STUDIES OF URANIUM AFFECTED DRINKING WATER AND SOIL OF DISTRICT KARAK, KPK AND ITS EFFECT ON PLANTS GROWTH.

By

SHAKEEL REHMAN

Department of Bioinformatics &Biotechnology Faculty of Basic and Applied Sciences International Islamic University Islamabad

(2018)

STUDIES OF URANIUM AFFECTED DRINKING WATER AND SOIL OF DISTRICT KARAK, KPK AND ITS EFFECT ON PLANTS GROWTH.

Reg #246-FBAS/MSBT/S16

Researchers Shakeel Rehman

Supervisor Dr Jabar Zaman Khan Khattak
Associate Professor
International Islamic University Islamabad

Co-Supervisor Dr. Jamil Khattak
Associate Professor
Kust University

Department of Bioinformatics &Biotechnology Faculty of Basic and Applied Sciences International Islamic University Islamabad

2018)

Department of Bioinformatics &Biotechnology Faculty of Basic and Applied Sciences International Islamic University Islamabad

(2018)

Department of Bioinformatics &Biotechnology International Islamic University Islamabad

Dated: 4/6/2018

FINAL APPROVAL

It is certificate that we have read the thesis submitted by Mr. Shakeel Rehman and it is our Judgment that this project is of sufficient standard to warrant its acceptance by the International Islamic University, Islamabad for the M.S Degree in Biotechnology.

COMMITTEE

External Examiner

Dr. Shazia Erum

Senior Scientific Officer

PGRI, NARC Islamabad

Internal Examiner

Dr. Arshad Malik

Assistant Professor

Department of BI & BT

Supervisor

Dr. Jabar Zaman Khan Khattak

Associate Professor

Department BI & BT

International Islamic University, Islamabad

Co-Supervisor

Dr. Muhammad Jamil

Associate Professor

KUST, Kohat

Chairman

Dr. Asif Mir

Department BI & BT

Dean, FBAS

International Islamic University, Islamabad

A thesis submitted to Department of Biotechnology and Bioinformatics,
International Islamic University, Islamabad as a partial
Fulfillment of requirement for the award of the
Degree of (MS Biotechnology and Bioinformatics)

DEDICATION

Every challenging work needs self-effort as well as Gaudiness of elders especially those who were very close to our heart. My humble effort I dedicate to my sweet and loving.

Father and Mother

Whose affection, love, encouragement and prays of day and night makes me able to get such success and honor, along with all hard working and respected

Teachers

DECLARATION

I hereby declare that the work present in the following thesis is my own effort, Except where otherwise acknowledged and that the thesis is my own composition. No part of the thesis has been previously presented for any other degree.

Date 4/6/2018

Shakeel Rehman 

TABLE OF CONTENTS

List of Abbreviations

S.NO		
1	GMC	Geiger Muller Counter
2	WHO	World Health Organization
3	JAEC	Jordan Atomic Energy Commission
4	SV	Stipa Viridula
5	LS	Lygeum Spartum
6	CS	Containminted Sample
7	FTT	Fission Track Technique
8	ENU-SA	Empresa Nacional do Uranio
9	DRPS	Department of Radiological protection and Safety

ACKNOWLEDGEMENTS

Words are bound and knowledge is limited to praise ALLAH, The most Beneficent, The Merciful, cordial and the empathetic whose bounteous and exaltation flourished thoughts and thrived ambitions to have the cherish fruit of modest efforts in the form of his manuscript from the blooming spring of blossoming knowledge.

Special honor for the Holy Prophet Hazrat Muhammad (Peace Be Upon Him), the greatest educator, the everlasting source of guidance and knowledge for humanity. He taught the principles of decency and endless values.

Words cannot explain our heartfelt gratitude to our research supervisor Dr .Jabar Zaman Khan Khattak, Department of Bioinformatics and Biotechnology, who has always provided optimistic encouragement, precious suggestions, guidance, vigilant evaluation and constructive comments.

Shakeel Rehman

Reg #246-FBAS/MSBT/S16

MS Bioinformatics & Biotechnology

ABSTRACT

The aim of the present study is to find the uranium distribution in the soil and drinking water of District Karak. It is also to examine the effect on plant growth. Four different samples were taken to examine the presence of uranium distribution in soil and water. Uranium effect on plant growth was also estimated. The collected soil and water samples from three main locations these areas were mainly from Uranium mine and two near villages. The collected plants and grasses include Plum (*Ziziphus mauritiana* L*)*, Kekar (*Vachellia nilotica* L) and Shisham (*Dalbergia Sissoo* L). The grasses (*Stipa viridula* L), (*Lygeum spartum* L) and (*season grass* L) are also included. The collected plants containing (*leaves and roots samples*) were examined. The weights of these samples before and after oven dry were noted. The non contaminated samples from other village Sabir Abad *(Tehsil Karak)* were collected to compare it with the contaminated sample. For the water samples were sent for testing procedure but they do not allow us to give the proper results due to some national security issues, and then Geiger muller counter was used. The soil samples of Shanawa Gudi Khel were compares with Sabir Abad to check uranium concentration and to get the result. Soil samples of Shanawa Gudi Khel have more concentration as compares to Sabir Abad. (Present study)

After Geiger muller counter effect of uranium on plant growth was examined. The effect on grasses and vegetables were examined. In grasses sample named as (*Stipa viridula* L), which are mostly eaten by the animals have high concentration of uranium and it is unsafe for the animals. Animals of these area die mainly due to high concentration of uranium and these animals mainly suffer from bone marrow cancer (Hospital data).

It affects the growth of vegetable like tomato (*Solanum lycopersicum* L) lady finger (*Abelmoschus esculentus* L) and some other vegetable. Due to high quantity of uranium growth of these vegetables are so rare. It also affects the growth of trees that is mainly Kekar (*Vachellia Nilotica* L) . (Present study)

Key Words:

Uranium, Water, Soil Plants, Fission Track Technique, Geiger Muller Counter

I. INTRODUCTION

Uranium has been originated since the creation of the universe. Uranium in different concentration present as heavy metal in all soils, surface and ground water. In soil it is present with composition of 238U (>99%), 235U (0.72%) and 234U (<0.01%). High abundance by weight naturally occurring 238U is of high interest. Uranium comes from rocks have high minerals. Through leaching processes uranium enters into water from the naturally occurring deposits (Chen and Yiacoumi, 2002). Its chemical and radiological toxicity are too high, so the quantitative estimation of uranium is very important.

Uranium and its salts are present in +2, +3, +4, +5, +6, oxidation states and are highly toxic. The most prevalent are +4 and +6 oxidation states. Hexvalent compounds are more water soluble then tetravalent compounds. Uranium includes hexavalent compounds so the chemical toxicity of ingested uranium is too high. Through water and food it enters into human body. Through ingestion, uranium rapidly comes in the blood stream and then meets with the RBC. It accumulates in the kidneys and skeletons after sequential phases and destroys it, permitting normal release of waste products. The amount of uranium concentration in drinking water should be less than 15g/l recommended by WHO (WHO 2004).

Geographical area of District Karak is 2,650 sq. km. It is one of the populated Districts. Mainly three Tehsil i.e. Banda Daud Tehsil Karak, Shah and Takht-e-Nasrati are present. The uranium mineralization has been discovered in the east of Takht-e-Nasrati to Shanawa Godi-Khel area within a north-south strip of 19 km in the form of yellow colored secondary uranium mineral carnotite (K2UO2)2(VO4).3H2O (Hussain Ullah *et al.,* 2013).

In radionuclide's form uranium are naturally present in the environment. Inflammatory reactions take place in the nasal kidney damage. Respiratory effects such as lung disease occur mainly due to (long-term) inhalation of uranium in humans. Radium includes leucopenia. Radionuclide includes cancer. In humans radium causes Bone tumors while radon causes lung cancer (Akram *et al.,* 2004).

Uranium has several applications in nuclear plants and weapons. In photography in small amounts uranium is also used. It is used for the purpose of silk and dyes in wood industries. An amount of 0.0007 to 0.007 picocuries per day should be used.U-238 is mostly present in soil and rocks. Various tests of animals had showed that uranium has low concentration in mice. Uranium shows kidney disorder. Toxic effect is built by ATSDR which will decrease risk level for uranium (soluble salts) (MRL) of 0.0003 milligrams per cubic meter (mg/m) which cause renal tubule disease in dogs. The daily human exposure is noted by MRL of dangerous agents (ATSDR, 1999).

Natural uranium has three (isotopic) forms. Uranium is a silver-colored radioactive metal. 99% of U 238 and 0.005% U 234 is present. The heavy metals that are present for plant that is easily soluble by root (Aerb, 2004).

From a large area when a contaminant is come out, it enters into the environment. If you are near to uranium you can also be exposed to its radiation since uranium is radioactive. Even if you are in touch to uranium, you might not be affected. When you are affecting it also depend on whether you are in touch to any other chemicals or radioactive materials. The half-lives of uranium isotopes are very long. Half life is defined as time needed for half isotope to give its radiation. U 238 is major isotopewith4.5 billion years of half life. Unprotected U contains the same three U isotopes. Uranium concentration in any plant exceeding 2 ppm may indicative of a geologically favorable situation for uranium deposit. (Chen and Yiacoumi, 2002).

Uranium comes in nature mainly through wind. Uranium is present in air, soil and water. In the air, it is present as dust. In water uranium is present in higher level to form wells drilled. In soil it exists in the form of rocks and all soil. Plant physiologist's shows that uranium is a necessary nutrient for plant growth (Cannon, 1957).

Uptake of radionuclide by plants depends on the plant species, the radionuclide and on substrate characteristics (Dunn and Byman, 1985).The root uptake of nutrients and other mineral elements (as well as radionuclide's) takes place via the soil solution. The uranium is an essential nutrient for higher plants and radishes showed a response to soil uranium similar to nutrient elements (Mengel and Kirby, 1979).Keeping the above in view the effect of different concentrations of uranyl acetate is studied on the growth performance of barley in soil (Timperely and Peterson, 1970).

Different national health authorities' shows limits range between 10 g/L. Limit for uranium concentration which is recommends by the World Health Organization (WHO) is 15 g/L for daily water consumption of 2 L per day (Windom *et al.*, 2000). In much surface uranium is a mainly mobile element. The amount of uranium in seawaters is 3.3 µg/ L, and it gradually decrease in freshwater (Domingo *et al.*, 1999).

Uranium and its salts are present in the high danger with various valance states. Hexavalent states are the widespread one. In water, other food items the hexavalent state is mainly important. Water also consists of less amount of uranium which may cause danger to the human food (Shafique *et al.*, 2004).

Uranium is much highly chemically toxic mainly due to radioactivity. It is dangerous when exceed in limit. By leaching processes or through human activity it may enter into drinking water i-e mining .It comes into the body of human through ingestion and almost all the uranium which is ingested is removed. Through bloodstream it is carried into the kidneys. This ingestion causes kidneys failure, which results in renal dysfunction. (*Cothern and Lappenbusch*). Minimization in rice plants height is examined. For Cd, minimization in shoot and root growth in wheat plants take place (Kabata Pendias, 2001).

There is an increase in nutrient content of tomato plants when compared with the control. Another study noted that the heavy metals i.e. (Cd, Cr, and Pb) have effect on the growth of maize. Cancers of Gastrointestinal are mostly present in the universe. 20-25% of all cancer deaths are due to this disorder (Longo, 1998).The regions where cancer are mostly present have desert and high rocks areas. Also metals are present in soil and contain some of the toxic compounds. From various studies we have found that high rate of cancers, mostly GI Ca in such regions where these metals, and also there products are present in nature which are polluted with industrial waste (Peeters, 1987, Boffetta, 1993, Hayes, 1997). In this study the heavy metal in soil water and plants samples of district Karak are observed.

It is important to note that certain plants are able to allow high concentration of heavy metals in their environment. Baker found that these plants are able to allow these metals via 3 mechanisms, namely, (Baker 1997). (i) exclusion: restriction of metal transport and maintenance of a constant metal concentration in the shoot over a wide range of soil concentrations; (ii) inclusion: metal concentrations in the shoot reflecting those in the soil solution through a linear relationship; and (iii) bioaccumulation: accumulation of metals in the shoot and roots of plants at both low and high soil concentration (Baker 1997).

Through inhalation or ingestion uranium enters into the body and then into the bloodstream and at last it comes in tissues, mostly kidneys. Kidney and also defect of liver, muscles occur from animal and human exposed to Uranium. (Taylor *et al.,* 1997). Cadmium (Cd) is present in organs and Lead (Pb) has effects on the nervous and reproductive systems. Selenium (Se) cause neurological problems (Kirkam M.B 2006).

In vegetables study of heavy metal contamination is not so easy. Vegetables contain vitamins and fibers. Vegetable containing heavy metal have a danger effect on human health. Heavy metal contamination in the food is one of the most important issues (Radwan a and Salama, 2006).From environments and contaminated soil plants take up heavy metals by absorbing them from their parts.(Khairiah *et al.,* 2004 & Jassir *et al.,* 2005)

Various heavy metals such as iron (Fe), manganese (Mn), zinc (Zn), copper (Cu) are necessary for the organisms. There are other heavy metals which perform a single function i.e. vanadium (V) in some peroxidases. These heavy metals are always dangerous to organisms and it should not be keep remain i.e. cadmium (Cd), lead (Pb), uranium (U), thallium (Tl).Arsenic (As) and selenium (Se) are non heavy metals. But they shows toxicity when they meet with heavy metals, and they are mostly termed as to as "metalloids". There are many heavy metals i.e. Cu, Zn, and Mo which act as micronutrients for the growth of animals and human beings, whereas others i.e. Cd, As, and Cr act as carcinogens (Feig *et al.,* 1994).

Objective of the Study

The purpose of this study is to investigate the uranium distribution in drinking water and soil sample.

To determine its effects on plants growth.

II. REVIEW OF LITERATURE

Human beings are constantly exposed to ionizing radiation in nature. Measurement of uranium concentration is important in radio-epidemiological assessment, diagnosis. Kurttio *et al.,* 2002 have measured the uranium concentrations in drinking water and urine .The uranium concentration in drinking water is 2 8 μ gl-1 (Kumar *et al.,* 2011).

Kim *et al.,* 2004 have examined the uranium concentration in groundwater of Korea. Amakom *et al.,* 2010 have reported that, in Nigeria the measured concentration of uranium ranges from 0.51 to 6.77 μgl-1.Singh *et al.,* 2009 have measured the uranium concentration in water taken from Upper Siwaliks, Northern India. This value is from 1.08 to19.68 μgl-1. Kumar *et al.,* 2003 have reported that uranium concentration in the water samples varies from 1.65to74.98 μgl-1. Mehra *et al.,* 2007 have employed the fission technique for uranium concentration in Malwa region of Punjab. This value is found in the range of 5.41to 43.39 μgl (Ahmad, Akhtar *et al.,* 2012).

Kibra 2008 examined decrease in height of rice plants with 1 mgHg/kg. Reduced tiller and panicle formation also occurred at this concentration of Hg in the soil. For Cd, reduction in roots of wheat plants occurred when Cd in the soil solution was as low as 5 mg/L. For instance, Jayakumar *et al.* reported that, at50 mgCo/kg, an increase in nutrient content of tomato plants compared with the control. Conversely, at 100 mgCo/kg to250 mgCo/kg, reductions in plant nutrient content were recorded. Nicholls and Mal have reported that the combination of Pb and Cu at both high concentration (1000 mg/kg each) and low concentration (500 mg/kg) resulted in a rapid and complete death of the leaves and stem of Lythrum salicaria (Eldar, Jordan 2015). Fission Track Technique used for determination of uranium in drinking water samples (Hussain Ullah et. al., (2013)

In 2007 the Jordan government finalized its plan to make nuclear power. This natural fuel (uranium) development stock is introduced by Officials not only as a fix stock but also is a energy source (Dawood and, Sayidh 2005). Jordan Atomic Energy is built in 2008, Commission (JAEC), and its Chairman pointed that it should be used for uranium mining.

The first step of Jordan's nuclear program is mining and extraction of uranium. It includes essential money being present in trade quantities in Jordan".(Haddad *et al.,)* Gamma airborne survey is performed in 1980, in whole country which shows that 11 areas contain high background measurable amount up to 2000 counts per second (cps).

For the production of uranium in Portugal, 60 deposits of radioactive ore are obtains between 1908 and 2001.The property of this company, Empresa Nacional do Urânio (ENU-SA), in 2001have been moved to the (EDM). For this purpose they arrange a programme in 2006 in the places where uranium mines sites are present and they started execution of this programme in 2007.These regions need a regular monitoring to confirm the estimation of radioactivity and to produce data for the protection that contain protection of the natural stock i-e, animal products and also soils. Among the previous 20 years the Department of Radiological Protection and Safety have performed monitoring. In 2001when stopping of all mining activities take place then a new period should be start.

Among ten year radioactive waste is examined and mining right areas are of limited entrance and examine by the (JEN) and then by (ENU).In uranium mining areas the estimation of radioactivity levels is start again through a research project and pointed at recognizing in those regions. IAEA support this project, assign to reanalyze the places of uranium, search the surrounding radiation doses (Batista AS 2005).

Forest model of Avila 2006 consist of different types of soil trees .Concentration ratio (CR) usually examine plant uptake mostly called transfer factor which is then calculated plant U concentration divided by soil concentration (Avila 2006 IAEA 2010) .Soil PH in soil, is one of the main factors which affect U.UO2 2+ is the mostly taken up and move by plants. This U concentration in different plant parts causes difference in CR of plant. Different

changes in U concentration of plant parts have also been examine. Dicotyledonous plant has more chances to accumulate more U than monocotyledon plant (Shahandeh and Hossner 2002).

Cancers of Gastrointestinal are mostly present in the universe. 20-25% of all cancer deaths are due to this disorder (Longo, 1998).The regions where cancer are mostly present have desert and high rocks areas. Metals are present in soil and contain some of the toxic compounds. From various studies we have found that high rate of cancers, mostly GI Ca in such regions where these metals and their products are present in nature which are polluted with industrial waste (Peeters, 1987, Boffetta, 1993 and Hayes 1997).

In agriculture plant uranium concentration has been studied from soil to plant transfer. (Shahander and Hossner 2002) Here uranium concentration and heavy metal in soil and water sample is studied and also its effect on plant growth is observed.

In Saudi Arabia (Jassir *et al.,* 2005) it was found that the levels of heavy metals in vegetables. These vegetables were taken from Riyadh city. Later on it was found that mainly it occur due to atmospheric dethronement. Recently, *Sharma et al.,* (2008) have search that atmospheric dethronement importantly promote the heavy metals decay in vegetables commonly present in Varanasi, India. Heavy metal variation has been grown by plants of totally different structure. It is found in Brassicaceae and Caryophyllaceae, Poaceae, and others. Approximately 34 various plant families have grown heavy metal liberal species (Verbruggen *et al.,* 2009).

III. MATERIALAND METHOD

3.1. Site Description:

Karak is also one of the populated districts with in Khyber Pakhtunkhwa. Its area is 2,650 sq. km. Comprises of three Tehsil Karak, Banda Daud Shah and Takht-e-Nasrati. Different types of rocks are present in District Karak.

The uranium concentration in natural water changes from region to region due to different rocks and water composition, climatic changes and flow system of ground water. Three different types of radioactive sandstone horizons have been investigated. The uranium mineralization has been discovered in the east of Takht-e-Nasrati to Shanawa Godi-Khel area within a north-south strip of 19 km in the form of yellow colored secondary uranium mineral carnotite (K2UO2)2(VO4).3H2O (Azizullah and Hamid Khan 1997).

3.2. Sample Collection and Analysis:

3.2.1. Contaminated Sample:

Water Sample:

The collected samples were taken from Tehsil Takht-e- Nasrati, mineralization of Uranium were present in the east of Takht-e- Nasrati (*Shanawa Godi-Khel*). Water samples three main areas (Shanawa Gudi Khel, Zarkai and Darsha Khel) were collected from different sources such as pressure pump and tube well (Present study).

Soil Sample:

Soil samples were collected from Tehsil Takht-e- Nasrati which include clay sandy and normal soil. The collected samples were taken from uranium mineralization and the villages (Shanawa Gudi Khel, Zarkai and Darsha Khel).

Plant Sample:

Plant samples were collected from Tehsil Takht-e- Nasrati. The collected samples from different villages containing trees and grasses (*Leaves and roots*). The collected samples such as trees includes (*Ziziphus Mauritiana* L), (*Vachellia Nilotica* L) and (*Dalbergia Sissoo* L). Grasses also include (*Stipa viridula* L), (*Lygeum spartum* L) and (*season grass* L). The weight was measured before and after dried collected leaves and roots samples.

(*Stipa viridula* L)

(*Lygeum spartum* L)

(*Season grass* L)

Fig. 1

3.2.2 Non Contaminated Sample:

Non Contaminated samples were collected from District Karak (*Sabir Abad*) for the comparison with the contaminated sample, to observe the uranium concentration in the samples. Non contaminated samples include trees and grasses. The collected samples of tress comprise of *(Ziziphus Mauritian* L*), (Vachellia Nilotica* L*)* and (*Dalbergia Sissoo* L*)*. Grasses include (*Stipa viridula* L), (*Lygeum spartum* L) and (*season grass* L).The leaves and roots of both trees and grasses were taken (Present study).

Table no 1: Sample Description

Tables for Sample Description		
Plants collected	**Plant Name**	**Botanical Name**
Trees	Plum	Ziziphus mauritiana
	Kekar	Vachellia nilotica
	Shi sham	Dalbergia sissoo
Grasses	Needle grass Green	Stipa viridula
	Esparto grass	Lygeum spartum
	Lawn grass	Season grass

3.3.1 Measuring Techniques for Estimation of Uranium

This method was not accessible due to some national security issue so for these samples (*water, soil and plants)* Geiger Muller counter was used to estimate the uranium concentration in these samples.

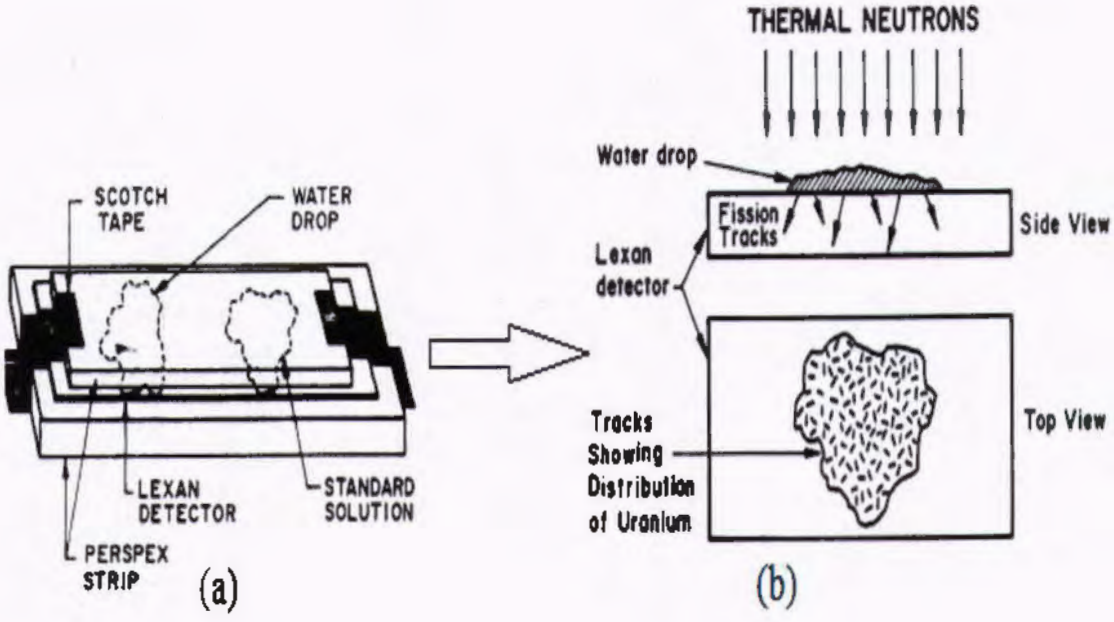


Fig. 2

3.3.2 Geiger Muller Counter

This assembly consists of a mixture of argon and ethyl alcohol (*Geiger Muller tube)* detector at low pressure and closed in a moisture proof cylindrical housing. Iron or tungsten is present in the interior which act as the cathode. At the center fitted with protecting plugs at both ends of the tube a thin metallic wire runs that act as anode. Composite count-rate meter is connected to the detector with the supply for construct-in high voltage power supply unit needed for the detector and suitable electronic circuits to draw the detected signals.

The gamma radiation released by the source surrounding the detector is disturbed by the cathode and the resulting interaction produces ionization in the tube resulting electric signals. The signals are raise by suitable electronic devices. The converted electrical signals are noted on the count rate meter which indicates the intensity of radiation in terms of current. Through Geiger Muller Counter we know the permissible concentration of uranium in water, soil and plant samples. Geiger Muller counter was also used for the above experiments to examine the uranium concentration in water, soil and plant samples (Glenn, 2000).

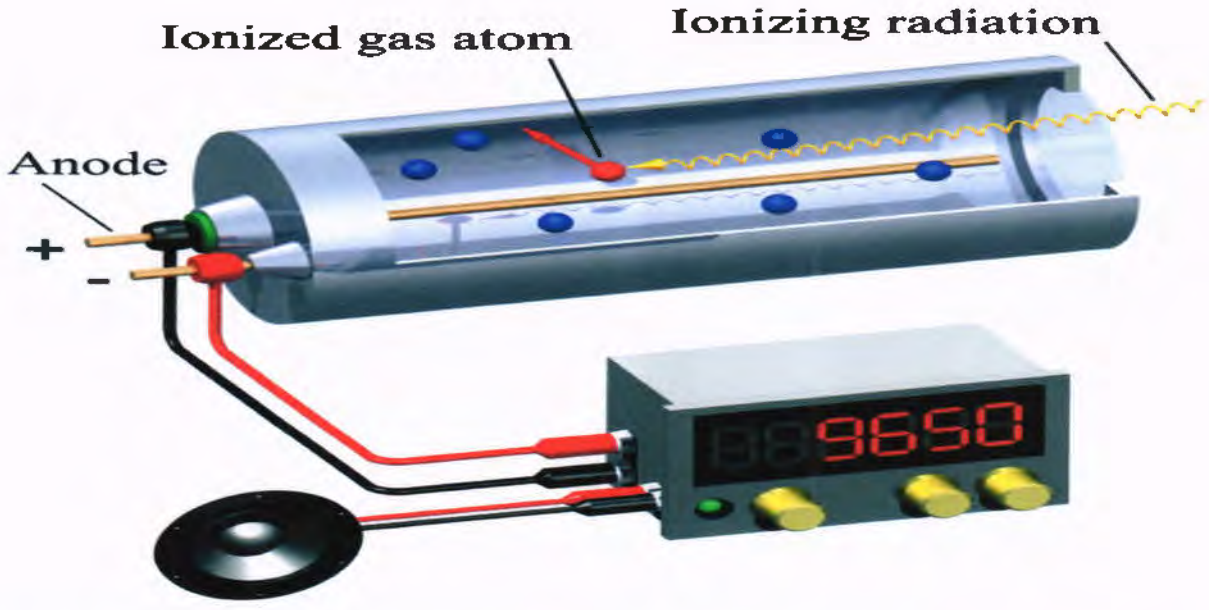


Table no 2: Natural uranium in the soil sources of Shanawa Gudi Khel and Mitha Khel.

Union Council	Sample No (Soil)	Location	Uranium Presence
Shanawa Gudi Khel	C1	Shanawa Gudi Khel	Yes
	C2	Zarkai	Yes
	C3	Darsha Khel	Yes
Mitha Khel	N1	Dab Sangeny	No
	N2	Sangatri	No
	N3	Tarkha kho	No

3.3.3 Effect of Uranium on plant Growth

The effect of uranium on plant growth (*grasses and vegetables*) were observed after performing Fission Track technique and Geiger muller counter. The collected grasses samples such as (*Stipa viridula* L) which are mostly eaten by the animals contain high concentration of uranium and it is unsafe for the animals.

The concentrations of uranium in vegetables were also high. The affects on growth of vegetables such as tomato (*Solanum lycopersicum* L) lady finger (*Abelmoschus esculentus* L) and many more were examined. Due to high uranium concentration growth of these vegetables are so rare. The affects on growth of trees such as Kekar (*Vachellia Nilotica* L) were also observed. (From questioner study)

Questionnaire

Name _____

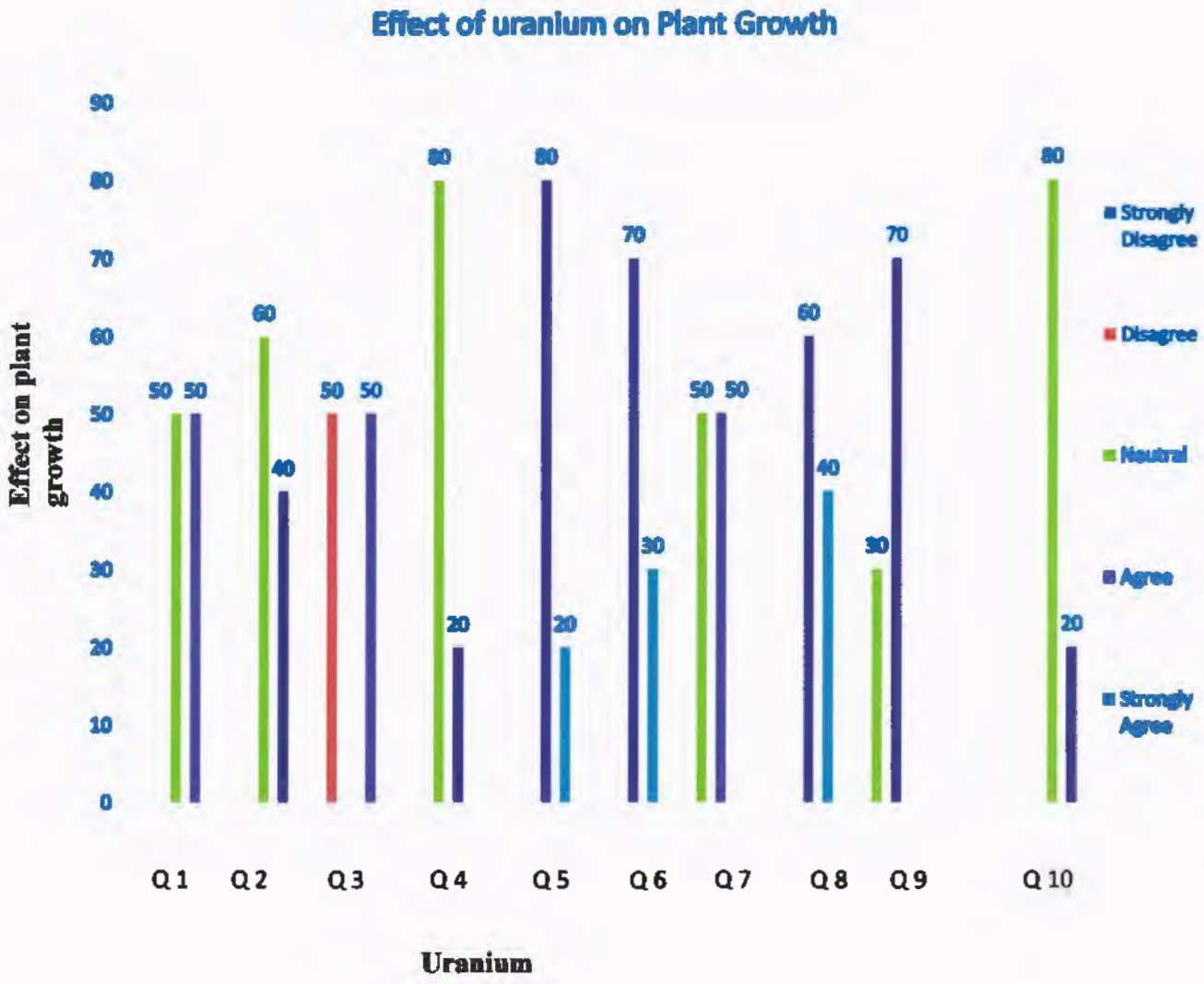
Age _____ **year**

Gender **Male** ☐ **Female** ☐

Profession _____

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

Effect of uranium on Plant Growth						
S/No	Question	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	Do you know about uranium and other heavy metal?			**50**	**50**	
2	Do you have some knowledge to use uranium?			**60**	**40**	
3	Is uranium are dangerous too?		**50**		**50**	
4	What is the growth of plant before and after?			**80**	**20**	
5	Do you think growth of plant is effected due to uranium?				**80**	**20**
6	Is uranium are hazardous for plant growth?				**70**	**30**
7	Do you think uranium have effect on environment?			**50**	**50**	
8	Do you think uranium causes diseases?				**60**	**40**
9	Do you believe uranium effect growth of trees and grasses?			**30**	**70**	
10	Are you satisfied with the existing facilities for uranium disposal in your areas?			**80**	**20**	


Effect of uranium on Plant Growth
Effect on plant growth
90
80
70
60
50
40
30
20
10
0
50 50
60 40
50 50
80 20
80 20
70 30
50 50
60 40
30 70
80 20
Q1 Q2 Q3 Q4 Q5 Q6 Q7 Q8 Q9 Q10
Uranium
Strongly Disagree
Disagree
Neutral
Agree
Strongly Agree

3.4 Water Content Ratio in Plants:

The collected Plant samples (*Leaves and roots)* were weighted before and after oven dried. The desired results of water content were found which are listed in the form of Tables and Figures. It shows that water absorption in uranium containminted areas is high in various plants and grasses of District Karak. Containminted sample (*leaves*) of tress (*Ziziphus mauritiana* L*), (Vachellia nilotica* L*)* have less water absorption than Non containminted sample (*leaves*) while *(Dalbergia sissoo* L*)* have high water absorption. Containminted sample (*roots*) of tress (*Ziziphus mauritiana* L*), (Vachellia nilotica* L*)* and *(Dalbergia sissoo* L) have high water absorption than Non containminted (*roots*) sample.

Containminted sample (*leaves*) of grasses (*Stipa viridula* L*), (Lygeum spartum* L*)* and *(Season grass* L*)* have less water absorption than Non containminted (*leaves*) sample. Containminted sample (*roots*) of grasses (*Stipa viridula* L*), (Lygeum spartum* L*)* have less water absorption than Non containminted (*roots*) sample while *(Season grass* L*)* have high water absorption.

3.4.1 Weight of Containminted and Non containminted fresh and oven dried leaves of trees (gm).

S/N	Trees Name	Containminted (Fresh weigh) (gm)	Containminted (oven dry) (gm)	Non Containminted (Fresh weight) (gm)	Non Containminted (oven dry) (gm)
1	*Ziziphus mauritiana*	10	5.5	10	4.35
2	*Vachellia nilotica*	10	6.54	10	7.21
3	*Dalbergia sissoo*	10	3.74	10	3.44

3.4.2 Weight of Containminted and Non containminted fresh and oven dried roots of trees (gm).

S/N	Trees Name	Containminted (Fresh weight) (gm)	Containminted (oven dry) (gm)	Non Containminted (Fresh weight) (gm)	Non Containminted (oven dry) (gm)
1	*Ziziphus mauritiana*	10	3.69	10	6.02
2	*Vachellia Nilotica*	10	3.34	10	3.56
3	*Dalbergia sissoo*	10	1.79	10	2.63

3.4.3 Weight of Containminted and Non containminted fresh and oven dried leaves of grasses (gm)

S/N	Grasses Name	Containminted (Fresh weight) (gm)	Containminted (oven dry) (gm)	Non Containminted (Fresh weight) (gm)	Non Containminted (oven dry) (gm)
1	*Stipa viridula*	10	4.30	10	3.50
2	*Lygeum spartum*	10	4.71	10	2.67
3	*Season grass*	10	3.27	10	3.17

3.4.4 Weight of Containminted and Non containminted fresh and oven dried roots of grasses (gm)

S/N	Grasses Name	Containminted (fresh weight) (gm)	Containminted (oven dry) (gm)	Non Containminted (Fresh weight) (gm)	Non Containminted (oven dry) (gm)
1	*Stipa viridula*	10	5.04	10	4.33
2	*Lygeum spartum*	10	2.15	10	2.06
3	*Season grass*	10	4.50	10	4.15

IV. RESULTS

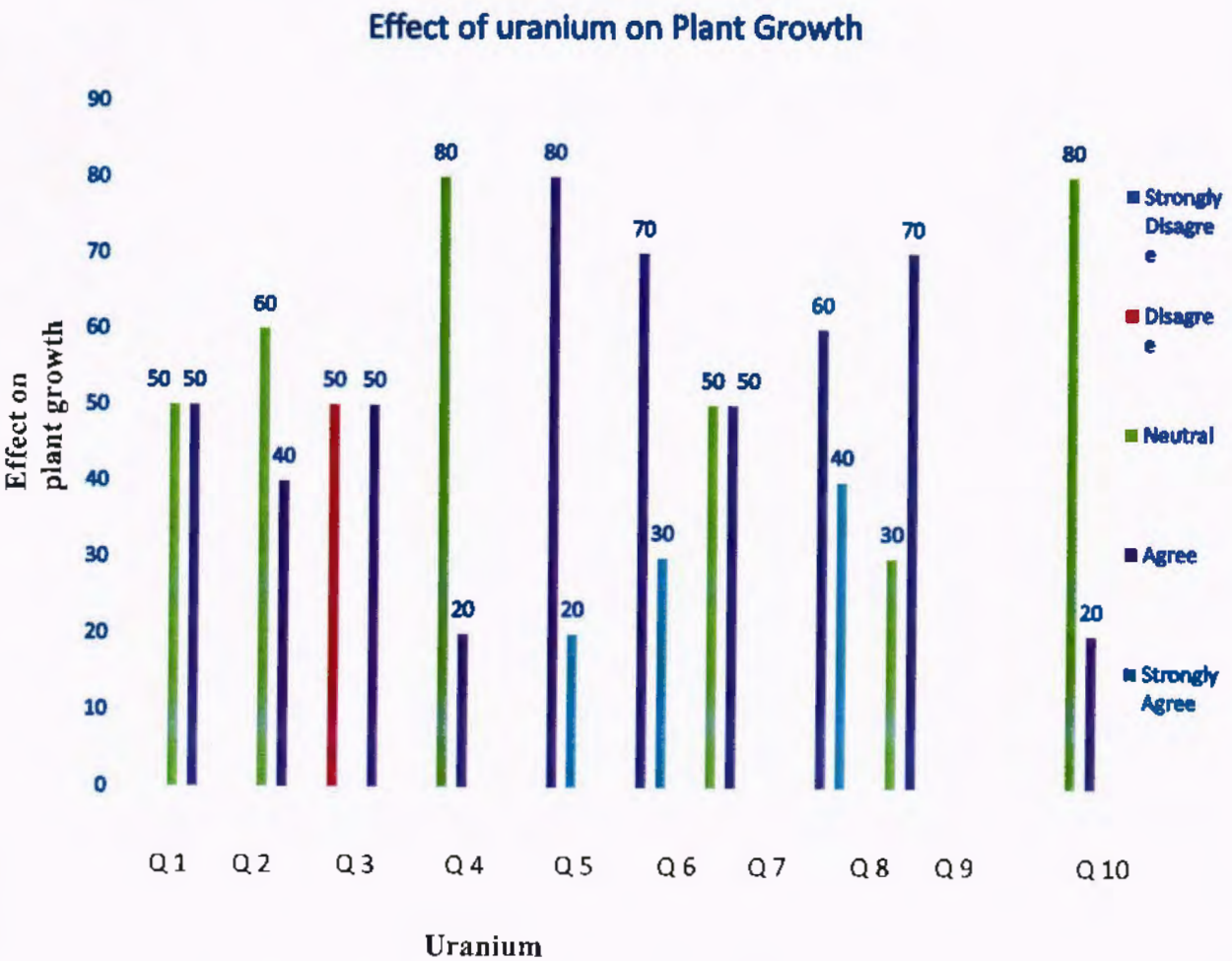
The uranium concentration in natural water changes from region to region due to different rocks and water composition, climatic changes and flow system of ground water. The experiments were performed to observe the uranium concentration in the soil of the Takht-e- Nasrati (*Shanawa Godi-Khel*).

In soil sample the uranium concentration were also observed, and the desires result were obtained. The results were obtained from the samples (*Shanawa Gudi Khel and Zarkai*).

Union Council	Sample No	Location	Uranium Presence
Shanawa Gudi Khel	C1	Shanawa Gudi Khel	Yes
	C2	Zarkai	Yes
	C3	Darsha Khel	Yes
Mitha Khel	N1	Dab Sangeny	No
	N2	Sangatri	No
	N3	Tarkha kho	No

From the above results it is concluded that soil of the Takht-e- Nasrati (*Shanawa Godi-Khel*) and the villages Zarkai have high concentration of uranium and it is unsafe for plants growth because it affects growth of vegetables and grasses.

In vegetable the effects on tomato (*Abelmoschus esculentus* L) and lady finger (*Solanum lycopersicum* L*)* were examined. Due to high uranium concentration growth of these vegetables are so rare. The affects on growth of trees such as Kekar (*Vachellia Nilotica* L) were also observed.



Containminted sample (*leaves*) of tress (*Ziziphus mauritiana* L*), (Vachellia nilotica* L*)* have less water absorption than Non containminted sample (*leaves*) while *(Dalbergia sissoo* L*)* have high water absorption. Containminted sample (*roots*) of tress (*Ziziphus mauritiana* L*), (Vachellia nilotica* L*)* and *(Dalbergia sissoo* L) have high water absorption than Non containminted (*roots*) sample.

Containminted sample (*leaves*) of grasses (*Stipa viridula* L*), (Lygeum spartum* L*)* and *(Season grass* L*)* have less water absorption than Non containminted (*leaves*) sample.Containminted sample (*roots*) of grasses (*Stipa viridula* L*), (Lygeum spartum* L*)* have less water absorption than Non containminted (*roots*) sample while *(Season grass* L*)* have high water absorption.

3.4.1 Weight of Containminted and Non containminted fresh and oven dried leaves of trees (gm).

S/N	Trees Name	Containminted (Fresh weigh) (gm)	Containminted (oven dry) (gm)	Non Containminted (Fresh weight) (gm)	Non Containminted (oven dry) (gm)
1	*Ziziphus mauritiana*	10	5.5	10	4.35
2	*Vachellia nilotica*	10	6.54	10	7.21
3	*Dalbergia sissoo*	10	3.74	10	3.44

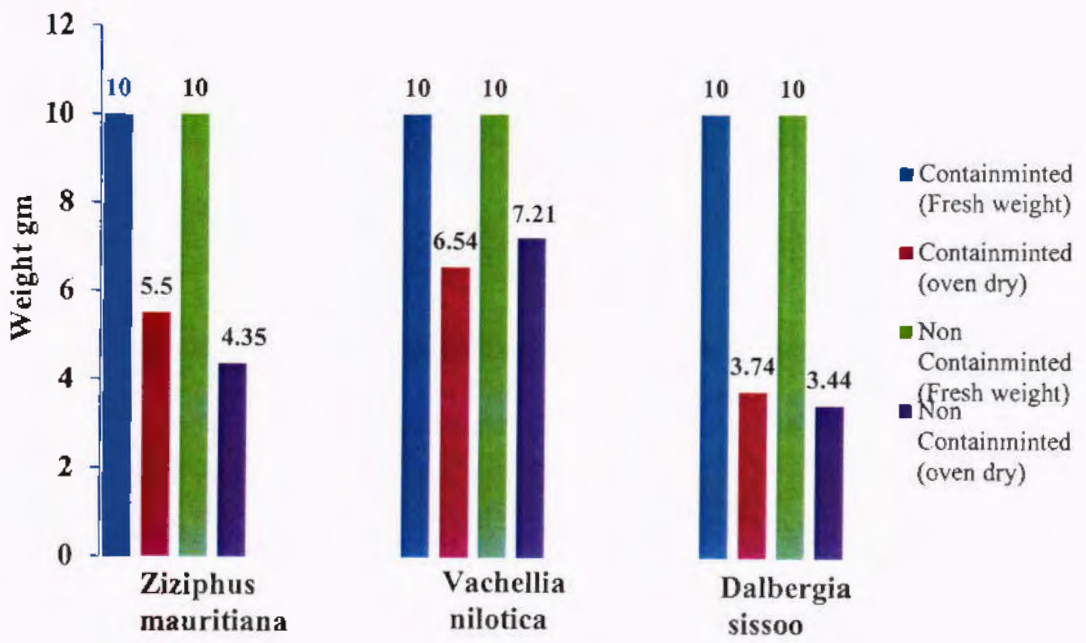


Fig. 3 Comparison of weight of Containminted and Non containminted fresh and oven dried leaves of trees (gm).

3.4.2 Weight of Containminted and Non containminted fresh and oven dried roots of trees (gm).

S/ N	Trees Name	Containminted (Fresh weight) (gm)	Containminted (oven dry) (gm)	Non Containminted (Fresh weight) (gm)	Non Containminted (oven dry) (gm)
1	*Ziziphus mauritian a*	10	3.69	10	6.02
2	*Vachellia nilotica*	10	3.34	10	3.56
3	*Dalbergi a sissoo*	10	1.79	10	2.63

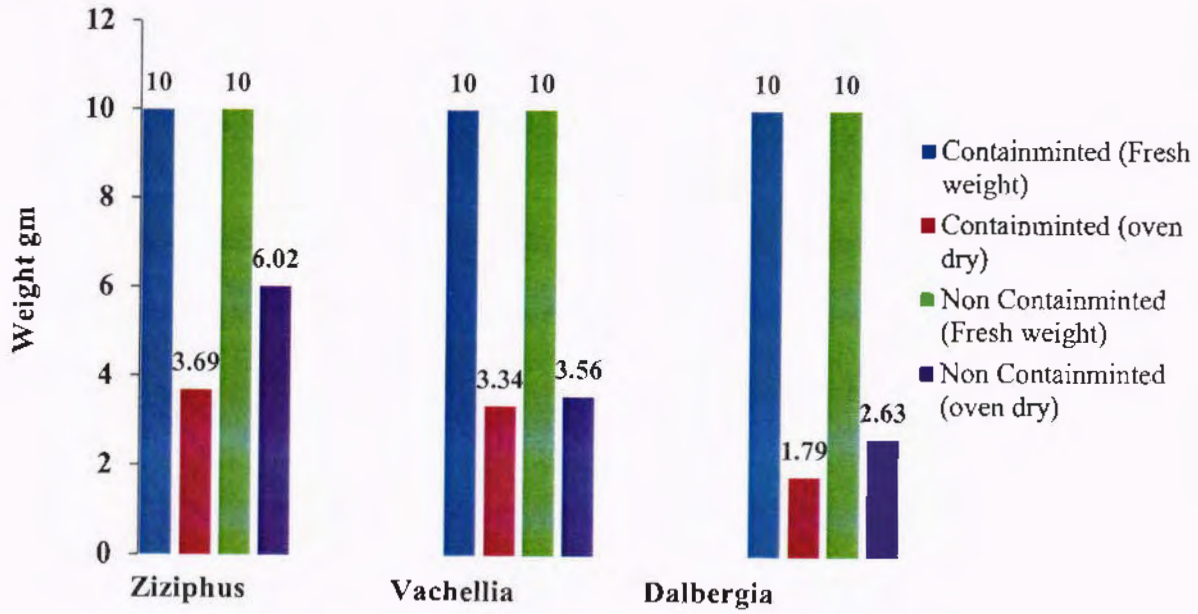


Fig.4 Comparison of weight of Containminted and Non containminted fresh and oven dried roots of trees (gm).

3.4.3 Weight of Containminted and Non containminted fresh and oven dried leaves of grasses (gm)

S/N	Grasses Name	Containminted (Fresh weight) (gm)	Containminted (oven dry) (gm)	Non Containminted (Fresh weight) (gm)	Non Containminted (oven dry) (gm)
1	*Stipa viridula*	10	4.30	10	3.50
2	*Lygeum spartum*	10	4.71	10	2.67
3	*Season grass*	10	3.27	10	3.17

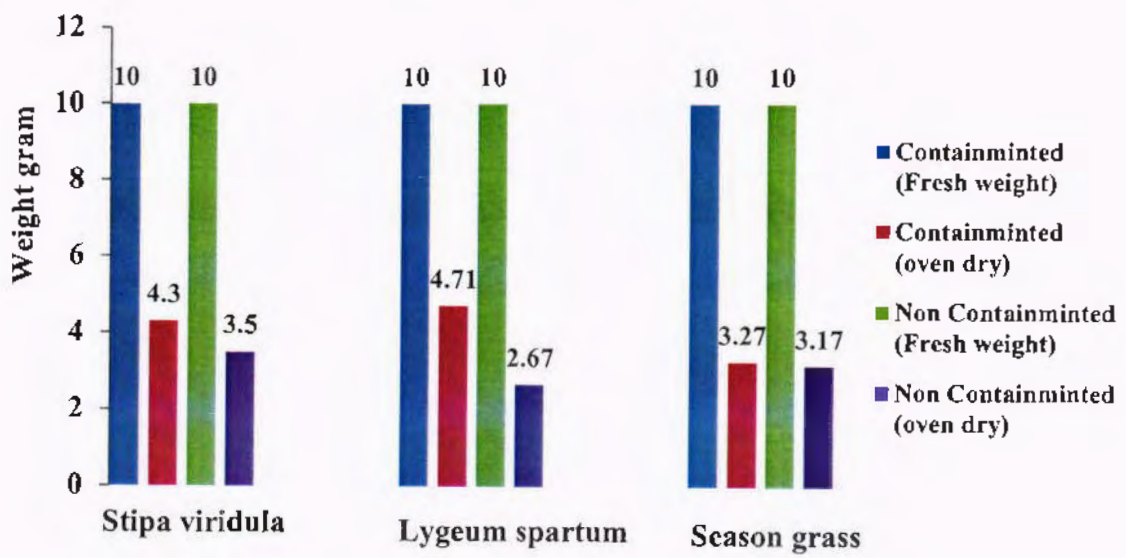


Fig.5 Comparison of weight of Containminted and Non containminted fresh and oven dried leaves of grasses (gm)

3.4.4 Weight of Containminted and Non containminted fresh and oven dried roots of grasses (gm)

S/N	Grasses Name	Containminted (fresh weight) (gm)	Containminted (oven dry) (gm)	Non Containminted (Fresh weight) (gm)	Non Containminted (oven dry) (gm)
1	*Stipa viridula*	10	5.04	10	4.33
2	*Lygeum spartum*	10	2.15	10	2.06
3	*Season grass*	10	4.50	10	4.15

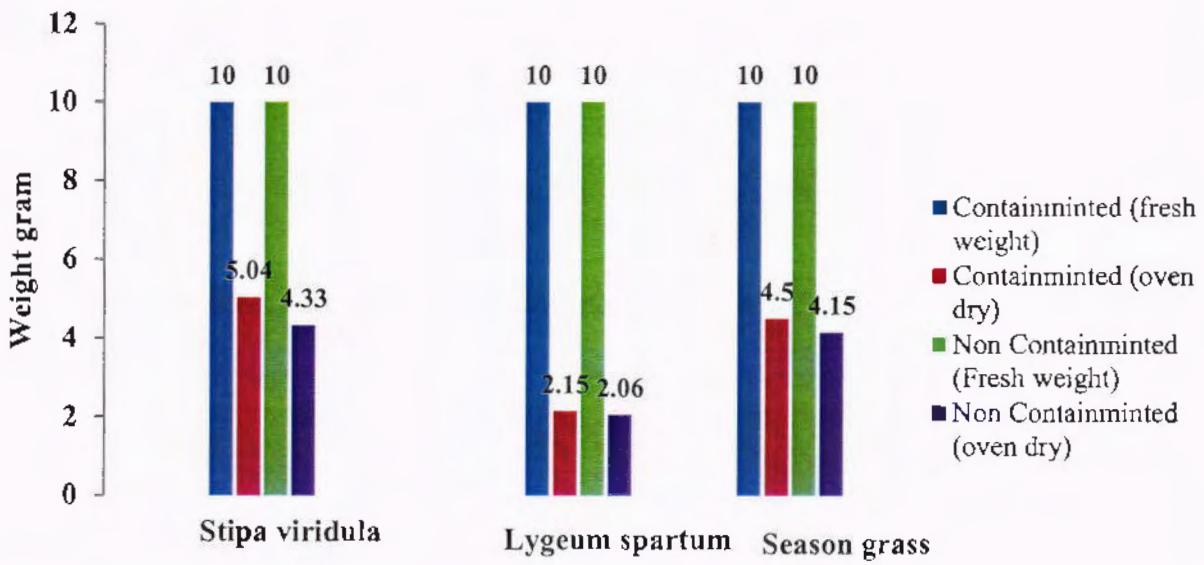


Fig.6 Comparison of weight of Containminted and Non containminted fresh and oven dried roots of grasses (gm).

From the current study results were analyzed. The rocks of specified region as mentioned above have high concentration of uranium. There is a safe limit given by WHO i.e. 11-15ug/l naturally existing which allows for human health (WHO, 2004). Uranium is present in the drinking water and it is unsafe for drinking purposes. In addition to that the soil of the Takht-e-Nasrati (*Shanawa Godi-Khel*) and the village Zarkai contains high concentration of uranium and it is unsafe for plants growth. (Present study).

V. DISCUSSION

The uranium concentration in natural water changes from region to region due to different rocks and water composition, climatic changes and flow system of ground water. The experiments were performed and examined uranium concentration in the soil of uranium mineralization to gets the desired result.

We find that uranium is present in the drinking water of Takht-e- Nasrati (*Shanawa Godi-Khel*) using Geiger Muller counter and according to WHO the normal level of uranium in drinking water range from 11 -15ug/l while at (*Shanawa Godi-Khel)* it was higher than the safe limit of WHO, so it is unsafe for drinking purposes. Hussain Ullah *et al.*, (2012), also work on drinking water of (*Shanawa Godi-Khel*) and find the result that it is unsafe for drinking purposes.

Comparing the values of water and soil samples with the other results differences among these values were observed. The results were then compares with the WHO recommended values and these values exhibit diversion. From these values result were analyzed that drinking water of Takht-e- Nasrati (*Shanawa Godi-Khel*) is unsafe for drinking. The drinking water of Takht-e- Nasrati (*Shanawa Godi-Khel*) has high concentration of uranium. (Hussain Ullah *et al.*, 2012)

The soil samples were also compares with other region. Differences among them were observed. The samples of Takht-e- Nasrati (*Shanawa Godi-Khel*) were compared with Sabir Abad region where uranium concentration is quite rare. Tajht-e-Nasrati (*present study*) demonstrates the presence of uranium in soil. The results were quite different from each other.Kurttio *et al.*, 2002 have measured the uranium concentrations in drinking water and urine .The uranium concentration in drinking water is 2 8 μ gl-1. Mehra *et al.*, 2007 have employed the fission technique for uranium concentration in Malwa region of Punjab.

From various studies we have found that high rate of cancers, mostly GI Ca in such regions where these metals and their products are present in nature which are polluted with industrial waste (Peeters, 1987, Boffetta, 1993 and Hayes 1997). In agriculture plant uranium concentration has been studied from soil to plant transfer. Here uranium concentration and heavy metal in soil and water sample is studied and also its effect on plant growth is observed. (Shahander and Hossner 2002).

Heavy metal variation has been grown by plants of totally different structure. It is found in Brassicaceae and Caryophyllaceae, Poaceae, and others. Approximately 34 various plant families have grown heavy metal liberal species (Verbruggen *et al.,* 2009).

These rocks have more concentration of uranium than the limit which WHO permits for human health. So from the above discussion it is concluded that drinking water and soil samples of Takht-e- Nasrati (*Shanawa Godi-Khel*) is unsafe for drinking and also for plant growth.

The effect on plant growth was also observed. The samples such as (*Stipa viridula* L) which are mostly eaten by the animals contain high concentration of uranium and it is also unsafe for the animals. The affects on growth of vegetable like tomato (*Solanum lycopersicum* L) lady finger (*Abelmoschus esculentus* L) and many more were examined. The vegetables growths are so rare due to high uranium concentration (Questioner Data).

Recently, *Sharma et al.,* (2008) have search that atmospheric dethronement importantly promote the heavy metals decay in vegetables commonly present in Varanasi, India Cancers of Gastrointestinal are mostly present in the universe. 20-25% of all cancer deaths are due to this disorder. The regions where cancer are mostly present have desert and high rocks areas (Longo, 1998).

Singh *et al.,* 2009 have measured the uranium concentration in water taken from Upper Siwaliks, Northern India. This value is from 1.08 to19.68 µgl-1. Kumar *et al.,* 2003 have reported that uranium concentration in the water samples varies from 1.65to74.98 µgl-1.

Forest model of Avila 2006 consist of different types of soil trees .Concentration ratio (CR) usually examine plant uptake mostly called transfer factor which is then calculated plant U concentration divided by soil concentration (Avila 2006 IAEA 2010)

Containminted sample (*leaves*) of tress (*Ziziphus mauritiana* L*), (Vachellia nilotica* L*)* have less water absorption than Non containminted sample (*leaves*) while *(Dalbergia sissoo* L*)* have high water absorption. Containminted sample (*roots*) of tress (*Ziziphus mauritiana* L*), (Vachellia nilotica* L*)* and *(Dalbergia sissoo* L) have high water absorption than Non containminted (*roots*) sample (Present study).

Containminted sample (*leaves*) of grasses (*Stipa viridula* L*), (Lygeum spartum* L*)* and *(Season grass* L*)* have less water absorption than Non containminted (*leaves*) sample. Containminted sample (*roots*) of grasses (*Stipa viridula* L*), (Lygeum spartum* L*)* have less water absorption than Non containminted (*roots*) sample while *(Season grass* L*)* have high water absorption. The reason for water content ratio in plants is to observe the water content of different plant in various contaminated and non contaminated areas of district karak and also uranium effect on these plants whether these plant observed more or less concentration of uranium.

The uranium concentration in natural water changes from region to region due to different rocks composition, water composition, climatic changes and flow system of ground water. All the experiments were performed and examined uranium concentration in the soil and water of uranium minerization to get the desired and good result.

From the above discussion results were obtained from the existing research indicates that the presence of uranium in soil and water as well as in the tress and grasses may effects the human health and naturally existing organism around it. (Present study)

VI. Conclusion and Futnre Recommendation

Uranium is a naturally occurring radioactive metal, and it has both chemical and radiological toxicities. Uranium environments ratio is increasing because of new mining and milling activates. From the above discussion we concluded that water and soil samples of Takht-e- Nasrati have high concentration of uranium and thus drinking water of (*Shanawa Godi-Khel*) is unsafe for drinking purpose and also soil is not good for plant growth.

Uranium have also affect on plant growth in the case of trees and vegetables. The effect on plant growth was also observed. The samples such as (*Stipa viridula* L) which are mostly eaten by the animals contain high concentration of uranium and it is also unsafe for the animals. Animals of these area die due to high concentration of uranium and the animals suffer from bone marrow cancer. The affects on growth of vegetable like tomato (*Solanum lycopersicum* L) lady finger (*Abelmoschus esculentus* L) and many more were examined. The vegetables growths are so rare due to high uranium concentration.

From the above discussion results were obtained from the existing research indicates that the presence of uranium in soil and water as well as in the tress and grasses may effects the human health and naturally existing organism around it. For the future prospect it is the need of the time to develop the system where one can easily detect and estimate the total quantity of uranium in soil, water and plants.

VII. REFERENCES

- AERB (2004). Drinking water specifications in India. Department of Atomic Energy, Govt. of India.

- Ahmad I., Akhtar M. J., Zahir Z. A., and Jamil A.,(2012) "Effect of cadmium on seed germination and seedling growth of four wheat (*Triticum aestivum* L.) Cultivars," Pakistan Journal of Botany, 44, 1569–1574.

- Akram M., Khattak N. U, Qureshi A. A., Iqbal A., Tufail M., Qureshi I. E (2004). Qureshi, Health Physics .86, 96-98.

- Amakom, U. & B.I. Ezema (2010). Financing for Development and Outcomes: Appraisal of Nigeria's Environmental Development Foundation, 43. 367-382.

- Anke M., Seeber O., Muller R., Schafer U., Zerull J. (2009) "Uranium transfer in the food chain from soil to plants, animals and man", Chemie der Erde - Geochemistry, 69, 75-90.

- Assche F. and Clijsters H. (1990) "Effects of metals on enzyme activity in plants," Plant, Cell and Environment, 24, 1–15.

- ATSDR (1999). Toxilogical profile for uranium. Atlanta, Georgia: US Department.

- Auvinen A. Kurttio P., Pekkanen J., Pukkala E. and Llus T., (2002) Cancer Cause Control, Einsenbund M., Gesell T. 1 (1997).Enviromental Radioactivity: From Natural, Industrial and Military Sources. 4th Ed. UK, 134

- Azizullah and Khan M. H. (1997). Geological Bulletin University of Peshawar, 30, 165.

- Baker B.A. J. M. (1981) "Accumulators and excluders strategies in the response of plants to heavy metals," Journal of Plant Nutrition, 3, 643–654.

- Barnett M.O, Jardine P. M, Brooks S. C, Selim H. M. (2000) "Adsorption and transport of uranium (VI) in subsurface media". Soil Science Society of America Journal, 64, 908–917.

- Batista AS. 2004. Vienna (2005). The programme for remediation of contaminated sites: its regulation and follow-up in Portugal. In: International Atomic Energy Agency. Proceed. Of an International Workshop on Environmental Contamination from Uranium Production Facilities and Remediation Measures held in Lisbon, 13, 223-232.

- Boffetta, P. (1993). Carcinogenicity of trace elements with reference to evaluations made by the International Agency for Research on Cancer. Scand. J. Work Environ. Health 19, 67-70.

- Cannon, H.L. (1952). "The effect of uranium - vanadium deposits on the vegetation of the Colardo Plateau," Am. J. Sci. 250, 735-770.

- Cannon, H.L. (1957). Description of indicator plants and methods of botanical prospecting for uranium deposits on the Colardo Plateau, U.S. Geol. Surv. Bull., 103, 399-516.

- Chen J. P and Yiacoumi S (2002), Water Air and Soil Pollution. 140, 173 -176.

- Cothern C. R. and Lappenbusch W. L. (1983) "Occurrence of Uranium in Drinking in the US," Health Physic, 45, 89-99.

- Crancon P., Pili E., Charlet L., (2010) "Uranium facilitated transport by water-dispersible colloids in field and soil columns", Science of The Total Environment, 408, 2118-2128.

- Dawood A., Sayidh W. Nofal (2015). Head of the Atomic Energy Commission in a Comprehensive Dialogue, Ad-Dustour.

- Domingo J. L. (2001) "Reproductive and developmental toxicity of natural and depleted uranium: a review" Reproductive Toxicology, 15, 603-609.

- Dreesen D. R. Williams J. M., Marple M. L., Glad-ney E. S. and Perrin D. R (1982) "Mobility and Bioavailability of Uranium Mill Tailings Constituents," Environmental Science & Technology, 16. 702-709.

- Dreesen, D.R., Marple, M.L. and Kelley, N.E. (1978). Contaminant transport, revegetation, and trace element studies at inactive uranium mill tailings piles. In: Symposium on Uranium Mill Tailings Management, 20-21 November 1978, Civil Engineering Department, Coarado State University, Fort Collins, CO, 111-113.

- Dunn, C.E.K.J. and Byman, J. (1985), Uranium Biogeochemistry, Internet, Atomic Energy Agency Vienna TECDOC No. 327.

- Durakoviae A. (1999) Croatian Medical Journal. 40, 1-5.

- Egyptian fruits and vegetables. Food Chem., Toxicol 44, 1273-1278.

- Eldar, Jordan A (2015)., Aims to Develop Nuclear Power1.210 -246.
- Feig, D.I., Reid, T.M., Loeb, L.A., (1994). Reactive oxygen species in tumor genesis. Cancer Res. 54, 1890-1894.
- Geraldo E.M, Cesar L. P., Mafra M. F., & Tanaka O. Y (1979). Determination of Uranium concentration in water samples by fission track registration technique .Journal of Radio analytical and Nuclear Chemistry, 49, 115-126.
- Ghani, A. (2010) "Toxic effects of heavy metals on plant growth and metal accumulation in maize (Zea maysL.)," Iranian Journal of Toxicology, 3, 325–334.
- Glenn FK (2000). Detection and Measurement. Third Edition, John Wiley & Sons.
- Haddad S., Hgazeen, Alarab Alyawm Amman, Jordan, (2009) F. No Real Obstacles in Front of Jordan to Implement its Nuclear Program.
- Hayes, R.B., (1997). The carcinogenicity of metals in humans. Cancer Causes Control 8, 371-375.
- Jassir, M.S., Shaker, A., Khaliq, M.A.,(2005). Deposition of heavy metals on green leafy Vegetables sold on roadsides of Riyadh city, Saudi Arabia. . 75, 1020–1027.
- Jayakumar K. M. Rajesh, L. Baskaran, and P. Vijayarengan (2013) "Changes in nutritional metabolism of tomato (Lycopersicon esculantum Mill.) Plants exposed to increasing concentration of cobalt chloride," International Journal of Food Nutrition and Safety, 4, 62–69.
- Kabata,Pendias A. (2001) Trace Elements in Soils and Plants, CRC Press, Boca Raton, Fla, USA, 3rd edition.

- Khairiah, T., Zalifah, M.K., Yin, Y.H., Aminath, A, (2004). The uptake of heavy metals by fruit type vegetables, grown in selected agricultural areas. 7. 1438–1442.

- Kibra M. G (2008) "Effects of mercury on some growth parameters of rice (Oryza sativa L.)," Soil & Environment, 27.23-28.

- Kim M, et al. (2004). The yeast Rat1 exonuclease promotes transcription termination by RNA polymerase II. 432. 517-522.

- Kirkam M.B (2006). Cadmium in plants on polluted soils: Effects of soil factors, hyper accumulation, and amendments. Geoderma, 137, 19–32.

- Kumar A., Rout S., Narayanan U., Mishra M. K., Tripathi R. M., Singh J., et al. (2011). Geochemical modeling of uranium speciation in the subsurface aquatic environment of Punjab State in India. Journal of Geology and Mining Research, 3, 137-146.

- Kurttio, J. Pekkanen, E. Pukkala and T. Llus, (2002). *Cancer Cause Control*, **13**, 825.

- Mehra, R., Singh, S., & Singh, K. (2007). Uranium studies in water samples belong to Malwa region in Punjab by track etching technique. Radiation Measurements.

- Meinrath A., Schneider P., Meinrath G. (2003) "Uranium ores and depleted uranium in the environment, with a reference to uranium in the biosphere. From the Erzgebirge/Sachsen, Germany". Journal of Environmental Radioactivity, 64, 175-193.

- Mengel K. and Kirby E.A (1979). Principles of plant nutrition (2nd Edn) (Bern. Switzerland: International Potash Institute).

Turnitin Originality Report

M.Phil Thesis by Shakeel Ahmed

From Shakeel Thesis (M.Phil)

- Processed on 15-Mar-2018 21:10 PKT
- ID: 930859825
- Word Count: 4596

Similarity Index
3%
Similarity by Source

Internet Sources:
0%
Publications:
3%
Student Papers:
0%

sources:

1 2% match (publications)
Sharma, R.K., "Heavy metals in vegetables collected from production and market sites of a tropical urban area of India", Food and Chemical Toxicology, 200903

2 < 1% match (publications)
Mohamed H.H. Ali, Khairia M. Al-Qahtani, "Assessment of some heavy metals in vegetables, cereals and fruits in Saudi Arabian markets", The Egyptian Journal of Aquatic Research, 2012

3 < 1% match (publications)
Kurttio, Paivi Auvinen, Anssi Salonen, L, "Renal effects of uranium in drinking water. (Articles).", Environmental Health Perspectives, April 2002 Issue

4 < 1% match (publications)
Ned Xoubi, "Evaluation of Uranium Concentration in Soil Samples of Central Jordan", Minerals, 2015

5 < 1% match (Internet from 10-Mar-2016)
http://content.iospress.com/articles/asian-journal-of-water-environment-and-pollution/11-3-13

6 < 1% match (publications)
M. Akram, "FISSION TRACK ESTIMATION OF URANIUM CONCENTRATIONS IN DRINKING WATER FROM AZAD KASHMIR, PAKISTAN", Health Physics, 03/2004

paper text:

ABSTRACT The aim of the present result is to find the uranium distribution in the soil and drinking water of District Karak. It is also to examine the effect on plant growth. Four different samples were taken to