers nurses and doctors who are in hospital are

competent in their fields, so they want speed and accuracy in handling patients. The the lowest priority is "using the identity tandal on the duty of doctors and nurses, because this attribute is not so much noticed.

Public Satisfaction Index of Health Service in General Hospital

Table 5. Public Satisfaction Index in General hospital

Index	Index Conversion	Service Quality	Service Unit Performance
3,45	86,4	A	Very Good

Table 5 interpreted that the majority people who have used health services at Sumenep Regency general hospital expressed satisfaction, because the public satisfaction index got a value of 3.45 and was converted to 86.4 so the quality of service getting A, indicates that the service performance was very good.

Relationship Pattern of Service Satisfaction Dimensions to Health Services Sumenep Regency General Hospital

Determining the pattern of health services by using logistic regression analysis, the dependent variable is public satisfaction and independent variable is reliability, empathy, assurance and tangible. If the dependent variable (Y = 0), then the community does not feel satisfied with the general hospital services, and then the dependent variable (Y = 1) then the community towards the general hospital services. Here are the steps:

Parameter Significance Test

The formation of a simultaneous logistic regression model aims to obtain an appropriate and simple model based on factors that are considered to influence the response variable. The results of the multivariate significance test on hospital satisfaction data are as follows.

Hypothesis:

H0: $\beta1 = \beta2 = \beta3 = \beta4 = \beta5 = 0$ (There is no significant effect between independent variables and hospital satisfaction)

H1: There is at least one $\beta j \neq 0$ with j = 1,2,3,4,5 (There is at least one of the independent variables that has a significant effect on satisfaction in the hospital)

Table 6 shows the results of multivariate parameter significance testing. By using a significant level (α) of 0.05 and the rejection area H0 is rejected if $\chi2 > \chi2$ (0.025; 5) and / or P-value <α then the decision is accepted H0 because 43.998> 11.0705 and 0.000 <0.05 so it can be concluded that there is at least one independent variable that has a significant effect on satisfaction in the hospital.

Table 6. Parameter of Significance Test

		Chi-square	df	Sig.
Step 1	**Step**	43,987	5	,000
	Block	43,987	5	,000
	Model	43,987	5	,000

Model Estimation Test

This test aims to estimate model that is formed to ensure that there really is a significant independent variable. Based on the Table 7. the logistic regression model as follows:

$$\pi = \frac{e(-13,331 - 0,164X_1 - 0,303X_2 + 0,825X_3 - 0,344X_4 + 3,904X_5)}{1 + e(-13,331 - 0,164X_1 - 0,303X_2 + 0,825X_3 - 0,344X_4 + 3,904X_5)}$$

Table 7. Model Estimation Test

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	Responsive	-,164	,337	,237	1	,626	,849
	Reliability	-,303	,478	,400	1	,527	,739
	Emphaty	,825	,404	4,162	1	,041	2,282
	Assurance	-,344	,542	,401	1	,526	,709
	Tangible	3,904	,898	18,880	1	,000	49,577
	Constant	-13,331	3,014	19,566	1	,000	,000

At a significant value <0.05, the dimensions of satisfaction that have an influence on health services in general hospitals are two, they are emphaty and tangible dimensions with each significant value of 0.041 and 0.000.

In empathy dimensions have a positive relationship with public health services, that means when doctors and nurses who handle patients should have a sense of friendliness towards the person who is treated there, by serving with all their heart and smile because the patient will feel comfortable and satisfied with the treatment. Therefore, every doctor and nurse on duty should serve with all their heart so that the patient will be satisfied 2,282 times compared to the ignorant and unfriendly.

Then for tangible dimensions, the positive relationship with public health services happened when they chooses a hospital based on the building and environment condition in the hospital, they need a comfortable place and complete facilities. Therefore, if the hospital implements it, the patient will feel satisfied by 49,577 times compared to the hospital that does not make improvements in the building or facilities.

The suitability of the model

This test was conducted to determine the feasibilty of the model produced based on multivariate logistic regression. There is no difference between the results of observations and possible predictions of the model. Model suitability testing is carried out with the following hypothesis.

Hypothesis:

H0 : Appropriate model (there is no significant difference between the results of observations with possible predictions of the model)

H1 : The model is not suitable (there is a significant difference between the results of observations with possible predictions of the model)

Table 8. Test of The Suitability of the Model

Step	Chi-square	Df	Sig.
1	6,533	8	,588

By using a significant level of 0.05 and the rejection area H0 is rejected if >2> χ2 (0.025; 5) and / or P-value <α then the decision of H0 is rejected because 6.533 <15.507 and 0.588> 0.05 so it can be concluded that the model corresponding.

Table 9. Determination Test

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	93,199[a]	,356	,477

The model formed has a R^2 value of 0.477 which means that the variability of the model explained by the five independent variables is 47.7% while the remaining 52.3% is explained by other independent variables that are thought to affect the model.

Classification accuracy

Table 10. Data Classification

Observed	Predicted	Y		Percentage Correct
		1	2	
Y	1	31	13	70,5
	2	10	46	82,1
Overall Percentage				77,0

The classification accuracy of this model is useful to find out whether the data is classified correctly or not. Table 10 shows that, of the 41 respondents who were satisfied with general hospital, there were 31 respondents correctly predicted by the model. As well as 59 respondents who felt dissatisfied with the general hospital, there were 46 respondents correctly predicted by the model. So that as a whole there are 77 out of 100 respondents can be predicted correctly by the model that is equal to 77%.

CONCLUSION

The main priority of patients towards health services in Sumenep General hospital is the speed and accuracy of the services of doctors and nurses in handling patients. The majority of the public feel satisfied with the service carried out by the hospital with the index of value of 3.45 (conversion value is 86.4) which means that the quality of service is A grade (very good). Service attributes that have a direct impact on patient satisfaction are emphaty and tangible attributes, namely satisfaction with the friendliness of doctors and nurses in serving

patients so that patients feel comfortable in treatment. In addition, buildings and environments in hospitals that do not seem shabby, and are well organized so that patients treated there feel calm.

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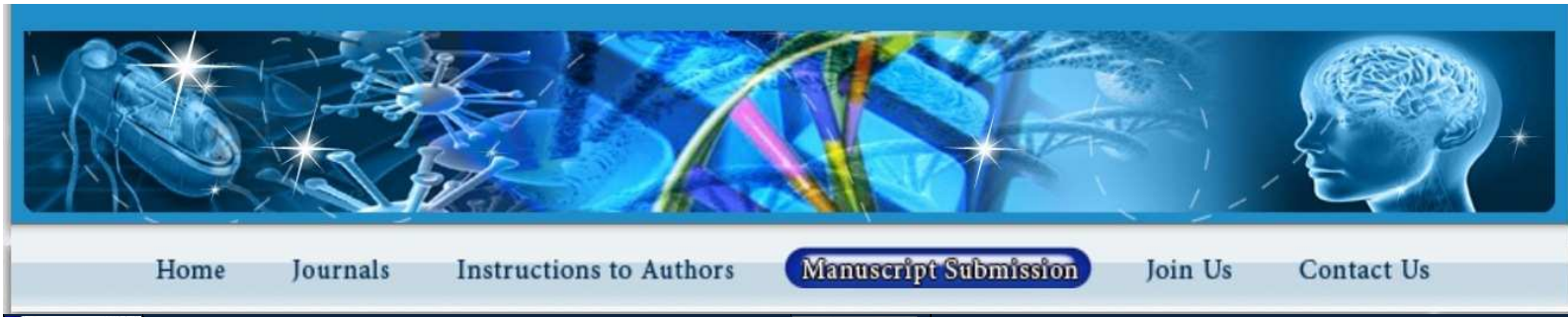

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