Handbook of Radionuclide Transfer Parameters Soil - Plant for Radioecological Modelling and Emergency Preparedness in Arid Environment

RadCon

Cognitive Radioecology CONSULTING

Contributors to text, drafting and review

N. Semioshkina r.e.m. GbR, Consultant to RadCon GmbH, Germany

G. Voigt r.e.m. GbR, Consultant to RadCon GmbH, Germany

G. Proehl Consultant to r.e.m GbR, Germany

F. Wagner r.e.m. GbR, Consultant to RadCon GmbH, Germany

M. Hiller RadCon GmbH, Germany

2025

Foreword

The idea of creating a database on radionuclide transfer in arid environments first came to us many years ago during a visit to the Kuwait Institute of Scientific Research. At that time, our colleagues at the Institute suggested launching a joint radioecological project. Unfortunately, the project was never realized due to the passing of the senior investigator.

In preparing for such a project, it was necessary to assess the type and extent of scientific research already conducted in this field. We therefore began reviewing available literature on the migration of radionuclides in arid environments. We soon discovered that published studies on soil-to-plant transfer of radionuclides were very limited, and even fewer existed on plant-to-animal transfer.

Around the same time, we established a new task group within the International Union of Radioecologists (IUR), dedicated to radioecology in arid regions. Later, within the framework of the IAEA Project MODARIA II, we proposed the creation of a subgroup on "Transfer Parameters in Non-Temperate Systems" as part of Working Group 4. This provided an opportunity to collect data directly from subgroup members representing different countries. The results of this long-term effort were eventually published as IAEA TecDoc-1979 [28] and in the *Journal of Environmental Radioactivity* [27].

For the database, more than 800 publications describing studies on radionuclide uptake by edible plants in arid areas were analysed. The review covered both anthropogenic radionuclides (e.g., Cs-137, Sr-90, Pu-240, Am-241) and naturally occurring radionuclides (e.g., K-40, Ra-226, Th-232, U-232), as well as certain elements and metals.

Only studies meeting predefined quality criteria were included. In total, soil-to-plant transfer parameters from just 16 countries were added to the database: Morocco, Libya, Egypt, Israel, Jordan, Syria, Iraq, Iran, Saudi Arabia, Kazakhstan, South Africa, the USA, Tunisia, Algeria, Sudan, and Turkey.

The data are presented exactly as published, without editing, recalculation, or modification. This format allows users to select data relevant to their local conditions and to calculate mean values as needed.

Contents

1 Introduction

Nuclear technologies play a vital role in both developed and developing countries. In particular, nuclear energy serves as a natural complement to renewable sources by supplying reliable, carbon-free electricity.

In addition, nuclear technologies have diverse applications across various sectors, including agriculture, food preservation, water and environmental management, medicine, research, industry, aeronautics, and military equipment.

Modern technologies, along with strict government oversight, enable the construction of highly reliable and accident-resistant nuclear power plants. However, any country utilizing nuclear technology must not only have a plan for the immediate resolution of malfunctions but also a long-term strategy for managing the consequences of emergencies. This includes rehabilitating and restoring contaminated areas and assessing the population's exposure and health impacts. These efforts are typically supported by sophisticated decision support systems capable of evaluating contamination scenarios in both time and space.

Such systems are especially critical in countries with arid climates, where nuclear power development is accelerating, but data on the behaviour of radionuclides in such environments remain limited. Establishing a robust long-term decision support system requires extensive data, including demographic statistics, agricultural and industrial production figures, and information on food products and consumption patterns.

A key factor in radiation risk assessment is the transfer of radionuclides from contaminated soil into plants consumed by humans or used as animal feed. The most important parameters in these processes are **radionuclide transfer factors, TF**, which indicate the potential contamination levels of various agricultural products. These processes in arid climates differ significantly from those in temperate or humid regions.

To address this gap, we compiled and analysed a wide range of sources, including internal institutional reports and published scientific literature. The resulting database contains numerous radionuclide transfer coefficients (or concentration ratios) from arid soils to agricultural crops. These coefficients are essential for calculating food contamination levels, assessing radiation doses, identifying vulnerable areas, and pinpointing critical links in the food chain.

This database will be continuously updated and made available online. This booklet contains a selection of the data as of August 2025.

2 Radioecology

Radioecology is a branch of ecology which studies how radioactive substances interact with nature; how different mechanisms affect the substances' migration and uptake in food chains and ecosystems. Investigations in radioecology might include aspects of field sampling, designed field and laboratory experiments and the development of predictive simulation models. This science combines techniques from some of the more basic, traditional fields, such as physics, chemistry, mathematics, biology, and ecology, with applied concepts in radiation protection. Radioecological studies form the basis for estimating doses and assessing the consequences of radioactive pollution for human health and the environment.

Significant economic and social disruptions arise after radioactive contamination of land because of releases of radioactivity into the environment be it from accidents, routine, and war operations or during decommissioning and waste management of nuclear facilities. Measures carried out to reduce and minimise radiation doses to the public can give rise to even more concerns as often they are not understood, accepted and the stakeholders are often not involved into the decision-making process. Countermeasures are needed to reduce population exposure, at the same time minimising economic and social effects and costs. The effectiveness of countermeasures is not only highly dependent on factors which are connected to environmental transfer, but also on special behaviour and consumption behaviours in varying food production systems. It is clearly desirable that countermeasures are implemented in the most efficient way, targeting expensive resources to areas and/or food products for which they are most required at the same time minimizing their social and economic and ecological impact.

2.1 Radioecology in arid environments

With climate change and global warming, ecosystems and consequently their use is likely to change in future with more zones to represent more arid/desert worldwide areas but especially in Southern Europe. The climate change specifically will impact agricultural use and products and will influence human behaviour at a large scale. Since the intention of the use of nuclear power is increasing, specifically in countries with a predominantly arid climate, information is needed on the behaviour of radionuclides in such climates, among others for radiation protection, licensing of nuclear facilities, management of areas with enhanced levels of man-made or natural radionuclides, emergency preparedness and public/stakeholder information [1]. Existing models describe the transfer of radionuclides in the environment — particularly in the food chain — are primarily based on data from temperate environments and are compiled in various IAEA reports which include recommendations on the values to be used for modelling purposes. In the IAEA project MODARIA II, a subgroup has been initiated to analyse existing data on the transfer of radionuclides in arid environments and a CRP (**Coordinated Research Project**) [2] had been initiated to provide more experimental data to fill the knowledge gaps.

The definition of arid environments is challenging as they are highly diverse in landforms, soils, fauna, flora, water balances, and human activities. The Köppen-Geiger classification [3] is considered to be the most suitable system for classifying arid zones. (Fig. 1)

Aridity in all classification models is mainly determined by the occurrence of rainfall and average temperatures. Unlike in temperate regions, the rainfall distribution in arid zones varies between summer and winter and also varies annually in arid zones. Another parameter is rainfall intensity and duration: Because the soil may not be able to absorb all water during a heavy rainfall, water may be lost by runoff. Likewise, the water from low intensity rain can be lost due to evaporation, particularly on a dry and hot surface as well as increase the risk of soil erosion and temporal flooding events.

Although rainfall and temperature are the primary factors for aridity, other factors have an important influence such as the air moisture, which is important for the water balance in the soil. When the moisture content in the soil is higher than in the air, there is a tendency for soil water to evaporate quickly. Soil humidity in general is low in arid zones.

The chemical properties of soil control the availability of nutrients and consequently radionuclides and its uptake. Arid soils are typically characterized by limited leaching of nutrients and reduced weathering of minerals, as both processes slow down with decreasing rainfall. Natural fertility (which largely depends upon the organic matter content, the water supply and the nutrient status of the topsoil) is often low due the low crop yields and the low accumulation of organic matter. When these soils are cultivated, the limited organic matter content that exists may decompose quickly and needs to be replaced by organic fertilizers.

Landuse in arid environments is driven by the specific environmental conditions and is highly dependent upon seasons and rain occurrence. Vegetables and fruits locally produced are mainly cultivated in greenhouses or shelters to protect from evaporation and heat exposures under irrigation and with soil mixtures containing sufficient nutrients. Here, leafy vegetables like tomato, cucumber, squash, beans and other green vegetables are produced. During rainy seasons, pasture grass can be grown outdoors for animal feeding. Only small amounts of cow milk are produced locally; instead, camel milk and meat as well as sheep and goat milk and meat are locally more available. One component of agricultural productivity is the cultivation of date palms for date production, and production of olive oil if climate allows. Olive oil mainly is produced in areas with available surface water as in oasis or under irrigation systems. Areas with naturally growing shrubs on which camels and sheep or goats feed are used for animal husbandry in addition to pastureland during vegetation periods. In general, an important portion of food is imported from other countries.

It should not be neglected that the topography of the terrain also plays an important role. For instance, the shallows and the lower parts of sand dunes can accumulate a considerable quantity of water which can be used by an adapted vegetation as well as spring water resulting in oasis where intensive plant cultivation occurs.

3 Arid environments

3.1 Description of arid region and the main factors influencing radionuclide behaviour in the environment

Arid environments are extremely diverse in terms of their landforms, soils, fauna, flora, water balances, and human activities. Because of this diversity, it is challenging to give a generic definition of arid environments. There are different attempts for classification of climate areas by different authors and institutions such as M. I. Budyko, [4], adopted by UNEP (UN Environment Program) or W. Köppen and R. Geiger [3]

However, one common element to all attempts is the existence of a long-term water deficit, i.e., aridity. Aridity is usually expressed as a function of rainfall and temperature. Consequently, a useful "representation" of aridity is the climatic aridity index (AI) as adopted by UNEP in the world aridity Atlas [5]

$$AI = p/ETP \qquad (1)$$

where

P = precipitation
ETP = potential evapotranspiration, considering atmospheric humidity, solar radiation, and wind.

Three arid zones can be identified by this index: namely, hyper-arid, arid and semi-arid. Of the total land area of the world, the hyper-arid zone covers 4.2 percent, the arid zone 14.6 percent, and the semiarid zone 12.2 percent. Therefore, almost one-third of the total area of the world is arid land [6].

The *hyper-arid zone* (arid index 0.03) comprises dryland areas without vegetation, except for a few scattered shrubs. True nomadic pastoralism is frequently practiced. Annual rainfall is low, rarely exceeding 100 mm. The rains are infrequent and irregular, sometimes with no rain during long-lasting dry periods up to several years.

The *arid zone* (arid index 0.03-0.20) is characterized by pastoralism and no farming except when irrigation is applied. Mostly, the native vegetation is sparse, consisting of annual and perennial grasses and other herbaceous vegetation, as well as shrubs and small trees. There is a high rainfall variability with annual amounts ranging from 100 to 300 mm.

The *semi-arid zone* (arid index 0.20-0.50) can support rain-fed agriculture with more or less sustained levels of production including limited livestock production. Native vegetation is represented by a variety of species, such as grasses and grass-like plants, fortes and half-shrubs, and shrubs and trees. Annual precipitation varies from 300-600 to 700-800 mm, during summer rains, and from 200-250 to 450-500 mm during winter rains.

Arid conditions also are found locally in the *sub-humid* zone (arid index 0.50-0.75).

Aridity results from the presence of dry, descending air. Therefore, aridity is found mostly in places where anticyclonic conditions are prevailing, as is the case in the regions lying under the anticyclones of the subtropics. The influence of subtropical anticyclones on rainfall increases with the presence of cool surfaces. Arid conditions also occur in the lee of major mountain ranges disrupting the structure of passing cyclones, creating "rain shadow" effects. Rainfall is also hindered by the presence of greatly heated land surfaces; consequently, large areas of dry climate exist far from the sea [7].

The arid zone considered in this report is characterized by excessive heat in the summer season, insufficient precipitation and highly variable precipitation patterns. In general, climatic contrasts result from differences in diurnal temperature, the season in which rain falls, and in the degree of aridity. Three major types of climates can be distinguished when describing the arid zone: the Mediterranean climate, the tropical climate and the continental climate (World atlas of desertification [8])

In the Mediterranean climate, the rainy season lasts during autumn and winter. Summers are hot with no or few rains; winter temperatures are mild. The Mediterranean climate is characterised by a wet season starting in October and ending in April or May, followed by a 5-month dry season.

In the tropical climate, rainfall occurs during the summer. The greater the distance from the equator, the shorter the rainy season. Winters are long and dry.

In the continental climate, the rainfall is distributed evenly throughout the year, although there is a tendency towards higher summer precipitation. In Alice Springs, Australia, the dry season extends over the whole year.

In the IAEA project MODARIA [9], the Köppen-Geiger classification [3] has been selected for classification of arid zones. With climate change those zones are likely to change in the future with more arid/desert like areas especially in Southern Europe.

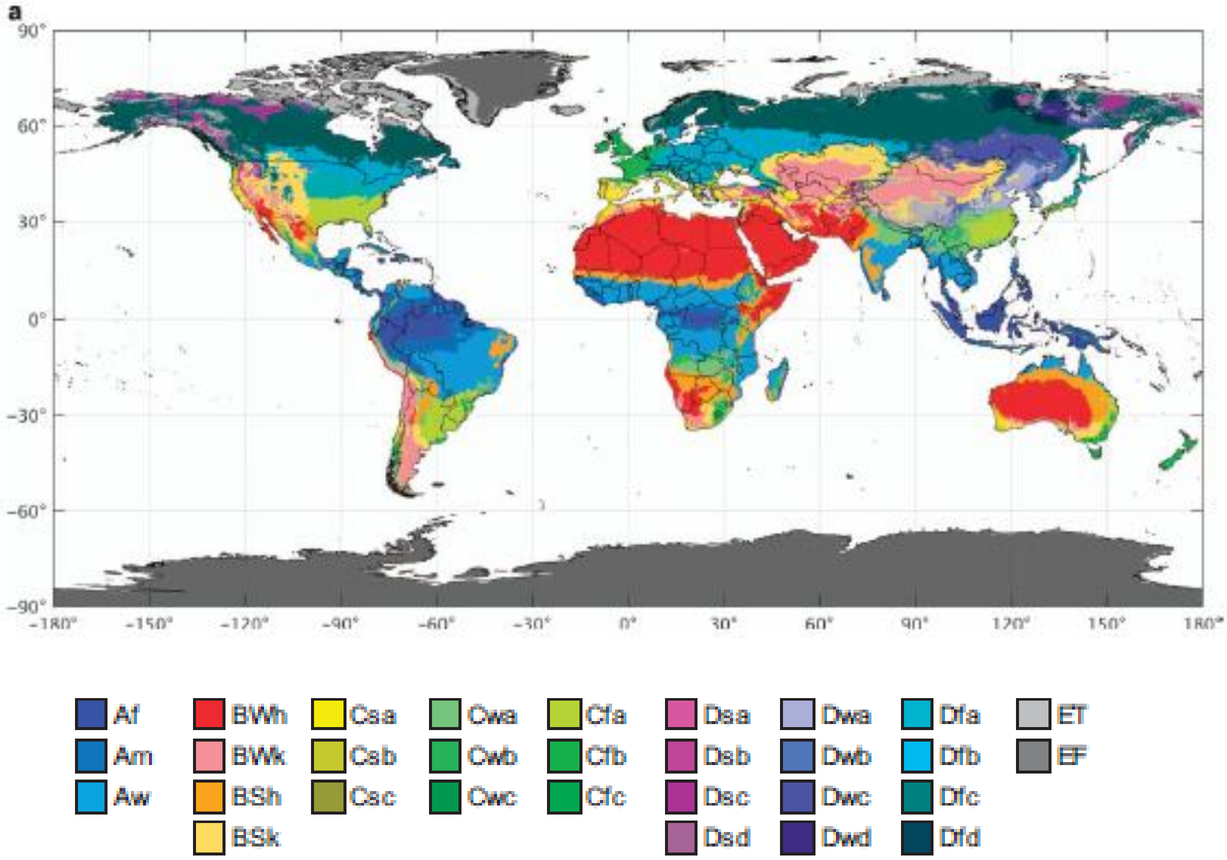


Fig.1. Köppen-Geiger climate classification [3]

3.2 Factors influencing the radionuclide behaviour in arid zones

3.2.1 Precipitation

The rain that falls from the atmosphere at a location is either intercepted by trees, shrubs, and other vegetation, or it reaches the ground surface and is then subject to surface runoff or infiltration to deeper layers to the unsaturated zone and the aquifer. However, in arid regions, much of the rainfall eventually is returned to the atmosphere by evapotranspiration processes from the vegetation or by evaporation from streams and other water bodies such as lakes and oceans into the atmosphere. The dynamics of the hydrologic processes in an area are determined mainly by the spatial and temporal nature of the rainfall patterns, temperature and atmospheric humidity regimes, soil and topographic features, and vegetative characteristics of the area. A comprehensive description of arid environments is given by the FAO (www.fao.org) [10]

Unlike in temperate regions, the rainfall distribution in arid zones strongly varies between summer and winter. For example, Rabat, Morocco, receives rain during the cold winter period, while the warm summer months are almost devoid of rainfall. On the other hand, Sennar, Sudan, has a long dry season during the winter, while the rains fall during the summer months. Although Rabat and Sennar receive about the same amount of rainfall, the variation in rainfall is considerable. Winter rains in Rabat can penetrate the soil to underground storage, while the summer rains in Sennar fall on a hot soil surface and are lost to evaporation, particularly when rain falls in the form of light showers. Therefore, the effective rainfall available to plants is higher in Rabat than in Sennar.

This example shows that more annual precipitation is required in summer rainfall climates than in cooler winter rainfall climates to obtain the same amount of water available to plants. However, hibernating plants will not consume water during that period.

Rainfall also varies annually in arid zones; this can easily be confirmed by looking at rainfall statistics over time for one place. The difference between the lowest and highest rainfall recorded in different years can be substantial, although it is usually within a range of ± 50 %of the mean annual rainfall. The monthly rainfall variation can be even greater. In most instances, the expected rainfall is not the same as the mean annual rainfall recorded over several years. Variation in rainfall is important to forestry activities, because too few rains result in degradation of newly forested plantations. Therefore, the selection of a planting date to coincide with rainfall is of paramount importance to the success of a forest plantation.

Rainfall intensity is another parameter for consideration. Because the soil may not be able to absorb all water during a heavy rainfall, water may be lost by runoff. Likewise, the water from low intensity rain can be lost due to evaporation, particularly on a dry and hot surface. Rainfall intensity can be either measured as the number of rainy days or, more preferably, as the amount of rain per hour or per day.

Rainfall intensity influences also the risk of soil erosion. Individual raindrops carry enough energy capable of removing soil, particularly topsoil. The erosion caused by falling drops of water, called splash erosion, results in degradation or destruction of the soil structure. As the rainfall intensity approaches 35mm/h, there is a steep rise in the erosive power of rain especially in tropical environments.

The climatic pattern in the arid zones is frequently characterized by a relatively "cool" dry season, followed by a relatively "hot" dry season, and ultimately by a "moderate" rainy season. In general, there are significant diurnal temperature fluctuations within these seasons as given by NOAA (National Oceanographic and Atmospheric Administration) [11].

In many situations, these diurnal temperature fluctuations restrict the growth of plant species. Extremely high or low temperatures can be damaging to plants. Plants might survive high temperatures, if they can compensate for these high temperatures by transpiration, but growth will be affected negatively. High temperatures in the surface layer of the soil result in rapid loss of soil moisture due to the high levels of evaporation and transpiration. Although problems of low temperatures, in general, are less common in arid zones, but, when they do occur for relatively long periods of time, plant growth can be restricted; at temperatures below 0°C , the plants can die.

Although rainfall and temperature are the primary factors for aridity, other factors have an important influence, too. For example, the air moisture is important for the water balance in the soil. When the moisture content in the soil is higher than in the air, there is a tendency for water to evaporate into the air. Reversely, water will condense into the soil. However, humidity is generally low in arid zones.

In many areas, the occurrence of dew and mist is necessary for the survival of plants. Dew is the result of condensation of water vapor from the air onto surfaces during the night, while mist is a suspension of microscopic water droplets in the air. Water that is collected on the leaves of plants in the form of dew or mist can penetrate through the open stomata, or alternatively, fall onto the ground and contribute to soil moisture. The presence of dew and mist leads to higher humidity in the air and, therefore, reduced evapotranspiration and conservation of soil moisture. Because of the sparce vegetation that could reduce air movements, arid regions typically are windy. Winds remove the moist air around plants and soil and, as a result, increase evapotranspiration.

Soil erosion by wind will occur wherever soil, vegetative, and climatic conditions are conducive to erosion. These conditions (loose, dry, or fine soil, smooth ground surface, sparse vegetative cover, and wind sufficiently strong to initiate soil movement) are frequently found in arid zones. Depletion of vegetative cover on the land is the basic cause of soil erosion by wind. The most serious damage from wind-blown soil particles is the sorting of soil material; wind erosion gradually removes silt, clay, and organic matter from the surface soil. The remaining materials may be sandy and infertile. Often, sand piles up in dunes and presents a serious threat to surrounding lands.

Precipitation represents the main transfer of moisture from the water vapor of the air to the ground. The completion of this hydrologic cycle is through evaporation. Loss of water from the soil due to evaporation is important when considering "effective" rainfall. Evaporation increases with strong winds, high temperatures, and low humidity.

Plants will transpire to compensate for high temperatures. Transpiration accounts for great losses of moisture from the soil. The intensity of transpiration depends on wind, temperature, humidity, and the plant species itself. Some plants are more adapted to dry conditions and transpire less than others mainly due to cuticle structures. Therefore, the composition of the vegetation has a great influence on the rate of transpiration. The combination of evaporation and transpiration, called evapotranspiration, is the principal component of the water cycle that can be influenced by land management.

3.2.2 Soil properties

Soils are formed over time as climate and vegetation act on parent rock material. Important aspects of soil formation in an arid climate are:

- Significant diurnal changes in temperature, causing mechanical or physical disintegration of rocks and
- Wind-blown sands that score and abrade exposed rock surfaces.

The physical disintegration of rocks leaves relatively large fragments, which can only be broken up by chemical weathering. The process of chemical weathering in arid zones is slow because of the characteristic water deficit. Also, extended periods of water deficiencies are important in the elimination or leaching of soluble salts, for which the accumulation is enhanced by the high evaporation. Short periods of water runoff do not permit deep penetration of salts (only short-distance transport), often resulting in accumulation of salts in closed depressions (salt lagoons).

Vegetation plays a fundamental role in the process of soil formation by breaking up the rock particles and enriching the soil with organic matter from aerial and subterranean parts. However, this role of the vegetation is diminished in arid zones because of the sparse canopy cover and the limited development of aerial plant parts. Nevertheless, the root systems often show exceptional extensions and have the greatest influence on the soil. Of primary importance for arid zone soils are the water-holding capacity and the ability to supply nutrients.

The water-storage capacity of a soil depends on its physical characteristics, including texture, structure, and soil depth [12]. Texture refers to the relative distribution of the particles (clay, sand, and silt). In general, the finer the texture, the greater is the water retention. The soil structure, i.e. the internal arrangement of the soil components is influenced by the amount of organic matter. As the organic matter content increases, soil aeration and water storage capacity typically improve which has a positive effect on soil fertility.

The soil depth governs the amount of soil moisture and the type of root disposition of trees. In general, colluvial and alluvial soils are deep; but residual soils are highly variable in depth, depending on the degree of slope, the length and intensity of weathering, and other biotic influences (cultivation, livestock grazing, etc.). Soils of the ridges and upper slopes are often shallow, while those of the middle slopes and valleys are moderately deep to very deep. The depth of soils in arid regions is often limited by a "hardpan" layer. Such hardpans, which consist of ironstone or laterite gravel in the tropical zone and consolidated calcite in the Mediterranean region, can be continuous and from 5 to 60 centimetres below the surface.

As there is little deposition and accumulation of organic litter in arid zones, the organic matter content of the soil is low. When these soils are cultivated, the microbiological degradation of the organic matter is accelerated with increasing soil moisture.

The chemical properties of soil control the availability of nutrients and thus radionuclides. Arid soils are characterized by significant leaching of nutrients and intensive weathering of minerals, although these two activities are slowed with decreasing rainfall. Natural fertility (which largely depends upon the organic matter content of the topsoil) is often low.

Because of the aridity of the climate, edaphic characteristics which ease the water constraints will be favourable to planting of trees or shrubs. Some of these edaphic characteristics are [13]:

- The presence of a water table at a depth attainable by the roots.
- A soil thickness adequate to allow a water reserve.
- A soil texture which retains the maximum amount of water.

3.2.3 Vegetation and landuse

The vegetation cover in arid zones is scarce. Nevertheless, three major plant forms can be distinguished [14]:

- Ephemeral annuals
- Succulent perennials
- Non-succulent perennials

Ephemeral annuals, which appear after rains, complete their life cycle during a short season (± 8 weeks). Their growth is restricted to and by a short and wet period. Ephemerals do not have the xeromorphic features of perennials. In general, ephemerals are small in size, have shallow roots, and their physiological adaptation consists of their active growth. Ephemerals live through the dry season, which may last several years, in the form of seeds. At times, ephemerals can form dense stands and provide some forage.

Succulent perennials are able to accumulate and store water (that may be consumed during periods of drought); this is because of the proliferation and enlargement of the parenchymal tissue of the stems and leaves and their physiological feature of low rates of transpiration. Cataceae are typical succulent perennials.

Non-succulent perennials comprise the majority of plants in the arid zone. These are hardy plants, including grasses, woody herbs, shrubs and trees that withstand the stress of the arid zone environment. Many non-succulent perennials have "hard" seeds that do not readily germinate; these seeds often must be initiated (by soaking in water or acid) before they will germinate. Three growth forms of non-succulent perennials can be distinguished:

- Evergreen - biologically active throughout the year.
- Drought-deciduous - biologically dormant during the dry season.
- Cold-deciduous - biologically dormant during the cold season.

Ephemerals are drought-escaping species and, in general, are not considered true xerophytes; succulent and non-succulent perennials are drought-enduring and drought-resisting species and are true xerophytes. Xerophytism refers to adaptive attributes of plants which can subsist with small amounts of moisture. Some of the features of xerophytic plants are given in [15]:

- Development of an extensive root system - the main growth of the roots can be vertical, horizontal, or both, and depends on local conditions. Roots penetrating 10 to 15 m in depth are not unusual; horizontally extending roots are common in shallow soils. Some xerophytic species produce "rain roots" below the soil surface, in response to light rainfall or during periods of dew formation.
- Shoots not as large as their roots - shoot-to-root ratios of 1:3.5 to 1:6 are frequent.
- Reduction of the transpiring surface - transpiring surfaces reduced by shedding of foliage and rolling of leaves.
- Seasonal reduction of the transpiring surface of the plant this feature results in a reduction of the water loss during the dry season.
- Special adaptations in "evergreen" species lessen transpiration their leaves are leathery and often heavily wax-coated; these plants are referred to as sclerophylls.

Other distinguishing anatomical characteristics associated with xerophytism are:

- Cuticularization - the formation of a surface plaster-like layer of cutin.
- Cutinisation - the impregnation of the cell wall with cutin, which forms a watertight layer with abundant hairs.
- Special arrangements of the stomata in recesses and grooves which provide protection from the arid atmosphere.

In classifying the vegetation of the arid zones, the major "delineations" are usually characterized in terms of rainfall amount and its pattern of occurrence according to the UNESCO Map of the world distribution of arid regions – explanatory notes [16].

Desert: Here, the term "desert" is used in its narrowest sense to classify land where vegetation is virtually absent, except by watercourses. Ephemeral grasses and herbs can appear after infrequent rain showers. On the average, rainfall is less than 100 mm per year.

Semidesert: Vegetation in semidesert regions is a mixture of grasses, herbs, and small, short trees and shrubs up to 2 meters in height, interspersed with bare areas. Semidesert grasslands occur in areas where geological erosion has been less intense, and the soils can absorb the limited rainfall; the resulting vegetation is a uniform cover of mixed grasses and herbs. Scattered trees and scattered shrubs occur on areas with an excess of water, along drainage lines, and on catchment sites. Succulent shrubs consist of open plant communities dominated by succulent plants; grasses may or may not be present. In general, the vegetation in semidesert regions is characterized by an abundance of plants with extreme reduction of leaves, the development of storage tissues to form succulent stems, and the presence of thorns and spines. The rainfall in these regions varies from 100 to 300 mm; most of this is unreliable and confined to several months, occurring as local storms or scattered rain showers.

Low rainfall woodland savanna: The vegetation in this region includes a mixed type of grasses and herbs, with shrubs or trees (or both), in which the proportion of grass to shrubs or trees is determined by the frequency and intensity of fires. The trees and shrubs often have flat, umbrella-like crowns. Their crowns do not form a closed canopy, but leave large openings filled with low shrubs, grasses, and herbs, although bare spots occur as well; sometimes these bare areas are covered with ephemerals after rains. Grasses seldom attain 2 m, and the shrubs and trees are not higher than 6 m. The shrubs and trees normally do not provide sufficient shade to prevent the development of grasses. During the dry season, these plants become a potential fire hazard. However, the species of the woodland savanna have some degree of fire tolerance. When grasses and herbs are dominant and shrubs and trees cover less than 50 per cent of the ground, the woodland is classified as open and wooded grassland. This kind of woodland savanna is typical of the dry tropics, with a short rainy period followed by a long, hot dry period. Rainfall ranges from 300 to 600 mm.

Evergreen scrub: This type of arid zone vegetation consists of a closed scrub of evergreen or semi-evergreen shrubs, small trees, climbers, and occasionally, some large trees. Shrubs have glossy, leathery leaves or thorny, succulent leaves and are 2 to 3 meters high. The larger trees are widely scattered. Annual rainfall exceeds 500 mm.

3.3 Contamination routes for plants

Following the release of radionuclides to the atmosphere, the contamination of plants may occur via different contamination routes. The relevant processes are shown in Fig. 2.

From near-ground atmosphere, radionuclides may be directly deposited on the above ground parts. This includes:

- Direct deposition onto edible parts of plants: This will affect fruit, seeds and other edible plant organs
- Deposition of radionuclides on the foliage of crops: Radionuclides may be transported within the plant from the leaves to the edible parts. This systemic transport is called translocation. Translocation is an element-dependent process [17].

Direct deposition onto plants only occurs during the growing period. Outside the growing period these processes are not relevant. As the focus of this report is on the uptake of radionuclides from soil, these processes are not discussed further in this report.

Once deposited on soil, radionuclides are a long-term source for contaminating crops. The contamination is caused by the following processes (Fig.2):

- Deposition on soil and uptake through the roots
- Resuspension of soil particles and re-deposition on leaves and edible parts

These processes will be discussed below in detail.

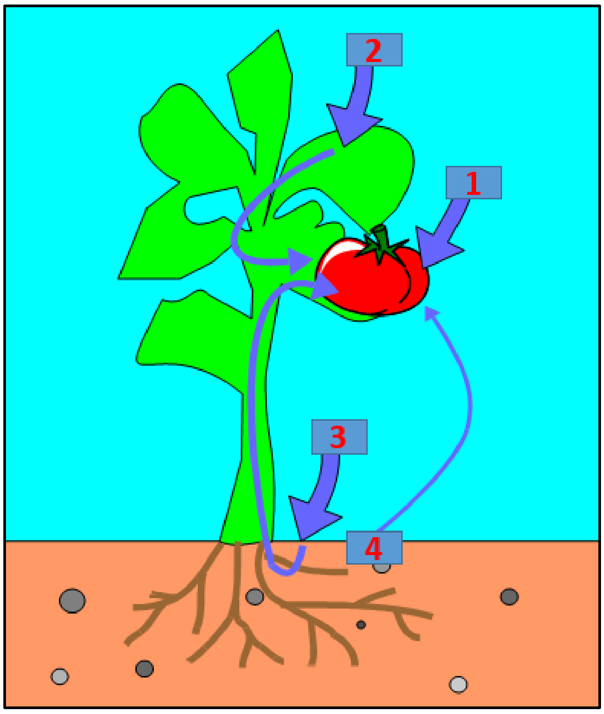


FIG.2: Scheme of contamination routes for plants following deposition of radionuclides from the air to the ground. 1) Deposition of radionuclides on edible parts, 2) Deposition of radionuclides on leaves and subsequent transport of radionuclides within the plant to the edible parts, 3) Uptake of radionuclides by crops from soil, and 4) resuspension of radionuclides from soil and subsequent re-deposition on plants.

3.3.1 Uptake of radionuclides from soil: Soil to plant transfer

In this report, the uptake of radionuclides from soil by crops is quantified by the transfer factor soil-plant TF which is defined as the ratio of the activity concentrations of a radionuclide in plants at harvest C_p (Bq kg^{-1} dry mass) to that in the soil C_s (Bq kg^{-1} dry mass) according to IAEA (2010). The unit of TF is [Bq/kg plant per Bq/kg soil]:

$$TF = \frac{C_P}{C_s}$$

Usually, both quantities, C_p and C_s are given in terms of dry matter to reduce the variability of the transfer factor due to varying water contents of crops. In other reports or publications, the transfer factor soil plant is be called "concentration ratio" $CR_{soil\ plant}$.

For the assessment of radiation doses due to the ingestion of crops growing on soil containing radionuclides, usually the food consumption rates refer to the fresh mass of food. In this case, the transfer factors need to be converted to a fresh mass basis using standardized dry matter contents of crops. A compilation of dry matter contents of crops and foodstuffs is given in [17].

The concept of the transfer factor is defined for equilibrium conditions, i.e. the activity concentration in the soil is not subject to drastic changes during the growth period of the crop. Such drastic changes occur for radionuclides with very short half-lives in the order of a few weeks (e.g. I-131) or for elements that are only very weakly sorbed in the soil and can therefore be quickly washed out into deeper soil layers during plant growth.

The transfer factor implicitly includes all factors that influence the uptake of radionuclides from the soil by plants, such as soil type, pH value, chemical form of the radionuclide, redox potential of the soil, soil management, nutrient supply and the sorption capacity of the soil. The transfer factors can vary from plant to plant; as a rule, the transfer factors are higher for vegetative plant parts (leaves, roots) than for generative organs (seeds, fruits).

The transfer factor is based on the total activity in the soil. The fractions of the activity in the soil that are actually available for uptake by the roots are not explicitly taken into account. For many radionuclides, however, significant fractions are not bioavailable because they are strongly bound to soil particles or are incorporated in insoluble compounds [18]. These factors lead to great variability in the activity concentration of plants that grow on different soils but have the same activity concentration in the root zone. Nevertheless, transfer factors are often used to quantify the uptake of radionuclides from the soil by plants, as they are easy to determine in the field and can easily be used in assessment models. Therefore, almost all information on root uptake is available in the form of transfer factors.

For the experimental determination of transfer factors, protocols have been developed by the International Union of Radioecologists [19] to facilitate the comparability of transfer factor studies and to reduce the uncertainties due to different experimental designs. The estimation of transfer factors refers to the average activity concentration in the upper 20 cm of the soil, which corresponds approximately to the ploughing depth of arable soil. For pasture and grassland, the average radionuclide concentration refers to the upper 10 cm of soil. It is assumed that all roots and all activity are present in the standardized soil layer of 20 cm and 10 cm for arable land and pasture respectively.

Following the input of radionuclides to soil, radionuclides may be sorbed to soil constituents or undergo chemical reactions during which the bioavailability of radionuclides is reduced. These are long-term processes that cause a long-term decrease of the uptake of radionuclides from soil. This phenomenon is quantified by the effective half-life of a radionuclide in an environmental medium, which includes all ecological and physical processes that cause a decline of activity in crops. Further details on effective half-lives are given in [17,18] and [20].

3.3.2 Contamination of crop due to resuspension of contaminated soil

Resuspension of radionuclides from soil to the near-surface air is the result of the interaction of many of factors as the soil composition, the roughness of the surface, the moisture of the surface, the density of the vegetation cover, the tillage and the time since the last tillage. The resuspension is quantified by the experimentally determined resuspension factor K as the ratio of the activity concentration due to resuspension in air C_a [Bq/m³) and the initial surface contamination C_s [Bq/m²] [17:

$$K(t) = \frac{C_a(t)}{C_s\,(t)}$$

Usually, the activity of radionuclides which is present in the upper soil layer of 0-1 cm is considered available for resuspension. For fresh deposits in temperate climate, an initial resuspension factor in rural areas of the order of 10^{-6} m^{-1} appears to be appropriate (IAEA, 2010). In arid regions, the initial resuspension factor is a about of the order of 10^{-5} m^{-1} , which is approximately a factor of 10 higher than in temperate regions. However, the resuspension factor declines quickly due to migration of radionuclides into deeper soils layers where the radionuclides are less available for resuspension. Further details are given in IAEA (2009, 2010).

Radionuclides resuspended to the near-surface air may be re-deposited on crops. The contribution of resuspended activity to the crop contamination in comparison to the uptake of radionuclides via the roots can be estimated from the dust concentration in air, which depends on factors such as wind speed, soil conditions and human activities. In arid areas, the dust content in the atmosphere in such regions is between 50 µg/m³ and over 500 µg/m³. During sandstorms, the values can be even higher [21.

For an *order-of-magnitude-estimation*, an average dust concentration of 200 µg/m³ and an activity concentration of soil of 1 Bq/kg are assumed; such soil is assumed to be subject to resuspension. Since the contamination of crops due to resuspension increases with increasing soil activity, it can also be expressed in units of the soil-plant transfer factor TF [Bq/kg plant per Bq/kg soil]. Assuming a deposition velocity of 1 mm/s, a crop yield of 1 kg/m² and a weathering half-life of approximately 14 d, [22], the resulting activity concentration in crops from resuspension is equivalent to a soil-plant transfer of the order of 0.001 [Bq/kg plant per Bq/kg soil]. The resuspended soil fraction is mainly clay and silt. In these soil constituents, the concentration of cationic radionuclides might be increased compared to the mean soil contamination due to the strong binding of cationic radionuclides to small soil components such as clay and silt [23. Therefore, the equivalent resuspension transfer factor soil-plant might be higher than 0.001.

This *order-of-magnitude-estimation* indicates that in arid regions resuspension of radionuclides with low bioavailability might contribute to the total activity of crops in a similar quantity as the uptake of radionuclides by crops through the roots.

It should be noted that in field experiments, it is very difficult to separate the contributions of root uptake and resuspension as these processes take place simultaneously.

3.3.3 Specific problems of agriculture in arid regions

The development of soils is the result of a complex interaction between host rock, temperature, precipitation, vegetation and soil tillage impacting on farming in arid climates. Agricultural activity must therefore address the following factors [24]

Due to the sparse vegetation, there is very little accumulation of organic matter. However, organic matter plays an important role for the water storage capacity of soil and the sorption of nutrients. Therefore, in general, low concentration of humus in soil limits the fertility of soil.

- The problem of low water storage capacity is exacerbated by the low rainfall. Low water storage capacity and rapid evaporation make irrigation difficult and require efficient water management systems.
- In arid climates, the evaporation of water exceeds the precipitation which causes capillary rise of water from deeper soil layers, which leads to an accumulation of salts at the soil surface and the upper soil layers. High levels of salt in the soil have a negative impact on plant growth and the production of salt-sensitive crops as e.g. wheat may not be possible.
- The main elements that accumulate on the surface are calcium and sodium, which have a negative effect on the soil structure in high concentrations. In addition, the evaporation of water favours

the crystallisation of minerals in the upper soil layers, resulting in dense and hard crusts on the soil surface. This reduces the permeability for scarce precipitation and makes soil cultivation more difficult. In addition, the bioavailability of phosphorus is reduced in soils with a high calcium content.

Therefore, arid regions require special agricultural practices, including the application of drip irrigation, the cultivation of salt-tolerant plants and the application of organic and mineral additives to improve the soil structure [25].

4 Data base on transfer factors soil-plant for arid areas

This work is based on an analysis of publications describing studies on the uptake of radionuclides in arid areas. The analysis covers both anthropogenic radionuclides such as Cs-137, Sr-90, Pu-240, and Am-241, as well as naturally occurring radionuclides such as K-40, Ra-226, Th-232, U-232, and others, along with certain elements and metals.

To date, more than 800 publications have been reviewed as potential sources for the database on radionuclide uptake under arid conditions. However, only 74 publications were deemed reliable enough to be included in the database.

Only those publications were included in the data base that comply with the experimental protocol that was defined by IUR [26] and with criteria given in [17,18].

Important factors in this protocol are:

- information on sampling strategies,
- composite plant-soil activity measurements,
- statistics,
- other relevant information as repetitions, description of experiment, seasons etc.

Only studies that provide sufficient information on these factors were included in the database. During the analysis of the publications, it turned out that the development of a data base for transfer factors soil-plant is challenging since few data are available in the open literature that comply with the criteria defined above.

It is assumed, that potentially such information would become available presently documented in non-English language internal institute reports but unpublished in the international scientific literature, or could be generated by structured experimental research in the countries of interest.

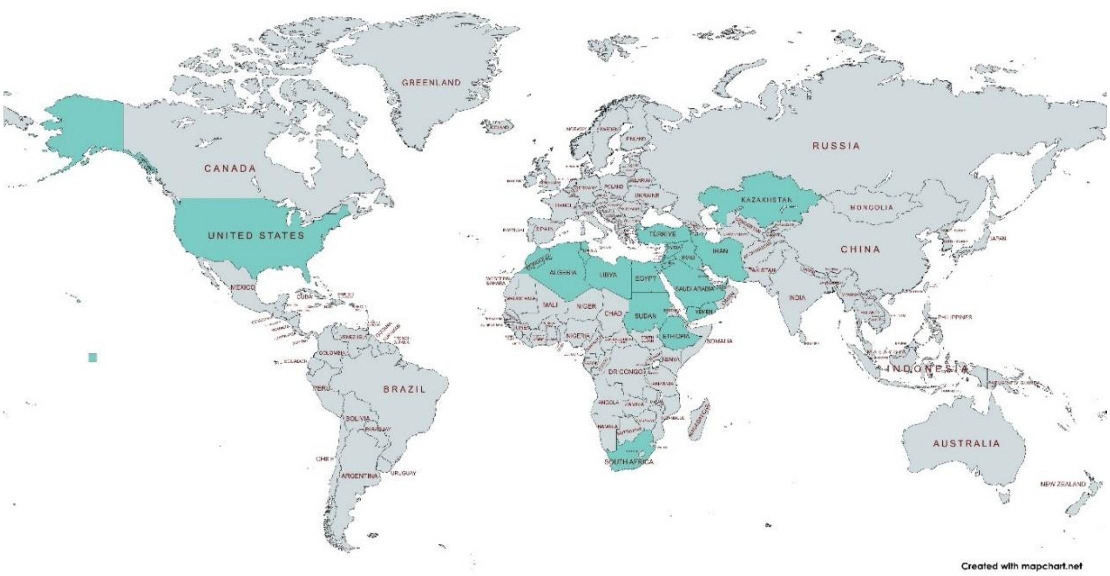


Fig. 3. Countries in arid zones with published transfer parameters.

Altogether, soil-to-plant transfer parameters from only 16 countries could be added to the databank: Morocco, Libya, Egypt, Israel, Jordan, Syria, Iraq, Iran, Saudi Arabia, Kazakhstan, South Africa, the USA, Tunisia, Algeria, Sudan, and Turkey (see Figure 3 above).

No data from semi-arid areas met the criteria of the agreed data sets to allow comparison with the tropical database or the TRS 472 [17] data. Part of our database formed the basis for the IAEA database on arid regions and was published in [27] and [28].

The majority of the radionuclides and elements covered relate to naturally occurring radioactivity. Data for anthropogenic radioisotopes—such as Am, Pu, Sr, and Cs—were available only for certain plant groups and are comparable to those in TRS 472. Most entries in the database pertain to cereals/grains and grasses/pasture grasses.

The following tables present a compilation of soil-to-plant transfer data for edible crops, as published in the open literature and referenced above. Only original data from the cited publications are included. The data are presented exactly as published, without any editing, recalculations, or modifications. This includes both arithmetic and geometric mean values, with or without standard deviations, and with or without information on soil texture or other details. Differences in values for the same compartment may be attributed to variations in sampling locations.

This database format allows users to select data that correspond to their local conditions and to calculate middle values as needed.

The tables below represent only a portion of the available information; the complete database is available online.

5 References

1. IAEA GSR- Part 3, 2014, International Basic Safety Standards
2. Transfer of Radionuclides in Arid and Semi-Arid Environments for Radiological Environmental Impact Assessment | IAEA
3. BECK, H.E., ZIMMERMANN, N.E., MCVICAR, T.R., VERGOPOLAN, N., BERG, A., WOOD, E.F., Present and future Köppen-Geiger climate classification maps at 1-km resolution, Scientific Data 5:180214 (2018).
4. BUDYKO, M.I., GERASIMOV, I.P. (1961). The Heat and Water Balance of the Earth's Surface, the General Theory of Physical Geography and the Problem of the Transformation of Nature. Soviet Geography, 2(2), 3–12. doi: 10.1080/00385417.1961.10770737
5. UNITED NATIONS ENVIRONMENT PROGRAMME (1992). *World Atlas of Desertification*. https://wedocs.unep.org/20.500.11822/42137.
6. J. INGLEZAKIS, S.G. POULOPOULOS, E. ARKHANGELSKY, A.A. ZORPAS, A.N. MENEGAKI, Chapter 3. Aquatic Environment in Environment and Development, Basic Principles, Human Activities, and Environmental Implications 2016,137-212.
7. https://wad.jrc.ec.europa.eu/patternsaridity
8. ARID ZONE FORESTRY: A GUIDE FOR FIELD TECHNICIANS, 1989, http://www.fao.org/docrep/t0122e/t0122e00.HTM
9. MODARIA: MODARIA II - Modelling and Data for Radiological Impact Assessments
10. FAO (www.fao.org).
11. National Oceanic and Atmospheric Administration
12. KHRESAT, S.A., RAWAJFIH, Z., BUCK, B., MONGER, H.C., Geomorphic features and soil formation of arid lands in northeastern Jordan, Archives of Agronomy and Soil Science 50 (2004) 607.
13. MABIT, L., BLAKE, W., Assessing recent soil erosion rates through the use of Beryllium 7 (Be-7), Springer (2019).
14. MUSAIGER, A.O., Socio-Cultural and Economic Factors Affecting Food Consumption Patterns in the Arab Countries, J. Roy. Soc. Health 113 2 (1993) 68.
15. . Xerophyte - Wikipedia
16. UNITED NATIONS EDUCATIONAL, SCIENTIFIC AND CULTURAL ORGANIZATION, Map of the world distribution of arid regions, Explanatory note, UNESCO, Paris (1977)
17. INTERNATIONAL ATOMIC ENERGY AGENCY, Handbook of Parameter Values for the Prediction of Radionuclide Transfer in Terrestrial and Freshwater Environments, Technical Reports Series No. 472, IAEA, Vienna (2010).

18. INTERNATIONAL ATOMIC ENERGY AGENCY, Quantification of Radionuclide Transfer in Terrestrial and Freshwater Environments for Radiological Assessments, IAEA-TECDOC-1616, IAEA, Vienna (2009)
19. INTERNATIONAL UNION OF RADIOECOLOGY, Protocol developed by the Working Group on Soil to Plant Transfer, 1982–1992, IUR, Saint-Paul-lez-Durance, France (1992).
20. PRÖHL G., EHLKEN, S., FIEDLER, I., KIRCHNER, G.,. KLEMT, E., ZIBOLD, G., Ecological half-lives of ^{90}Sr and ^{137}Cs in terrestrial and aquatic ecosystems, Journal of Environmental Radioactivity 91 (2006) 41-72.
21. https://unwetter-radar.de/staub-radar/).
22. INTERNATIONAL ATOMIC ENERGY AGENCY, Generic Models for Use in Assessing the Impact of Discharges of Radioactive Substances to the Environment, Safety Reports Series No. 19, IAEA, Vienna (2001)
23. LIVENS, F. R.; BAXTER, M. S. Particle size and radionuclide levels in some West Cumbrian soils. Sci. Total Environment 70:1-7; 1988
24. SCHEFFER, F.; SCHACHTSCHABEL, P.: Lehrbuch der Bodenkunde (Textbook of Soil Science, in German), Springer Spektrum, 2018
25. ACHTNICH, W.: Bewässerungslandbau (Irrigation farming, in German) Eugen, Publishing house Eugen Ulmer, Stuttgart 1980
26. www.iur-uir.org
27. Semioshkina, N., Voigt, G., 2021. Soil plant transfer of radionuclides in arid environments. J. Environ. Radioact. 237 (1), 106692. DOI: 10.1016/j. jenvrad.2021.106692
28. INTERNATIONAL ATOMIC ENERGY AGENCY, Soil-Plant Transfer of Radionuclides in Non-temperate Environment, IAEA TecDoc 1979, Vienna (2021)

6 Comments to considered literature

Abu Dhabi (UAE)

UAE2022 comes from Khalifa University (KU). It presents the TF's for NORM measured in a field experiment at Sa-al-Nakhl with date palms. The artificial soil was probed to about 22 cm depth. Two HPGe detectors were used.

UAE2024 from KU deals with concentration measurements of NORM in farms and open field. Cucumber, tomato, bell pepper, and ghaf leaf were collected together with their soils from representative locations of Abu Dhabi emirate. The reported concentration ratios are estimates because in the case of Ra-226 and Ra-228, a secular equilibrium could not be reached for the fruits so that the parental nuclides U-238 and Th-232 are not necessarily represented by their daughter nuclides.

Algeria (DZA)

DZA2016 comes from University of Djelfa. It reports TF's of 21 elements from soil to a medicinal herb. The location of collection was arid steppe at Bad Messaoud. Neutron activation analysis was performed at the Es-Salam research reactor.

Egypt (EGY)

19 papers are evaluated. Several papers report on pot and field experiments with artificial contamination with Cs-137, Sr-85 and Sr-90 and EU-152.

EGY1997 comes from the Atomic Energy Authority Cairo. Sandy soils were amended with organic sludge of two origins. The transfer of Uranium and Thorum to corn and Sesam seeds was investigated by help of neutron activation and subsequent analysis with a HPGE detector. Accumulation parameters are given in dependence of the percentage of sludge in the sand.

EGY2007 comes from National Institute of Standards in Giza. Soil samples were taken at desert areas which were developed as arable area by use of big amounts of fertilizers. The watering comes from artesian wells and does not contribute significantly to the background. 17 national and imported fertilizers were analysed for their concentration of NORM (K-40, Th-232, and U-238). Data for Cs-137 in soil and plants are given as well, but characterized as low activity. The soil samples were taken at 60 cm depth. Plants were banana, grape, apricot, olive and peach. TF's for NORM are given. A HPGe detector was used.

EGY2008 comes from the Protection department, NRC in Cairo. It very thoroughly reports on outdoor pot experiments with three soils of different Egyptian origins and compositions (sandy, sandy loam, and clayey); the physical and chemical parameters of the soils are listed. Wheat was selected as a major portion of the human diet in Egypt. The contaminants were Cs-137 and Sr-90. For Cs-137, a HPGe detector was used; Sr-90 was measured by a Phoswich detector which effectively discriminates the high-energy beta radiation of Sr-90 from other background. TF's for Cs-137 and Sr-90 are given. Radioactive Caesium and Strontium, both tend to be more mobile than the stable elements resulting in increased TF's.

EGY2011 reports the results of a co-operation of Tanta and other Egyptian universities with Universities in Gaza and Saudi Arabia. In several locations of North-Eastern Sinai, TF's of soil to wild plants were investigated for NORM and Cs-137 by use of a HPGe detector.

EGY2014 comes from South Valley University, Quena. TF's of NORM and Cs-137 to an number of non-specified natural plants (also in a forest) from Saluga and Ghazal Protectorate in Aswan are reported. A HPGe detector was used.

EGY2016A comes from Al-Azhar University, Assiut Branch. It deals with TF's of NORM from soil to wheat grains at harvest time. The samples were collected at Al-Mynia, Upper Egypt. A NaI(TL) detector was used.

EGY2016B from Al-Azhar University, Assiut Branch, deals with TF's of K-40, Th-232 and Ra-226 to seven strains of maize. The study area was Al-Mynia. A well shielded NaI(TL) detector was used.

EGY2016C from Zagazic University, El Sharkia, reports on pot experiments with soil collected up to 5 cm depth "near to a nuclear facility" (presumably at Inshas) at 5 cm depth. The soils were manually contaminated with different concentrations of radioactive Eu-152. Four crops (white and red bean, cucumber and zucchini) were cultivated. The TF's of Eu-152 were compared with those of NORM. Detector was a HPGe.

EGY2017A comes from the Nuclear Research Center, EAEA. The activity concentrations K-40, Ra-226, Th-232, and U-238 were measured in seven differently fertilized soils. The TF's to Jew's-mallow plant cultivated in clay soil were determined using a HPGe detector.

EGY2017B comes from EAEA and deals with concentrations of NORM in the farmland around Charcoal Kilns. The TF's to unnamed plants were determined by help of a HPGe detector.

EGY2019A from EAEA deals with the effects of six different fertilizers on NORM concentration in sandy loam soil compared to Jew's-mallow plant. Pot experiments were conducted to determine the TF's in dependence of the fertilization. A HPGe detector was used.

EGY2019B from Zagazig University reports on activity concentrations K-40, Th-232, and U-238 in white and red bean, cucumber and zucchini. The samples were taken at Sharqia governorate; Detector was a HPGe.

EGY2019C comes from Sohag University. It deals with the enhanced radioactivity of K-40, Ra-226 and Th-232 in the soil and dust of phosphate polluted areas, and the transfer to urban trees (Eucalyptus globulus, Blue Gum), i.e., not only the root uptake, but also the atmospheric deposition. The TF's were determined by help of a HPGe detector.

EGY2019D comes from ENRRA. It presents activity concentrations NORM in soil, water and plant samples of the Siwa oasis, western desert. From eight plants, only grass, woven, mulberry, and henna showed measurable activity concentrations of Th-232 and U-238; the corresponding TF's are listed. The detector was a HPGe.

EGY2020A comes from Al-Azhar University. It deals with the TF's of K-40, Ra-226 and Th-232 in clay loam soil from Minia governorate to sesame and cowpea. A shielded NaI detector was used. The physico-chemical characteristics of the soil were thoroughly analysed.

EGY2020B comes from Jouf University, Sakaka, Saudi Arabia, and Al-Azher University, Assiut Branch. TF's of K-40, Ra-226 and Th-232 for soybeans were measured in dependence of different soil textures by help of a NaI detector. The samples were taken in the El-Mynia governorate in Upper Egypt.

EGY2021A comes from ENRRA, Cairo. It deals with pot experiments in the open field with soil artificially contaminated with Cs-137 and Sr-85. The sandy clay loam soil was thoroughly characterized and fertilized. One campaign was conducted in winter, and one in summer. The plants were rice, wheat, beans, sesame, and clover. The activity concentrations (measured with a HPGe detector) in roots, shoots and seeds were separately determined. TF's are given for the first, second and third harvest.

EGY2021B from ENRRA studies the distribution of Cs-137 and Sr-90 in pot experiments after foliar contamination in order to simulate a fallout. Sandy clay loam was used; the plants were wheat, beans and clover carried out in winter, and rice and sesame in summer. Instead of the soil-to-plant transfer factor there is an "aggregated" transfer factor T_{ag} which is the specific activity in the plant divided by the activity sprayed upon the pots per m^2 as Bq kg^{-1}/Bq m^{-2}. The uptake was measured in roots, shoots and grains.

EGY2023 from EAEA Cairo deals with the concentration of K-40, Ra-226 and Th-232 in soil, water, plants and four vegetable crops under greenhouse conditions. By help of a HPGE detector, the TF's from fertilized sandy soil to cucumber, sweet and hot pepper, and tomato were determined.

Ethiopia (ETH)

ETH2020 Addis Ababa University. It reports the concentration of NORM in soil, cabbage and onions from horticultural factories in the province of Batu, 180 km south of Addis Ababa. Four samples were taken from soil, cabbage, and onions. TF's are explicitly given for each sample. The detector was a shielded NaI(TI).

Iran (IRN)

IRN2016 comes from a University in Tehran, SRTTU. Seven plants from 97 different locations were collected together with the associated soils. Soil samples were divided in 0-5 cm depth and 5-20 cm depth. TF's of Se are reported. ICP-OES was used for analysis.

Iraq (IRQ)

15 scientific papers are evaluated in relation to TF's of NORM; in IRQ2017B and IRQ2023A, also Cs-137 was included. The measurements were carried out by a HPGe detector and, in two cases with a NaI(TI)-detector.

IRQ2014 from Mosul University deals with soils taken from three important agricultural areas along Great Zab river; it reports TF's of K-40, Ra-226, and Th-232 to different local vegetables.

IRQ2017A from Baghdad University deals with soils taken about 10km east of Baghdad in depths of 0-25 cm. TF's are given for K-40, Th-232, and U-238; the related plants were specified as "herbs" and "grass".

IRQ2017B from Arak University (Iran) deals with the concentrations of K-40, Ra-226, Th-232, and Cs-137 in Karbala (Irak), and the TF's to wheat and barley.

IRQ2018 from Mosul University is published in the Al-Rafidain Journal of Science in Arabic language; abstract in English. The measurements were made before 2014. NORM concentrations were measured in soils from four locations in Nineveh Governorate. TF's were calculated for dry and fresh vegetables, i.e. tomatoes, cucumber, eggplant, green pepper, pamia, okra, leek, peter, and chard.

IRQ2019A from Salahaddin University in Erbil deals with the concentrations of K-40, Ra-226, Th-232 in soil and plant crops. Soil samples were taken in 20 cm depth and in greenhouses in Erbil city. TF's were determined for several grains, non-leafy vegetables, fruits, tuber, and root crop.

IRQ2019B comes from Salahaddin University in Erbil. Soil samples were taken in three greenhouses and ten agricultural fields in Erbil City, all up to 20 cm depth. Physico-chemical parameters of the soils are given. K-40, Ra-226, and Th-232 were measured by use of a HPGe. Detector. TF's were determined for wheat, barley, , rice, tomato, cucumber, eggplant, sweet and hot pepper, courgette, onion, watermelon, melon, potato, and radish.

IRQ2020A comes from Koya University, Kurdistan. Samples of soils and wheat grains were collected in 36 locations in Koysinjaq (south part of Kurdistan). Beside of NORM, also Cs-137 was found in the soils, but not in the wheat grains (< 0.012 Bq/kg): Soil and wheat was analysed by means of a HPGe detector. Instead of the concentration of Th-232, the concentration of Ra-228 was determined for the wheat grain samples. TF's for K-40, Ra-226 and Ra-228 are listed.

IRQ2020B from Mustansiriyah University, Baghdad, deals with samples from Al-Taji, a northern suburb of Baghdad. The measurements were made on soil and three parts of each plant sample (roots, stalk, and leaves). TF's are given for basil, celery, and mint.

IRQ2021 comes from Minia University, Egypt, but deals with TF's of K-40, Th-232 and U-238 from soil to 11 crops cultivated in farms in Baghdad and Al-Najaf, Iraq. The soils were collected at 20 cm depth; crops were rice, wheat, lemons, oranges, vigna, okra, chilli petters, Solanum melongena, Apium graveolens, Raphanus sativus, and Ocimum basilicum. No Cs-137 was found. Detector was HPGe.

IRQ2022 from Mosul University reports TF's of NORM from fertilized crops in Tikrit city. The soil was taken at 5-10 cm depth. The crops included various sorts of wheat, barley, and corn.

IRQ2023A from Mustansiriyah University Baghdad deals with the TF's of NORM and Cs-137 from soil to ten different leafy vegetables.

IRQ2023B comes from Sawa University, Al Muthanna. Plants and soil samples were collected from agricultural fields in the east of Tikrit city. Radioactivity measurements were carried out for K-40, Ra-226, Th-232. TF's are given for okra, onion, cucumber, tomatoes, eggplant, sweet potatoes, zucchini, and organic pepper.

IRQ2024 from Salahaddin University in Erbil deals with the TF's of K-40, Ra-226, Th-232 from soil to grass, and to milk of non-specified animals. Soil was taken at 20 cm depth at 14 different pastures in Erbil governorate. Detector was a shielded NaI(TI).

IRQ2025 comes from Al-Iraqi University, Baghdad, in co-operation with Al-Falluja University, Falluja, and Al-Nahrain University, Baghdad. It deals with TF's of U-238 in carrot, beet, potato, Jerusalem artichoke, Turnips, and Onion also considering edible parts of the roots. The samples were collected at Tarmiyah city about 50 km upstream Tigris river north of Baghdad. Samples of soil and plants were packed between CR-39 detectors and irradiated with moderated neutrons from an Am-Be neutron source. After etching, the tracks of the fission products were counted by help of a microscope.

Israel (ISR)

ISR2006 comes from the Environment Radiation Lab, Tel Aviv, and from Ben Gurion University, Beer Sheva. It deals with the surface contamination (up to 5 cm depth) of cultivated soils in eleven regions of Israel and their transfer to a large number of vegetables, fruits, dairy samples (milk products including dry milk), and foodstuff. The detector evidently was a HPGe using Marinelli beakers for the samples. TF's are presented for Be-7, K-40, Cs-137, Ra- 226, and Th-232. For each nuclide, detection limits, relative errors and estimates of systematic errors due to sample preparation and statistics are given.

Jordan (JOR)

JOR2006 comes from Al-Balqa' Applied University (BAU), As-Salt. It deals with the soil-to-plant TF's of NORM to apples, chickpeas and wheat from three regions in Jordan. The soils were characterized and moreover, the influence of temperature and rainfall on the TF's were investigated. Two HPGe detectors were used.

JOR2008 comes from BAU and the Royal Scientific Society, Amman. Samples of soil and crops were collected at 24 locations in the kingdom. Special attention was given to Khan Al-Zabeeb, where increased dose rates were found due to underlying uranium ore. The concentration of U-238, Th-232, Cs-137 and K-40 was measured with HPGe detectors in four steps up to 32 cm depth of the cultivated soil. TF's of watermelons and zucchini were determined using alpha and high-resolution gamma spectrometry. As well as Cs-137 was found only in traces, a negative correlation of the activity of K-40 vs. Cs-137 in apples was shown.

JOR2014 comes from Al Hussein Bin Talal University in Ma'an. It deals with the transfer of heavy metals from soils which were polluted with phosphogypsum waste materials. Mass concentrations and TF's from soil to tomato and pepper plants were determined for Cd, Cr, Cu, Ni, Zn, Pb, and V by AAS. The uptake by plants was investigated in dependence of the levels of heavy metals in soils.

JOR2023 comes from Jordan University of Sciences and Technology. TF's of NORM to orange fruits are assessed in dependence of the growth of the fruits. A mathematical model was developed for the activity concentration-time factor. The soil was taken in a depth of 20 to 30 cm. A HPGe detector was used.

Kazakhstan (KAZ)

KAZ2014A comes from Institute of Radiation Safety and Ecology (RSE), Kurchatov. A homogeneously contaminated field within the former Semipalatinsk atomic test site STS was chosen. TF's were determined for 15 agricultural plants distinguishing soil, roots, stalk, leaves, and fruits where applicable. Nuclides were Sr-90, Cs-137, Pu-239/240, and Am-241. Due to arid conditions, irrigation was performed with imported clean water. No fertilizers were used. The soil was analysed in the root zone, i.e., up to 10 cm depth. Gamma and ß-spectrometers as well as radiochemical methods were used for the determination of activity concentrations.

KAZ2014B comes from Shakarim State University in Semey. Water, milk, soil, plants, and meat were investigated for their content of Cs-137, Pu-239/240, and Am 241. 100 samples were collected at 5 different locations within the Semipalatisk Test Site (STS) and analysed with high resolution gamma and alpha spectrometry. TF's are not explicitly given, but could be calculated from the given data.

KAZ2018 comes from RSE. Samples of soil and natural perennial plants were collected from five locations in STS with differing contamination, i.e., from epicenters of aboveground testing, plumes of radioactive fallout, background areas, radioactive streamflows, and places of WRA tests ("dirty bomb tests"). They were analysed for Sr-90, Cs-137, Pu-239/240, and Am-241. High-end alpha, beta and gamma spectrometry was applied after suitable treatment of the samples. TF's were determined.

KAZ2022 comes from RSE. It deals with the accumulation and TF's of Sr-90 and Cs-137 in steppe grasses. The location was the dump zone of a crater on the STS originating from an underground nuclear explosion at the STS.

KAZ2023 comes from RSE. It deals with TF's from soil to parts of three different perennial plants due to contamination by so called peaceful nuclear explosions at STS performed at a depth of 31 m. Superficial (5 cm depth) samples were collected at 40 sites along the outside slope of two craters up to 200 m in the plain. The concentrations of Sr-90, Cs-137, Pu239/240 and Am-241 were determined by high-end alpha, beta and gamma spectrometry.

KAZ2024A comes from RSE. Between 2012 and 2015, two experimental fields were established at differently contaminated sites in STS. Apple, cherry, raspberry, plum and currant plants were grown and the dynamics of the transfer of Sr-90, Cs-137, Pu-239/240 and Am-241 from soil-to-plant was studied. Clean water was used for watering. The soils were physically and chemically characterized up to a depth of 15 cm. TF's were determined distinguishing the organs of the plants.

KAZ2024B is in Russian and comes from RSE. Soil from Aktan-Berli was probed up to 5 cm depth; naturally growing samples of plants were collected and mixed. The content of natural (K-40, Ra-226, Th-232) as well as of artificial nuclides (H-3, Sr-90, Cs-137, Pu-239/240, Am-241), both, were determined.

KAZ2024C comes from RSE. Soil and sagebrush were collected at the perimeters of two research reactors on the territory of the STS. The concentrations of Cs-137, Pu-239/240, and Am-241 were measured in two consecutive years. TF's of Cs-137 and Pu-239/240 were determined.

Kingdom of Saudi Arabia (SAU)

Five scientific papers are evaluated in relation to TF's of NORM; SAU2017 also includes Cs-137.

SAU2013 from Qassim University reports on measurements of K-40, Ra-226, and Th-232 in soils of the Qassim area, and their transfer to wheat grains, palm dates , and alfalfa. The soil samples were taken from the plant root zone. A NaI(TL) detector was used.

SAU2014 from Qassim University reports on the determination of K-40, Ra-226, Ra-228, and U-238 by help of a HPGe detector. Sandy and sandy loam soils were used in pot experiments. The activity concentrations of the two soil types, of groundwater for irrigation, and of plants (non-specified crops) of the Qassim area were determined. Correlations between the specific activities of Radium contents in the feeding water against the associated plants were determined.

SAU2016 from IMSIU, Riyadh, reports on TF's of Ra-226, U-234, and U-238 in 13 crops, i.e. wheat, onion, beans, potatoes, tomato, cucumber, pepper, capsicum, organic pepper, chili pepper, eggplant, organic eggplant, and zucchini. The samples were taken at eight farms in the North-Western province of Tabuk. The soil was taken from the root zones of the plants (10-20 cm depth). The crop plants were divided into the edible parts, stem and leaves, and roots. The nuclides were determined by alpha-spectrometry; a U-232 radiotracer was used for the determination of uranium; a Ba-133 tracer was used for the determination of Radium. *Our comment: Perhaps further clarification is needed to confirm whether the nuclides in question were U-232 and U-234..*

SAU2017 from Al-Majmaah University, Al-Zufi, deals with the activity concentrations of K-40, Cs-137, Ra-226, and Th-232 in soil and date palm pits. For this, a HPGe detector was used. The samples were collected at date palm farms in three different districts of central Saudi Arabia. TF's were determined except for Cs-137 which was not detectable in the pits.

SAU2018 from the Nuclear and Radiological Regulatory Authority, Cairo, Egypt, deals with the factors that influence the Ra-226 uptake by cabbage and lettuce from the soil. The samples were collected at seven neighbouring farms in the Al-Sharqiyyah Province, East Saudi Arabia. The radium concentration ratios were determined on the basis of both, the exchangeable and the total Ra-226 content in the soils. For the measurements, a 70% HPGe detector as well as an alpha spectrometer, both were used. The correlations of the Ra-226 uptake on the one hand, and exchangeable Ra-226 and organic matter in soil on the other hand, both were determined.

<u>Kuwait (KWT)</u>

KWT2015 comes from Kuwait University. Palm dates originating from eight states were analysed for activities of K-40, Ra-226, and Ra-228 [parent nuclide Th-232]. A HPGe p-type detector was used with 80% efficiency.

<u>Morocco (MAR)</u>

MAR2009 comes from Cadi Ayyad university, Marrakech. 16 samples of homeland honey and the corresponding soils, plant flowers and nectar solutions were investigated for of Rn-220, Rn-222, Th232, and U-238. Correlations of the concentration of these nuclides between soil and plant flower, plant flower and nectar, and nectar and honey were obtained by help of CR-39 and L115 nuclear track detectors.

MAR2011 comes from Sultan Moulay Slimane University, Beni-Mellal. "Preliminary results" are given for the TF's of Th-232 and U-238 from soil to different parts of 16 different medicinal plants.

The region investigated was Errachidia in SE-Morocco. The alpha activities were quantified by help of etch track foils.

MAR2013 is the follow-up of MAR2011 and concentrates on Rn-222 and Ra-220 and their decay products. Samples of 13 different medicinal plants and their corresponding soils were collected in Beni-Mellal (middle of Morocco). The TF's in root, stem, leaf, and, partly, fruit and seed were determined separately.

MAR2021 comes from Centre National de l'Énergie, des Sciences et des Techniques Nucléaires, Rabat. It reports TF's of K-40, Ra-226 and Pb-210 from soil to 11 different plants and the corresponding soil at three locations at El-Jadida, NW-Morocco. A HPGe detector was used.

Palestine (PSE)

Six scientific papers from Hebron University are evaluated in relation to measurements of NORM and Cs-137. Samples were taken from North and South Palestine, especially from Tulkarem and Hebron District, respectively. After thorough preparation, all activity concentrations were determined using a HPGe detector:

PSE2006 starts with the determination of radioactivity concentrations in various leaves as indicator of radioactive contamination. Soil samples were taken only from the surface, i.e., at 5 cm depth (after removing recent wastes). The activity concentrations of Cs-137 seemingly were near to the detection limit. The results are compared with literature values from Sinai, Egypt and UNSCEAR.

PSE2008 deals with soil samples collected on six sites in the southern part of the West Bank.

PSE2012A deals with soil samples taken at twelve different sites near the city of Tulkarem the north of West Bank. Beside NORM, also Cs-137 was found.

PSE2012B deals with radioactivity concentrations in plant leaves and grass samples collected in the Tulkarem district.

PSE2014 deals with the TF's from soil to grass and the leaves of plants in the Tulkarem district.

PSE2015 summarizes the upon publications and goes on to the determination of K_d for NORM and Cs-137. Crops are not included.

South Africa (ZAF)

ZAF2020 comes from University of KwaZulu-Natal, Pietermaritzburg. TF's of K-40, Ra-226, and Th-232 are reported for maize, potato and cowpea grown on farm soil. Products from oil-producing and non-oil-producing areas are distinguished. A HPGe detector was used.

ZAF2015 comes from North-West University, Mafikeng. It reports TF's of Th-232 and U-238 for three medicinal plants grown at contaminated gold mine tailings. The surface of the soil was cleaned from oil; samples were taken up to 100 cm depth. ICP-Mass Spectrometry was used to measure the concentration of Thorium and Uranium in soil and in the medically used leaves of the plants; after conversion of the of elemental concentrations to activity concentrations, TF's were calculated.

Sudan (SDN)

SDN1995 comes from Atomic Energy Research Institute, Khartoum together with Dept. of Radioecology, Uppsala, Sweden. Farm soils and crops from seven regions in Sudan were collected. Activity concentrations of Ra and Ca in soil and plants were compared. The soils were characterised for pH, organic matter content, exchangeable cations (Ca, Mg, K), phosphorous content. The influence of exchangeable Ra, Ca, i.e. K_d, on the concentration ratios was quantified. Plants were cowpea, lentil, tomato, sorghum, okra, eggplant, broad bean, millet, sesame, ground nut, beet, onion, radish, and carrot. A HPGe spectrometer was used; the alpha activity of Rn-gas and its daughters as well as of Ra, both were determined by use of a liquid scintillator.

SDN2013 comes from the Universities of Bahri and of Khartoum. It reports enrichment factors and TF's of nine elements - not of NORM - to sorghum (bi)colour. The soils from Blue and White Niles were analysed for particle size distribution and elemental concentration. An atomic absorption spectrometer was used for the analyses.

Syria (SYR)

SYR1996 is a conference poster coming from Atomic Energy Commission (AECS), Damascus. Two tables of TF's are shown, one with soil-to-plant TF's of four plants contaminated by fallout Cs-137, and another one with TF's of Cs-137 in an artificially contaminated experimental field for five crops in typical Syrian soils.

SYR1997 from AECS deals with TF's of Cs-137 in two differently contaminated experimental fields. The impact and effectiveness of changing land use was studied for several crops with and without fertilization.

SYR2006 from AECS reports TF's measured at an experimental field homogeneously contaminated with Sr-90 and Cs-137 up to a depth of 25 cm. The soil was Aridisol with a loamy clay texture. The plants: olive, apricot, and grape were harvested in four consecutive years. A HPGe was used.

SYR2008 comes from AECS and deals with TF's of NORM on two different soils in SW of Syria. The soils were analysed in three steps to a depth of 75 cm. Twelve different sorts of vegetables, legumes, cereals, and trees were planted. The fruits were collected at fruit maturity, moreover the different organs of the plants were separated. Detection methods were gamma and alpha spectrometry. TF's were determined for K-40, Pb-210, Po-210, and U-238.

SYR2010 comes from AECS and deals with TF's of Po-210 and Po-208 as tracer from soil to the organs of parsley and mint. The soil for the pot experiments was taken from farms near to Damascus city. Outdoor results are compared with those of a sheltered system. The nuclide concentrations were determined by the standard silver disc technique and an alpha spectrometer.

SYR2015A comes from AECS; it deals with the transfer of Po-210, Pb-210, and U-238 from 35 kinds of medicinal plants to their essential oils. New data about the potential interactions of the above nuclides with organic compounds are presented. An alpha spectrometer was used together with the standard silver disc technique.

SYR2015B from AECS reports TF's of Sr-90 and Cs-137 at four growing stages for lettuce and winter wheat. The experiment was carried out in lysimeters filled with Inceptisol soil, and without fertilizer. Sr-90 was determined via Y-90 by a Cherenkov counter; Sr-85 was used as tracer. For Cs-137, a HPGe detector was used.

SYR2021A from AECS compares the TF's of Sr-90 and Cs-137 to various crops for two soil types, Aridisol and Inceptisol. Moreover, the influence of fertilisation was studied. Plants were cereal (wheat, sorghum, barley, and maize), vegetables (cabbage, spinach, jew-mallow, lettuce, cucumber, tomato, watermelon, garlic, and onion), tubers (potato), leguminous vegetations (broad bean, chickpea, bean) and leguminous fodder (Alfalfa). Plant parts were distinguished. Sr-90 was determined via Y-90 by a Cherenkov counter; Sr-85 was used as tracer. For Cs-137, a HPGe detector was used.

SYR2021B from AECS compares agricultural soils from five different locations and the respective TF's of NORM to coriander, parsley and mint. The soils were Entisols, Aridisols, and Inceptisols. Moreover, K_d for Ra, U, Pb, and Po and its dependence on the activity concentration in the soils is reported. Detection was performed with a HPGe spectrometer for Ra-226 (via Pb-214 and Bi-214) and U-238 (via Th-234), an alpha spectrometer for Po-210 and Pb-210, an LSC for Ra-226 and Th-234, and a fluorometric technique for uranium.

SYR2022 from AECS reports on pot experiments with four different genotypes of barley. TF's of NORM were measured in contaminated and non-contaminated soils from five origins. The soils were Entisols, Aridisols, and Inceptisols. Correlation factors of the measured TF's with pH, EC, OM, CEC, sand, silt, and clay. Detection was performed with a HPGe spectrometer for Ra-226 (via Pb-214 and Bi-214) and U-238 (via Th-234), an alpha spectrometer for Po-210 (with Po209 tracer) and Pb-209, an LSC for Ra-226 and Th-234, and U-238.

Tunisia (TUN)

TUN2018 comes from Sfax University. It reports elemental concentrations of Cr, Cu, Mn, Zn, and Pb in a sandy soil irrigated with treated waste water, and the transfer to olive tree, olive oil and to milk from cows foraged with sorghum, alfalfa, and oats. The soil was analysed up to 30 cm depth. The detector was an atomic absorption spectrometer.

Turkey (TUR)

TUR2023 comes from Bitlis Eren University, Bitlis. Activity concentration of NORM and Cs-137 in 18 naturally growing medicinal and aromatic plants in the [semi-arid] province of Bitlis were measured; TF's for Cs-137 of 12 plants are reported. The detector was a HPGe spectrometer.

TUR2024A comes from the Nuclear Energy Research Institute in Ankara. Soil samples were taken in an area near to large thorium and rare earth deposits ("NORM area"), in the south east of Eskisehir province in Central Anatolia. Out of four plant groups, Barley, white beans, tomato and apple samples were collected from agricultural fields and gardens situated in the direction of prevailing wind from the NORM area. Physicochemical characteristics of the soils around the plants are given. For the determination of TF's, the activity concentrations of K-40, Ra-226 and Pb-210 were measured with HPGe detectors; for U-238 and Th-232, an alpha spectrometer was used.

USA (USA)

USA2006 comes from Idaho State University, Pocatello. Soils and natural vegetation were sampled at 27 sites in the region between Ashton, Idaho Falls, Pocatello, and Twin Falls. The soils were sampled to a depth of 15 cm and characterised for their physicochemical parameters. 330 plants representing 124 species, 79 genera, and 31 families were analysed. ICP-MS was used to determine the concentrations of natural Cs and Ti. In contrast to a rapid air-borne contamination, the detected concentrations would emerge only after many decades. Correlations of the two elements and TF's are listed for 17 different pants.

USA2020 comes from Arizona State University. It deals with the phytostabilization of soil with increased natural uranium content. The contaminated soils and natural plants on it were analysed by means of an energy dispersive x-ray fluorescence spectrometer (XRF). The mass transfer of uranium from soil to plant is described by a bioconcentration factor BCF. Five leaf tissues of desert shrubs and three woody tissues were analysed.

Yemen (YEM)

YEM2015 comes from the South Valley University , Egypt, and other universities in Egypt, SAU, and Yemen. The activity concentration of K-40, Ra-226, Th-232 in cultivated soils from 17 locations in south Yemen were determined using a NaI(Tl) detector.

YEM2019 comes from Assiut University, Egypt and the Aden University. By help of a HPGe detector, the activity concentrations of K-40, Ra-226, and Th-232 in topsoil specimen (up to 5 cm depth) of different farms in Abyan Delta, South Yemen were determined as well as those of ten foodstuffs. From this, the TF's of sorghum, maize, Pearl of cattail, millet, onion, radish, peanut, Jew's mallow, arugula, and coriander were calculated.

7 References

DZA2016 Oumelkheir Mokhtari, Bouzid NEDJIMI, and Mohamed TOUMI, Rev. Roum. Chim., 2016, 61(11-12), 935-940, http://web.icf.ro/rrch/

EGY2007 Ahmad, F, Isotope and Radiation Research, 38(4), p. 1043–1057, doi: 10.1080/10420150600903359

EGY2008 S. A. Abu-Khadr, 2M. F. Abdel -Sabour, A.T. Abdel - Fattah and H.S. Eissa, IX Radiation Physics & Protection Conference, 15-19 November 2008, Nasr City - Cairo, Egypt

EGY2011 Khaled A. Ramadan, Mostafa K. Seddeek, Abdelkareem Nijim, Taher Sharshare and Hussein M, Badran, *Isotopes in Environmental and Health Studies,* Vol, 47, No, 4, December 2011, 456–469, doi: 10.1080/10256016.2011.633165

EGY2016a M, A, Mostafa, M, A, M, Uosif, Reda Elsaman, Elsayed Moustafa, International Journal of Scientific & Engineering Research, Volume 7, Issue 2, February 2016

EGY2016b Ahmed Mohamed Ahmed Mostafa, Mohamed Amin Mahmoud Uosif, Reda Elsaman and Elsayed Moustafa, Journal of Physical Science, Vol, 27(3), 25–49, 2016, doi: 10,21315/jps2016,27,3,3

EGY2016c Mohammed Elywa, Fawzia Mubarak, H.A. Omar et al, Middle-East Journal of Scientific Research 24 (10): 3278-3283, 2016, doi: 10.5829/idosi.mejsr.2016.3278.3283

EGY2017 N.Y. Abdou, R.A. Hegazy and H.S. Eissa, World Applied Sciences Journal 35 (1): 128-136, 2020, doi: 10.5829/idosi.wasj.2017.128.136

EGY2019a M,A, Salama, Kh,M, Yousef, A,Z, Mostafa, Arab J, Nucl, Sci, Appl,, Vol, 52, 1, 33-43 (2019)

EGY2019b Mohammed Elywa, Fawzia Mubarak, H,A, Omar, A, Nassif, Mansour, Eman Selem and Noura Marwaan, Middle-East Journal of Scientific Research 24 (10): 3278-3283, 2016, doi: 10,5829/idosi,mejsr,2016,3278,3283

EGY2019c M, El-Zohry & M, H, El-ZayatArab J, Nucl, Sci, Appl,, Vol, 52, 4, 93-99 (2019), doi: 10,21608/ajnsa,2019,7713,1174

EGY2020a R. Elsaman, G.A.M. Ali, M.A.M. Uosif, A. El-Taher, K.F. Chong, Int. J. Radiat. Res., January 2020; 18(1): 157-166, doi: 10.18869/acadpub.ijrr.18.1.157

EGY2020b M. A. M. Uosif, Z. A. Alrowaili, Reda Elsaman and A. M. A. Mostafa, Radiation Protection Dosimetry (2020), pp. 1–7, doi:10.1093/rpd/ncaa005

EGY2021a A.B. Ramadan etal., Journal of environmental radioactivity, 234 (2021) 106632, doi: 10.1016/j.jenvrad.2021.106632

ETH2020 GEBI T. YACHISO, A.K. CHAUBEY, JETIR December 2020, Volume 7, Issue 12

IRN2016 Mohamad Sakizadeh , Fatemeh Mehrabi Sharafabadi , Eshagh Shayegan , Hadi Ghorbani, IOP Conf. Series: Earth and Environmental Science 44 (2016) 052027, doi: 10.1088/1755-1315/44/5/052027

IRQ2014 Ahmed K. Mheemeed, Laith A. Najam, Ali Kh. Hussein, J Radioanal Nucl Chem (2014) 302:87–96, doi: 10.1007/s10967-014-3259-y

IRQ2017b Reza Pourimani , Seyed Mohsen Mortazavi Shahroodi, *Iran J Med Phys, Vol. 15, No. 2, April 2018, 126-131, doi: 10.22038/ijmp.2017.24190.1238*

IRQ2018 Ali K. Hussein, Rafidain journal of science,Issue 2, Pages 135-150, 2018

IRQ2019 Hiwa H. Azeez, Habeeb Hanna Mansour, Saddon T. Ahmad, Applied Radiation and Isotopes 147 (2019) 152–158, doi: 10.1016/j.apradiso.2019.03.010

IRQ2019a Najeba Farhad Salih, Zakariya Adel Hussein, Shalaw Zrar Sedeeq, *Radiation Protection and Environment,* 47(4):128-137, Oct–Dec 2019, doi: 10.4103/rpe.RPE_37_19

IRQ2020b Iman Tarik Al-Alawy, Waleed Jabar Mhana, Rand Mudher Ebraheem, IOP Conf. Series: Materials Science and Engineering **928** (2020) 072139, doi: 10.1088/1757-899X/928/7/072139

IRQ2022 Laith Ahmed Najam and Imad Ahmed, Rabee B. Alkhayat, Taha Yaseen Wais, Int. J. Nuclear Energy Science and Technology, Vol. 16, No. 1, 2022

IRQ2023a Athraa Naji Jameel, Iraqi Journal of Science, 2023, Vol. 64, No. 2, pp: 643-652 DOI: 10.24996/ijs.2023.64.2.13

IRQ2023b Ahmed A. Sharrad , Huda N. Tehewel and Hussein R. Sultan, Asian Journal of Environment & Ecology , Volume 22, Issue 2, Page 31-39, 2023, DOI: 10.9734/AJEE/2023/v22i2478

IRQ2024 Ahmed I. Samad, Ali H. Ahmed, Saadon T. Ahmad, Applied Radiation and Isotopes 205 (2024) 111170, DOI: 10.1016/j.apradiso.2023.111170

IRQ2025 Zeena J, Raheem, Tebarak A,A, Al-Salmani, Raghad I, Mahmood, Nada F, Tawfiq, IRAQI JOURNAL OF APPLIED PHYSICS, Vol, 21, No, 1, January-March 2025, pp, 43-48

ISR2006 N. Lavi, G. Golob, Z.B. Alfassi, Radiation Measurements 41 (2006) 78 – 83, DOI: 10.1016/j.radmeas.2005.04.005

JOR2006 Mohammad. I. Awadallah and Dia-Eddin. M. Arafah, ABHATH AL-YARMOUK: "Basic Sci. & Eng." Vol. 15, No.2, 2006, pp. 207-223

JOR2008 Samer J. Al-Kharouf , Ibrahim F. Al-Hamarneh, Khan Al-Zabeeb, Jordan, Journal of Environmental Radioactivity 99 (2008) 1192e1199, DOI: 10.1016/j.jenvrad.2008.02.001

JOR2009 Anas M. Ababneh, Maisoun S. Masadeh, Zaid Q. Ababneh, Mufeed A. Awawdeh and Abdalmajeid M. Alyassin, Radiation Protection Dosimetry (2009), pp. 1-8, DOI: 10.1093/rpd/ncp064

JOR2015 Mohammad Al-Hwaiti, Omar Al-Khashman, Environ Geochem Health 37, 287–304 (2015), DOI: 10.1007/s10653-014-9646-z

JOR2017 Asma Fayyad Bzour, Hani Nicola Khoury, Sawsan Attalah Oran, Appl Microsc 2017; 47(3):148-156, DOI: 10.9729/AM.2017.47.3.148

JOR2023 Khaled F. Al-Shboul, Al-Montaser Bellah A. Al-Ajlony, Ghadeer H. Al-Malkawi, Journal of Environmental Radioactivity 262 (2023) 107149, DOI: 10.1016/j.jenvrad.2023.107149

KAZ2013 Larionova N.V.1, Lukashenko S.N.1, Sanzharova N.I., Radiazia I risk, 2013, v. 22, n4, 60-65

KAZ2014a T.E. Kozhakhanov, S.N. Lukashenko, N.V. Larionova,Journal of Environmental Radioactivity 137 (2014) 217e226, DOI: 10.1016/j.jenvrad.2014.06.026

KAZ2018 N.V. Larionova, S.N. Lukashenko, A.M. Kabdyrakova, A.Ye. Kunduzbayeva, A.V. Panitskiy, A.R. Ivanova, Journal of Environmental Radioactivity, Volume 186, June 2018, Pages 63-70, DOI: 10.1016/j.jenvrad.2017.09.006

KAZ2021 N.V. Larionova, S.N. Lukashenko, O.N. Lyakhova, A.K. Aidarkhanova etal, Journal of Environmental Radioactivity 237 (2021) 106684, DOI: 10.1016/j.jenvrad.2021.106684

KAZ2022 N.V. Larionova, P.Ye. Krivitskiy, A.V. Toporova, Ye.N. Polivkina, A.O. Aidarkhanov, *Вестник НЯЦ РК* выпуск 3, сентябрь 2022, DOI: 10.52676/1729-7885-2022-3-26-30

KAZ2024a T.E. Kozhakhanov, N.V. Larionova, S.N. Lukashenko, Zh.A. Baigazinov, A.M. Kabdyrakova, A.Ye. Kunduzbayeva, Journal of Environmental Radioactivity 271 (2024) 107317, DOI: 10.1016/j.jenvrad.2023.107317

KAZ2024b N. V. Larionova, A. V. Toporova, V. V. Polevik, E. N. Polivkina, P. E. Krivitskiy etal, Article in NNC RK Bulletin · March 2024, DOI: 10.52676/1729-7885-2024-1-80-88

KAZ2024c Natalya Larionova, Anna Toporova, Pavel Krivitskiy, Vasiliy Polevik etal, PLoS ONE 19(7): e0306531. DOI: 10.1371/journal.pone.0306531

SAU2013 Abdulaziz Alharb and A. El-Taher, Life Science Journal 2013(2), 532-539, DOI: 10.7537/marslsj100213.78

KSA2016 Ibrahim F. Al-Hamarneh , N. Alkhomashi, Fahad I. Almasoud, Journal of Environmental Radioactivity 160 (2016) 1-7, DOI: 10.1016/j.jenvrad.2016.04.012

SAU2017 Mohammad Abu Shayeb, Thamer Alharbi, Muzahir Ali Baloch, Omar Abdul Rahman Alsamhan, Journal of Environmnetal Radioactivity,167(2017) 75-79, DOI: 10.1016/j.jenvrad.2016.11.014

KWT2020 Abdulaziz Aba, Anfal Ismaeel, Omar Al-Boloushi, Nuclear Engineering and Technology 53 (2021) 960-966, DOI: 10.1016/j.net.2020.08.023

MAR2000 M.A. Misdaq , H. Khajmi, F. Aitnouh, S. Berrazzouk, W. Bourzik, Nuclear Instruments and Methods in Physics Research B,2000, 171,350-359, DOI: 10.1016/s0168-583x(00)00292-5

MAR2009 M A MISDAQ and A MORTASSIM, PRAMANA - Journal of Physics, 2009, Vol. 73, No. 5, pp. 859-879, DOI: 10.1007/s12043-009-0154-0

MAR2011 L. Oufni • S. Taj • B. Manaut • M. Eddouks, J Radioanal Nucl Chem (2011) 287:403–410. DOI: 10.1007/s10967-010-0888-7

MAR2013 L. Oufni,, N. Manaut, S. Taj, B. Manaut, Journal of Environmental Protection, 2013, Vol. 1, No. 2, 34-40. DOI: 10.12691/env-1-2-4

MAR2021 Samira El Aouidi, Ayoub Benmhammed, Azzouz Benkdad, Nezha Mejjad, Edit Toth-Bodrogi, Tibor Kovács , Abdelmourhit Laissaoui, E3S Web of Conferences 314, 01004 (2021), DOI: 10.1051/e3sconf/202131401004

PSE2014 M.M.Jazzar, K.M.Thybayneh, Int. Journal of Environmental Monitoring and Analysis, 2014; 2(5): 252-258, DOI: 10.11648/j.ijema.20140205.14

ZAF2020 Abiola Olawale Ilori & Naven Chetty, Environ Monit Assess (2020) 192:775, DOI: 10.1007/s10661-020-08756-7

SDN1995 Adam Khatir Sam, Aike Eriksson, J. Environ. Radioactivity, Vol. 29 No. 1, pp. 27-38, 1995

SDN2013 Kamal K.Taha, Mona I. Shmou, Maisoon H.Osman, M. H. Shayoub, Journal of Applied and Industrial Sciences, 2013, 1 (2): 97-102

SYR1995 I. Othman, T. Yassine, Proceedings of an international symposium on environmental impact of radioactive releases, Vienna, 8-12 may 1995

SYR2006 M. Al-Oudat, A.F. Asfary etal, Journal of environmental radioactivity, 90 (2006) 78-88, DOI: 10.1016/j.jenvrad.2006.06.005

SYR2006a M. Al-Oudat, F. Al-Asfary, IAEA-TECDOC-1497, https://www-pub.iaea.org/MTCD/publications/PDF/te_1497_web.pdf

SYR2007 M.S. Al-Masri, B. Al-Akel, A. Nashawani, Y. Amin, K.H. Khalifa, F. Al-Ain, Journal of Environmental Radioactivity 99 (2008) 322-331, DOI: 10.1016/j.jenvrad.2007.08.021

SYR2010 M.S. Al-Masri, A. Al-Hamwi, Z. Eadan, Y. Amin, Journal of Environmental Radioactivity 101 (2010) 1038-1042, DOI: 10.1016/j.jenvrad.2010.08.002

SYR2015a M.S. Al-Masri, Y. Amin, S. Ibrahim, M. Nassri, Journal of Environmental Radioactivity 141 (2015) 51-56, DOI: 10.1016/j.jenvrad.2014.11.021

SYR2021a Mohammad Al-Oudat, Lina Al Attar, Ibrahim Othman, Journal of Environmental Radioactivity 228 (2021) 106525, DOI: 10.1016/j.jenvrad.2020.106525

SYR2021b M.S. Al-Masri, Y. Amin, H. Khalily, W. Al-Masri, Y. Al-Khateeb, Journal of Environmental Radioactivity 229-230 (2021) 106538, DOI: 10.1016/j.jenvrad.2021.106538

SYR2022 M. S. Al-Masri, M. I. E. Arabi, A. Al-Daoude, H. Khalily, Y. Amin, A. Shoaib, Y. Al-Khateeb, Journal of Radioanalytical and Nuclear Chemistry (2022) 331:3439-3447, DOI: org/10.1007/s10967-022-08357-3

TUN2018 Nada Zaanouni, Mariem Gharssallaoui, Mabrouk Eloussaief, Slimane Gabsi, Environmental Science and Pollution Research, DOI: 10.1007/s11356-018-1474-8

TUR2023 Sultan Sahin Bal, Murat Kurs, Muhammed Fatih Kuluoztürk etal, Journal of Environmental Radioactivity 257 (2023) 107089, DOI: 10.1016/j.jenvrad.2022.107089

TUR2024a A. Dirican, H. Dikmen, M. Şahin, Y. Gülay, Y. Ö. Özkök, N. Kaya, M. Vural, Journal of Radioanalytical and Nuclear Chemistry (2024) 333:5597–5606, DOI:10.1007/s10967-024-09594-4

UAE2022 Prasoon Raj , Nemeer Padiyath , Natalia Semioshkina , Francois Foulon et al, Sustainability, 2022, 14, 11327, doi: 10.3390/su141811327

UAE2024 Prasoon Raj, Maryam Almakrani, Francois Foulon, Nemeer Padiyath et al, Journal of Environmental Radioactivity 276 (2024) 107415, doi: 10.1016/j.jenvrad.2024.107415

USA2007 L.L. Cooka, R.S. Inouyea, T.P. McGoniglea, G.J. White, Journal of Arid Environments 69 (2007) 40–64, DOI: 10.1016/j.jaridenv.2006.08.014

USA2020 Rachel Wetle, Beatrice Bensko-Tarsitano, Kyle Johnson, Ken G. Sweat, Thomas Cahill, Journal of Environmental Radioactivity 220–221 (2020) 106293, DOI: 10.1016/j.jenvrad.2020.106293

YEM2019 Hany El-Gamal, Maher Taher Hussien, Emran Eisa Saleh, Journal of Radiation Research and Applied Sciences, 2019, VOL. 12, NO. 1, 226–233, DOI: 10.1080/16878507.2019.1646523

8 Tables

8.1 Fruits

Almond

Element	Country	Soil Type	Plant compartment	TF AM/GM	STD/GSD	ID
Ra-226	Palestine	Clay	Leaves	0,49		PSE2014
Th-232	Palestine	Clay	Leaves	0,3		PSE2014
U-238	Palestine	Clay	Leaves	0,1		PSE2014
K-40	Palestine	Clay	Leaves	0,35		PSE2014

Apple

Element	Country	Soil Type	Plant compartment	TF(AM/GM)	STD/GSD	ID
Am-241	Kazakhstan	Clay loam	leaves	9,30E-02		KAZ2024a
Am-241	Kazakhstan	Clay loam	branches	1,50E-02		KAZ2024a
Am-241	Kazakhstan	Clay loam	fruits	0,00E+00		KAZ2024a
Am-241	Kazakhstan	Clay loam	leaves	1,30E-02		KAZ2024a
Am-241	Kazakhstan	Clay loam	branches	6,90E-03		KAZ2024a
Cs-137	Israel		Fruit	0,00800		ISR2006
Cs-137	Jordan		Fruit	0,267	0,049	JOR2006
Cs-137	Kazakhstan	Clay loam	leaves	0,0083		KAZ2024a
Cs-137	Kazakhstan	Clay loam	branches	0,0079		KAZ2024a
Cs-137	Kazakhstan	Clay loam	fruits	0,0069		KAZ2024a
Cs-137	Kazakhstan	Clay loam	leaves	0,0056		KAZ2024a
Cs-137	Kazakhstan	Clay loam	branches	0,0031		KAZ2024a
K-40	Syria	Clay	Leaves	1,40000		SYR2007
K-40	Syria	Clay	Fruit	0,70000		SYR2007
K-40	Israel		Fruit	0,75000		ISL2006
K-40	Turkey	Clay	Fruits	0,32		TUR2024a
K-40	Jordan		Fruit	2,174	0,001	JOR2006
Pb-210	Syria	Clay	Leaves	0,71000		SYR2007
Pb-210	Syria	Clay	Fruit	0,10000		SYR2007
Pb-210	Turkey	Clay	Fruits	0,12		TUY2024a
Po-210	Syria	Clay	Leaves	0,50000		SYR2007
Po-210	Syria	Clay	Fruit	0,08000		SYR2007
Pu-239,240	Kazakhstan	Clay loam	leaves	0,059		KAZ2024a
Pu-239,240	Kazakhstan	Clay loam	branches	0,021		KAZ2024a
Pu-239,240	Kazakhstan	Clay loam	fruits	0		KAZ2024a

Pu-239,240	Kazakhstan	Clay loam	leaves	0,005		KAZ2024a
Pu-239,240	Kazakhstan	Clay loam	branches	0,011		KAZ2024a
Sr-90	Kazakhstan	Clay loam	leaves	0,69		KAZ2024a
Sr-90	Kazakhstan	Clay loam	branches	0,58		KAZ2024a
Sr-90	Kazakhstan	Clay loam	fruits	0,11		KAZ2024a
Sr-90	Kazakhstan	Clay loam	leaves	0,67		KAZ2024a
Sr-90	Kazakhstan	Clay loam	branches	0,23		KAZ2024a
Th-232	Turkey	Clay	Fruits	0,0003		TUR2024a
Th-232	Jordan		Fruit	0,188	0,007	JOR2006
U-238	Syria	Clay	Leaves	0,01700		SYR2007
U-238	Syria	Clay	Fruit	0,00300		SYR007
U-238	Turkey	Clay	Fruits	0,0008		TUR2024a
U-238	Jordan		Fruit	0,781	0,003	JOR2006

Apricot

Element	**Country**	**Soil Type**	**Plant compartment**	**TF(AM/GM)**	**STD/GSD**	**ID**
Cs-137	Syria	Clay	Leaves new	0,007	0,001	SYR2006
Cs-137	Syria	Clay	Branches new	0,002	0,001	SYR2006
Cs-137	Syria	Clay	Branches old	0,001	0,001	SYR2006
Cs-137	Syria	Clay	Fruit	0,012		SYR2006
Cs-137	Syria	Clay	Fruit	0,012	0,002	SYR2006
Cs-137	Syria	Clay	Fruit	0,078	0,001	SYR2006
Cs-137	Syria	Clay	Fruit	0,095	0,001	SYR2006
Cs-137	Syria	Clay	Oil or seeds	0,004	0,001	SYR2006
Sr-90	Syria	Loamy clay	Leaves new	1,440	1,200	SYR2006
Sr-90	Syria	Loamy clay	Branches new	1,600	1,300	SYR2006
Sr-90	Syria	Loamy clay	Branches old	1,200	1,100	SYR2006
Sr-90	Syria	Loamy clay	Fruit	0,130	0,110	SYR2006
Sr-90	Syria	Loamy clay	Oil or seeds	0,080	1,100	SYR2006
Ra-226	Turkey		Fruits	0,62	0,04	TUR2024b
Th-232	Turkey		Fruits	0,58	0,03	TUR2024b
K-40	Turkey		Fruits	0,49	0,04	TUR2024b
Ra-226	Egypt	Sand	Fruits	0,69	0,06	EGY2007
Th-232	Egypt	Sand	Fruits	0,48	0,04	EGY2007
K-40	Egypt	Sand	Fruits	8,873	0,88	EGY2007
Se	Iran	Field	Fruits	0,75		IRN2016

Avocado

Element	Country	Soil Type	Plant compartment	TF AM/GM	STD/GSD	ID
Be-7	Israel		Fruit	0,61000		ISR2006
Cs-137	Israel		Fruit	0,02500		ISR2006
K-40	Israel		Fruit	3,53000		ISR2006

Banana

Element	Country	Soil Type	Plant compartment	TF AM/GM	STD/GSD	ID
Ra-226	Egypt	Sand	Fruits	0,478	0,04	EGY2007
Th-232	Egypt	Sand	Fruits	0,227	0,02	EGY2007
K-40	Egypt	Sand	Fruits	31,849	3,14	EGY2007

Cherry

Element	Country	Soil structure	Plant compartment	CR (AM/GM)	STD/GSD	ID
Am-241	Kazakhstan	Clay loam	Leaves	$3,8 \times 10^{-2}$		KAZ2014a
Am-241	Kazakhstan	Clay loam	Branches	$2,2 \times 10^{-1}$		KAZ2014a
Am-241	Kazakhstan	Clay loam	Berry	<2,0 ×10-4		KAZ2014a
Am-241	Kazakhstan	Clay loam	Leaves	$3,2 \times 10^{-3}$		KAZ2014a
Am-241	Kazakhstan	Clay loam	Branches	$5,3 \times 10^{-3}$		KAZ2014a
Cs-137	Kazakhstan	Clay loam	Leaves	$1,3 \times 10^{-2}$		KAZ2014a
Cs-137	Kazakhstan	Clay loam	Branches	$6,6 \times 10^{-2}$		KAZ2014a
Cs-137	Kazakhstan	Clay loam	Berry	$3,8 \times 10^{-3}$		KAZ2014a
Cs-137	Kazakhstan	Clay loam	Leaves	$2,5 \times 10^{-3}$		KAZ2014a
Cs-137	Kazakhstan	Clay loam	Branches	$1,1 \times 10^{-3}$		KAZ2014a
Sr-90	Kazakhstan	Clay loam	Leaves	1,1		KAZ2014a
Sr-90	Kazakhstan	Clay loam	Branches	2,7 ×10-1		KAZ2014a
Sr-90	Kazakhstan	Clay loam	Berry	1,6 ×10-2		KAZ2014a
Sr-90	Kazakhstan	Clay loam	Leaves	3,6 ×10-1		KAZ2014a
Sr-90	Kazakhstan	Clay loam	Branches	2,3 ×10-1		KAZ2014a
Pu-239,240	Kazakhstan	Clay loam	Leaves	$6,9 \times 10^{-1}$		KAZ2014a
Pu-239,240	Kazakhstan	Clay loam	Branches	$2,5 \times 10^{-1}$		KAZ2014a
Pu-239,240	Kazakhstan	Clay loam	Berry	$1,3 \times 10^{-4}$		KAZ2014a
Pu-239,240	Kazakhstan	Clay loam	Leaves	$4,9 \times 10^{-3}$		KAZ2014a
Pu-239,240	Kazakhstan	Clay loam	Branches	$8,4 \times 10^{-4}$		KAZ2014a

Currant

Element	Country	Soil Type	Plant compartment	TF AM/GM	STD/GSD	ID
Am-241	Kazakhstan	Clay loam	Berry	0,012		KAZ2014a
Am-241	Kazakhstan	Clay loam	Leaves	0,072		KAZ2014a
Am-241	Kazakhstan	Clay loam	Stalks	0,052		KAZ2014a
Cs-137	Kazakhstan	Clay loam	Berry	0,13		KAZ2014a

Cs-137	Kazakhstan	Clay loam	Leaves	0,0051		KAZ2014a
Cs-137	Kazakhstan	Clay loam	Stalks	0,0016		KAZ2014a
Sr-90	Kazakhstan	Clay loam	Berry	0,2		KAZ2014a
Sr-90	Kazakhstan	Clay loam	Leaves	0,35		KAZ2014a
Sr-90	Kazakhstan	Clay loam	Stalks	0,32		KAZ2014a
Pu-239,240	Kazakhstan	Clay loam	Berry	0,0072		KAZ2014a
Pu-239,240	Kazakhstan	Clay loam	Leaves	0,063		KAZ2014a
Pu-239,240	Kazakhstan	Clay loam	Stalks	0,099		KAZ2014a

Fig

Element	Country	Soil Type	Plant compartment	TF AM/GM	STD/GSD	ID
Ra	Palestine	Clay	Leaves	1,12		PSE2014
Th	Palestine	Clay	Leaves	1,12		PSE2014
U	Palestine	Clay	Leaves	0,34		PSE2014
K	Palestine	Clay	Leaves	0,13		PSE2014

Grape

Element	Country	Soil Type	Plant compartment	TF AM/GM	STD/GSD	ID
Cs-137	Syria	Loamy clay	Branches old	0,00320	0,00130	SYR2006
Cs-137	Syria	Loamy clay	Leaves new	0,00710	0,00130	SYR2006
Cs-137	Syria	Loamy clay	Branches new	0,00470	0,00130	SYR2006
Cs-137	Syria	Loamy clay	Fruit	0,00230	0,00104	SYR2006
K-40	Syria	Clay	Leaves	1,20000		SYR2006
K-40	Syria	Clay	Fruit	1,20000		SYR2006
K-40	Syria	Clay	Leaves	1,10000		SYR2006
K-40	Syria	Clay	Fruit	1,60000		SYR2006
K-40	Syria	Clay	Leaves	0,60000		SYR2006
K-40	Syria	Clay	Fruit	1,30000		SYR2006
K-40	Palestine	Clay	Leaves	1,6		PSE2014
Pb-210	Syria	Clay	Fruit	0,17000		SYR2006
Pb-210	Syria	Clay	Leaves	0,62000		SYR2006
Pb-210	Syria	Clay	Leaves	0,63000		SYR2006
Pb-210	Syria	Clay	Fruit	0,01000		SYR2006
Pb-210	Syria	Clay	Leaves	0,05000		SYR2006
Pb-210	Syria	Clay	Fruit	0,70000		SYR2006
Po-210	Syria	Clay	Leaves	0,55000		SYR2006
Po-210	Syria	Clay	Fruit	0,66000		SYR2006
Po-210	Syria	Clay	Leaves	0,48000		SYR2006
Po-210	Syria	Clay	Fruit	0,04000		SYR2006

Ra-226	Palestine	Clay	Leaves	0,37		PSE2014
Sr	Syria	Loamy clay	Leaves new	0,95000	0,00110	SYR2006
Sr	Syria	Loamy clay	Branches new	0,64000	0,00100	SYR2006
Sr	Syria	Loamy clay	Branches old	0,32000	0,00160	SYR2006
Sr	Syria	Loamy clay	Fruit	0,08000	0,00100	SYR2006
Th-232	Palestine	Clay	Leaves	0,36		PSE2014
U-238	Syria	Clay	Leaves	0,04600		SYR2006
U-238	Syria	Clay	Fruit	0,01700		SYR2006
U-238	Syria	Clay	Leaves	0,01800		SYR2006
U-238	Syria	Clay	Fruit	0,00400		SYR2006
U-238	Syria	Clay	Leaves	0,04800		SYR2006
U-238	Syria	Clay	Fruit	0,00800		SYR2006
U-238	Palestine	Clay	Leaves	0,23		PSE2014

Lemon

Element	**Country**	**Soil Type**	**Plant comp.**	**TF AM/GM**	**STD/GSD**	**ID**
K-40	IRAQ		Fruits	0,95		IRQ2021
Th-232	IRAQ		Fruits	0,21		IRQ2021

Melon

Element	**Country**	**Soil Type**	**Plant compartment**	**TF AM/GM**	**STD/GSD**	**ID**
Am-241	Kazakhstan	Clay loam	Fruits	0,00074		KAZ2014a
Am-241	Kazakhstan	Clay loam	Stalks/leaves	0,0054		KAZ2014a
Am-241	Kazakhstan	Clay loam	Roots	0,0025		KAZ2014a
Cs-137	Kazakhstan	Clay loam	Fruits	0,002		KAZ2014a
Cs-137	Kazakhstan	Clay loam	Stalks/leaves	0,023		KAZ2014a
Cs-137	Kazakhstan	Clay loam	Roots	0,011		KAZ2014a
K-40	IRAQ	Sand Clay Loam	Fruits	2,828	0,379	IRQ2019
Pu-239,240	Kazakhstan	Clay loam	Fruits	0,0011		KAZ2014a
Pu-239,240	Kazakhstan	Clay loam	Stalks/leaves	0,047		KAZ2014a
Pu-239,240	Kazakhstan	Clay loam	Stalks/leaves	0,044		KAZ2014a
Ra-226	IRAQ	Sand Clay Loam	Fruits	0,027	0,008	IRQ2019
Th-232	IRAQ	Sand Clay Loam	Fruits	0,012	0,004	IRQ2019

Nectarine

Element	Country	Soil Type	Plant compartment	TF AM/GM	STD/GSD	ID
Be-7	Israel		Fruit	0,35000		ISR2006
Cs-137	Israel		Fruit	0,01100		ISR2006
K-40	Israel		Fruit	0,83000		ISR2006

Nut

Element	Country	Soil Type	Plant comp.	TF AM/GM	STD/GSD	ID
K-40	Palestine	Clay	Leaves	0,67		PSE2014
Ra-226	Palestine	Clay	Leaves	0,96		PSE2014
Th-232	Palestine	Clay	Leaves	0,72		PSE2014
U-238	Palestine	Clay	Leaves	0,11		PSE2014

Olive

Element	Country	Soil Type	Plant comp.	TF AM/GM	TF GSD	ID
Cs-137	Syria	Loamy clay	Branches new	0,002	0,001	SYR2006
Cs-137	Syria	Loamy clay	Leaves old	0,002	0,001	SYR2006
Cs-137	Syria	Loamy clay	Leaves new	0,003	0,001	SYR2006
Cs-137	Syria	Loamy clay	Branches old	0,002	0,001	SYR2006
Cs-137	Syria	Loamy clay	Fruit	0,007	0,001	SYR2006
Cs-137	Syria	Loamy clay	Oil	0,001	0,002	SYR2006
Cs-137	Palestine	Clay	Leaves	0,01		PSE2014
Cs-137	Palestine	Clay	Leaves	0,16		PSE2014
Cs-137	Palestine	Clay	Leaves	0,41		PSE2014
Cs-137	Palestine	Clay	Leaves	0,12		PSE2014
Cs-137	Palestine	Clay	Leaves	0,77		PSE2014
Cs-137	Palestine	Clay	Leaves	0,11		PSE2014
K-40	Syria	Clay	Leaves	0,800		SYR2006
K-40	Syria	Clay	Fruit	0,900		SYR2006
K-40	Syria	Clay	Leaves	0,800		SYR2006
K-40	Syria	Clay	Fruit	1,200		SYR2006
K-40	Palestine	Clay	Leaves	0,5		PSE2014
K-40	Palestine	Clay	Leaves	0,84		PSE2014
K-40	Palestine	Clay	Leaves	0,79		PSE2014
K-40	Palestine	Clay	Leaves	0,15		PSE2014
K-40	Palestine	Clay	Leaves	0,55		PSE2014

K-40	Palestine	Clay	Leaves	0,28		PSE2014
K-40	Palestine	Clay	Leaves	0,34		PSE2014
Pb-210	Syria	Clay	Leaves	0,050		SYR2006
Pb-210	Syria	Clay	Fruit	0,070		SYR2006
Pb-210	Syria	Clay	Leaves	1,200		SYR2006
Pb-210	Syria	Clay	Fruit	0,200		SYR2006
Po-210	Syria	Clay	Leaves	0,050		SYR2006
Po-210	Syria	Clay	Fruit	0,070		SYR2006
Po-210	Syria	Clay	Leaves	1,300		SYR2006
Po-210	Syria	Clay	Fruit	0,060		SYR2006
Ra-226	Palestine	Clay	Leaves	0,63		PSE2014
Ra-226	Palestine	Clay	Leaves	0,39		PSE2014
Ra-226	Palestine	Clay	Leaves	0,65		PSE2014
Ra-226	Palestine	Clay	Leaves	0,31		PSE2014
Ra-226	Palestine	Clay	Leaves	0,2		PSE2014
Ra-226	Palestine	Clay	Leaves	0,21		PSE2014
Ra-226	Palestine	Clay	Leaves	0,19		PSE2014
Sr-90	Syria	Loamy clay	Leaves new	1,150	1,170	SYR2006
Sr-90	Syria	Loamy clay	Leaves new	2,400	1,200	SYR2006
Sr-90	Syria	Loamy clay	Branches new	1,000	1,020	SYR2006
Sr-90	Syria	Loamy clay	Branches old	0,510	1,150	SYR2006
Sr-90	Syria	Loamy clay	Fruit	0,093	2,030	SYR2006
Sr-90	Syria	Loamy clay	Oil or seeds	0,005	1,080	SYR2006
Th-232	Palestine	Clay	Leaves	0,45		PSE2014
Th-232	Palestine	Clay	Leaves	0,33		PSE2014
Th-232	Palestine	Clay	Leaves	0,57		PSE2014
Th-232	Palestine	Clay	Leaves	0,32		PSE2014
Th-232	Palestine	Clay	Leaves	0,23		PSE2014
Th-232	Palestine	Clay	Leaves	0,25		PSE2014
Th-232	Palestine	Clay	Leaves	0,09		PSE2014
U-238	Syria	Clay	Leaves	0,032		SYR2006
U-238	Syria	Clay	Fruit	0,050		SYR2006
U-238	Syria	Clay	Leaves	0,028		SYR2006
U-238	Syria	Clay	Fruit	0,050		SYR2006
U-238	Palestine	Clay	Leaves	0,23		PSE2014
U-238	Palestine	Clay	Leaves	0,16		PSE2014
U-238	Palestine	Clay	Leaves	0,75		PSE2014
U-238	Palestine	Clay	Leaves	0,21		PSE2014
U-238	Palestine	Clay	Leaves	0,32		PSE2014

U-238	Palestine	Clay	Leaves	0,44		PSE2014
U-238	Palestine	Clay	Leaves	0,3		PSE2014

Orange

Element	Country	Soil Type	Plant compartment	TF AM/GM	SD	ID
Be-7	Israel		Fruit	0,89000		ISR2006
Cs-137	Israel		Fruit	0,02500		ISR2006
K-40	Israel		Fruit	1,94000		ISR2006
K-40	Palestine	Clay	Leaves	0,70000		PSE2014
K-40	Jordan	Clay	Fruits	0,647	0,031	JON2023
K-40	IRAQ		Fruits	1,51		IRQ2021
Ra-226	Palestine	Clay	Leaves	0,85000		PSE2014
Ra-226	Jordan	Clay	Fruits	0,446	0,034	JON2023
Th-232	Palestine	Clay	Leaves	0,64000		PSE2014
Th-232	Jordan	Clay	Fruits	0,739	0,025	JON2023
Th-232	IRAQ		Fruits	0,05		IRQ2021
U-238	Palestine	Clay	Leaves	0,49000		PSE2014

Palm dates

Element	Country	Soil Type	Plant compartment	TF AM/GM	STD/GSD	ID
K-40	Saudi Arabia	silty sand	Date palm pits	0,76		SAU2017
K-40	Saudi Arabia	silty sand	Date palm pits	0,25		SAU2017
K-40	Saudi Arabia	silty sand	Date palm pits	0,12		SAU2017
K-40	Saudi Arabia	silty sand	Date palm pits	0,35		SAU2017
K-40	Saudi Arabia	sand	Date palm pits	1,00		SAU2017
K-40	Saudi Arabia	sand	Date palm pits	0,62		SAU2017
K-40	Saudi Arabia	silty sand	Date palm pits	0,88		SAU2017
K-40	Saudi Arabia	sand	Date palm pits	0,81		SAU2017
K-40	Saudi Arabia	silty sand	Date palm pits	0,68		SAU2017
K-40	Saudi Arabia	sand	Date	0,21		SAU2017
K-40	Saudi Arabia	sand	Date	0,20		SAU2017
K-40	Saudi Arabia	sand	Date	0,23		SAU2017
K-40	Saudi Arabia	sand	Date	0,23		SAU2017
K-40	Saudi Arabia	sand	Date	0,23		SAU2017
K-40	UAE, Abu Dhabi	Sand	Leaves	0,77	1,6	UAE2022
K-40	UAE, Abu Dhabi	Sand	Dates	1,12	1,2	UAE2022
Ra-226	Saudi Arabia	silty sand	Date palm pits	0,11		SAU2017
Ra-226	Saudi Arabia	sand	Date palm pits	0,16		SAU2017
Ra-226	Saudi Arabia	silt and sand	Date palm pits	0,61		SAU2017
Ra-226	Saudi Arabia	silt and sand	Date palm pits	0,14		SAU2017
Ra-226	Saudi Arabia	silt and sand	Date palm pits	0,65		SAU2017
Ra-226	Saudi Arabia	silty sand	Date palm pits	0,32		SAU2017

Ra-226	Saudi Arabia	silty sand	Date palm pits	0,66		SAU2017
Ra-226	Saudi Arabia	sand	Date palm pits	0,50		SAU2017
Ra-226	Saudi Arabia	sand	Date palm pits	0,57		SAU2017
Ra-226	UAE, Abu Dhabi	Sand	Leaves	0,13	1,4	UAE2022
Ra-226	UAE, Abu Dhabi	Sand	Dates	0,08	1,6	UAE2022
Th-232	Saudi Arabia	silt and sand	Date palm pits	0,83		SAU2017
Th-232	Saudi Arabia	silty sand	Date palm pits	0,16		SAU2017
Th-232	Saudi Arabia	silt and sand	Date palm pits	0,18		SAU2017
Th-232	Saudi Arabia	silt and sand	Date palm pits	0,32		SAU2017
Th-232	Saudi Arabia	silty sand	Date palm pits	0,13		SAU2017
Th-232	Saudi Arabia	silty sand	Date palm pits	0,15		SAU2017
Th-232	Saudi Arabia	sand	Date palm pits	0,31		SAU2017
Th-232	Saudi Arabia	sand	Date palm pits	0,18		SAU2017
Th-232	Saudi Arabia	sand	Date palm pits	0,21		SAU2017
Th-232	UAE, Abu Dhabi	Sand	Leaves	0,36	1,3	UAE2022
Th-232	UAE, Abu Dhabi	Sand	Dates	0,08	1,6	UAE2022

Peanuts

Element	**Country**	**Soil Type**	**Plant compartment**	**TF AM/GM**	**STD/GSD**	ID
K-40	Yemen		Nut	0,2176		YEM2019
K-40	Yemen		Nut	0,3055		YEM2019
K-40	Yemen		Nut	0,2308		YEM2019
Ra-226	Yemen		Nut	0,1263		YEM2019
Ra-226	Yemen		Nut	0,0429		YEM2019
Ra-226	Yemen		Nut	0,0874		YEM2019
Th-232	Yemen		Nut	0,0238		YEM2019
Th-232	Yemen		Nut	0,0128		YEM2019
Th-232	Yemen		Nut	0,0164		YEM2019

Pistachio

Element	**Country**	**Soil Type**	**Plant compartment**	**TF AM/GM**	**STD/GSD**	**ID**
Se	Iran	Field	Seeds	0,17		IRN2016

Plum

Element	**Country**	**Soil Type**	**Plant compartment**	**TF AM/GM**	**STD/GSD**	**ID**
Am-241	Kazakhstan	Clay loam	Leaves	0,083		KAZ2024a
Am-241	Kazakhstan	Clay loam	Branches	0,18		KAZ2024a
Am-241	Kazakhstan	Clay loam	Leaves	0,007		KAZ2024a
Am-241	Kazakhstan	Clay loam	Branches	0,0038		KAZ2024a
Cs-137	Kazakhstan	Clay loam	Leaves	0,0095		KAZ2024a
Cs-137	Kazakhstan	Clay loam	Branches	0,013		KAZ2024a
Cs-137	Kazakhstan	Clay loam	Leaves	0,0046		KAZ2024a
Cs-137	Kazakhstan	Clay loam	Branches	0,0081		KAZ2024a
Sr-90	Kazakhstan	Clay loam	Leaves	0,42		KAZ2024a

Sr-90	Kazakhstan	Clay loam	Branches	0,34		KAZ2024a
Sr-90	Kazakhstan	Clay loam	Leaves	0,37		KAZ2024a
Sr-90	Kazakhstan	Clay loam	Branches	0,021		KAZ2024a
Pu-239,240	Kazakhstan	Clay loam	leaves	0,069		KAZ2024a
Pu-239,240	Kazakhstan	Clay loam	branches	0,16		KAZ2024a
Pu-239,240	Kazakhstan	Clay loam	leaves	0,0054		KAZ2024a
Pu-239,240	Kazakhstan	Clay loam	branches	0,0053		KAZ2024a

Raspberry

Element	Country	Soil Type	Plant comp.	TF AM/GM	SD	ID
Am-241	Kazakhstan	Clay loam	leaves	1,40E-01		KAZ2024a
Am-241	Kazakhstan	Clay loam	stalks	7,00E-03		KAZ2024a
Am-241	Kazakhstan	Clay loam	berry	1,80E-03		KAZ2024a
Am-241	Kazakhstan	Clay loam	leaves	3,80E-02		KAZ2024a
Am-241	Kazakhstan	Clay loam	stalks	6,70E-03		KAZ2024a
Cs-137	Kazakhstan	Clay loam	leaves	0,024		KAZ2024a
Cs-137	Kazakhstan	Clay loam	stalks	0,0059		KAZ2024a
Cs-137	Kazakhstan	Clay loam	berry	0,0044		KAZ2024a
Cs-137	Kazakhstan	Clay loam	leaves	0,0053		KAZ2024a
Cs-137	Kazakhstan	Clay loam	stalks	0,0013		KAZ2024a
Sr-90	Kazakhstan	Clay loam	leaves	0,49		KAZ2024a
Sr-90	Kazakhstan	Clay loam	stalks	0,29		KAZ2024a
Sr-90	Kazakhstan	Clay loam	berry	0,031		KAZ2024a
Sr-90	Kazakhstan	Clay loam	leaves	0,81		KAZ2024a
Sr-90	Kazakhstan	Clay loam	stalks	0,17		KAZ2024a
Pu-239,240	Kazakhstan	Clay loam	leaves	0,12		KAZ2024a
Pu-239,240	Kazakhstan	Clay loam	stalks	0,0038		KAZ2024a
Pu-239,240	Kazakhstan	Clay loam	berry	0,31		KAZ2024a
Pu-239,240	Kazakhstan	Clay loam	leaves	0,02700		KAZ2024a
Pu-239,240	Kazakhstan	Clay loam	stalks	0,00870		KAZ2024a

Water melon

Element	Country	Soil Type	Plant comp.	TF AM/GM	STD/GSD	ID
Cs-137	Syria		Flesh	0,01000	0,00020	SYR1995
Cs-137	Syria	Aridisol	Fruit	0,011	1,6	SYR2021a
Cs-137	Syria	Aridisol	Vegetation	0,031	1,4	SYR2021a
K-40	IRAQ	Sand Clay Loam	Fruits	0,965	0,115	IRQ2019
Ra-226	IRAQ	Sand Clay Loam	Fruits	0,02	0,003	IRQ2019
Sr-90	Syria	Aridisol	Fruit	0,08	1,5	SYR2021a
Sr-90	Syria	Aridisol	Vegetation	3,43	1,6	SYR2021a
Th-232	IRAQ	Sand Clay Loam	Fruits	0,018	0,005	IRQ2019
U-234	JORDAN		Pulp	0,00025		JOR2008
U-234	JORDAN		Leaves/stems	0,0129		JOR2008
U-238	JORDAN		Pulp	0,00019		JOR2008
U-238	JORDAN		Leaves/stems	0,013		JOR2008

White mulberry

Element	Country	Soil Type	Plant comp.	TF AM/GM	STD/GSD	ID
Se	Iran	Field	Fruits	0,65		IRN2016

8.2 Cereals

Barley

Element	Country	Soil Type	Plant comp.	TF AM/GM	STD/GSD	ID
Am-241	Kazakhstan	Clay loam	Stalks	0,0028		KAZ2014a
Am-241	Kazakhstan	Clay loam	Roots	0,017		KAZ2014a
Cs-137	Syria	Inceptisol: silty-clay	Stem	0,00370		SYR2006
Cs-137	Syria	Aridisol: silty-loam	Grain	0,00160		SYR2006
Cs-137	Syria	Aridisol: silty-loam	Stem	0,00270		SYR2006
Cs-137	Syria	Aridisol: silty-loam	Grain	0,00210		SYR2006
Cs-137	Syria	Aridisol: silty-loam	Stem	0,01500		SYR2006
Cs-137	Syria	Inceptisol: silty-clay	Grain	0,00140		SYR2006
Cs-137	Syria	Inceptisol: silty-clay	Stem	0,00230		SYR2006
Cs-137	Syria	Inceptisol: silty-clay	Grain	0,00160		SYR2006
Cs-137	Syria	Aridisol: silty-loam	Grain	0,00220		SYR2006
Cs-137	Syria	Aridisol: silty-loam	Stem	0,00380		SYR2006
Cs-137	Kazakhstan	Clay loam	Stalks	0,017		KAZ2014a
Cs-137	Kazakhstan	Clay loam	Roots	0,1		KAZ2014a
Cs-137	Syria	Aridisol	Grain	0,002	1,2	SYR2021a
Cs-137	Syria	Aridisol	Vegetation	0,012	1,5	SYR2021a
Cs-137	Syria	Inceptisol	Grain	0,001	1,1	SYR2021a
Cs-137	Syria	Inceptisol	Vegetation	0,006	1,3	SYR2021a
K-40	Syria	Clay	Straw	1,90		SYR2007
K-40	Syria	Clay	Grain	0,40		SYR2007
K-40	Syria	Clay	Grain			SYR2007
K-40	Syria	Clay	Straw	1,20		SYR2007
K-40	Turkey	Clay	Grains	0,079		TUR2024a
K-40	IRAQ	Sandy Loam	Grains	0,435	0,058	IRQ2019
K-40	IRAQ	Sandy Loam	Grains	0,48		IRQ2017b
K-40	IRAQ	Sandy Loam	Grains	0,52		IRQ2022
K-40	IRAQ	Sandy Loam	Grains	0,53		IRQ2022
Pb-210	Syria	Clay	Straw	0,47		SYR2007
Pb-210	Syria	Clay	Grain	0,08		SYR2007
Pb-210	Syria	Clay	Straw	0,43		SYR2007
Pb-210	Syria	Clay	Grain	0,10		SYR2007
Pb-210	Turkey	Clay	Grains	0,038		TUR2024a
Pb-210	Syria	Clay	Stems	0,08	2,44	SYR2022
Pb-210	Syria	Clay	Stems	0,07	1,63	SYR2022
Pb-210	Syria	Clay	Stems	0,06	2,43	SYR2022
Pb-210	Syria	Clay	Stems	0,1	1,89	SYR2022

Po-210	Syria	Clay	Straw	0,20		SYR2007
Po-210	Syria	Clay	Grain	0,09		SYR2007
Po-210	Syria	Clay	Straw	0,28		SYR2007
Po-210	Syria	Clay	Grain	2,0		SYR2007
Po-210	Syria	Clay	Stems	0,02	1,68	SYR2022
Po-210	Syria	Clay	Stems	0,01	1,52	SYR2022
Po-210	Syria	Clay	Stems	0,02	1,65	SYR2022
Po-210	Syria	Clay	Stems	0,02	1,54	SYR2022
Pu-239,240	Kazakhstan	Clay loam	Stalks	0,0038		KAZ2014a
Pu-239,240	Kazakhstan	Clay loam	Roots	0,021		KAZ2014a
Ra-226	Syria	Clay	Stems	0,22	4,2	SYR2022
Ra-226	Syria	Clay	Stems	0,29	2,52	SYR2022
Ra-226	Syria	Clay	Stems	0,32	3,16	SYR2022
Ra-226	Syria	Clay	Stems	0,44	2,15	SYR2022
Ra-226	IRAQ	Sandy Loam	Grains	0,026	0,006	IRQ2019
Ra-226	IRAQ	Sandy Loam	Grains	0,02		IRQ2017b
Ra-226	IRAQ	Sandy Loam	Grains	0,96		IRQ2022
Ra-226	IRAQ	Sandy Loam	Grains	0,61		IRQ2022
Se	Iran	Field	Grains	0,46		IRN2016
Sr-90	Kazakhstan	Clay loam	Stalks	0,1		KAZ2014a
Sr-90	Kazakhstan	Clay loam	Roots	0,11		KAZ2014a
Sr-90	Syria	Aridisol	Grain	0,06	1,1	SYR2021a
Sr-90	Syria	Aridisol	Vegetation	0,37	1,6	SYR2021a
Sr-90	Syria	Inceptisol	Grain	0,04	1,4	SYR2021a
Sr-90	Syria	Inceptisol	Vegetation	0,21	1,1	SYR2021a
Th-232	Iraq	Sandy Loam	Grain	0,61		IRQ2022
Th-232	Iraq	Sandy Loam	Grain	0,51		IRQ2022
Th-232	Turkey	Clay	Grains	0,017		TUR2024a
Th-232	IRAQ	Sandy Loam	Grains	0,017	0,003	IRQ2019
Th-232	IRAQ	Sandy Loam	Grains	0,02		IRQ2017b
Th-232	IRAQ	Sandy Loam	Grains	0,51		IRQ2022
Th-232	IRAQ	Sandy Loam	Grains	0,58		IRQ2022
Th-234	Syria	Clay	Stems	0,09	2,73	SYR2022
Th-234	Syria	Clay	Stems	0,1	5,41	SYR2022
Th-234	Syria	Clay	Stems	0,08	5,55	SYR2022
Th-234	Syria	Clay	Stems	0,15	2,26	SYR2022
U-238	Syria	Clay	Grain	0,050		SYR2007
U-238	Syria	Clay	Straw	0,015		SYR2007
U-238	Syria	Clay	Grain	0,050		SYR2007
U-238	Syria	Clay	Straw	0,008		SYR2007
U-238	Turkey	Clay	Grains	0,013		TUR2024a

U-238	Syria	Clay	Stems	0,29	2,86	SYR2022
U-238	Syria	Clay	Stems	0,18	2,93	SYR2022
U-238	Syria	Clay	Stems	0,42	2,05	SYR2022
U-238	Syria	Clay	Stems	0,23	3,28	SYR2022

Maize

Element	Country	Soil Type	Plant comp.	TF AM/GM	STD/GSD	ID
Cs-137	Syria	Aridisol: silty-loam	Grain	0,0017		SYR2006a
Cs-137	Syria	Aridisol: silty-loam	Stem	0,009		SYR2006a
Cs-137	Syria	Inceptisol: silty-clay	Grain	0,0008		SYR2006a
Cs-137	Syria	Inceptisol: silty-clay	Stem	0,0038		SYR2006a
Cs-137	Syria	Aridisol	Grain	0,002	1,3	SYR2021a
Cs-137	Syria	Aridisol	Vegetation	0,011	1,1	SYR2021a
Cs-137	Syria	Inceptisol	Grain	0,001	1,2	SYR2021a
Cs-137	Syria	Inceptisol	Vegetation	0,006	1,1	SYR2021a
K-40	Egypt	Sandy Clay Loam	Grains	1,03		EGY2016b
K-40	Egypt	Sandy Clay Loam	Grains	1,02		EGY2016b
K-40	Egypt	Sandy Clay Loam	Grains	1,24		EGY2016b
K-40	Egypt	Sandy Clay Loam	Grains	1,3		EGY2016b
K-40	Egypt	Sandy Clay Loam	Grains	1,1		EGY2016b
K-40	Egypt	Sandy Clay Loam	Grains	1,42		EGY2016b
K-40	Yemen		Grains	0,1292		YEM2019
K-40	Yemen		Grains	0,1525		YEM2019
K-40	Yemen		Grains	0,1327		YEM2019
K-40	Yemen		Grains	0,1683		YEM2019
K-40	South Africa	Sandy Loam	Grains	0,16		ZAF2020
K-40	South Africa	Sandy Loam	Grains	0,18		ZAF2020
K-40	South Africa	Sandy Clay Loam	Grains	0,67		ZAF2020
K-40	South Africa	Sandy Clay Loam	Grains	0,46		ZAF2020
K-40	South Africa	Loam Sand	Grains	0,09		ZAF2020
K-40	South Africa	Loam Sand	Grains	0,47		ZAF2020
K-40	South Africa	Sandy Clay Loam	Grains	0,25		ZAF2020
K-40	South Africa	Sandy Clay Loam	Grains	0,54		ZAF2020
K-40	Egypt	Sandy Loam	Grains	1,03		EGY2016b
K-40	Egypt	Sandy Loam	Grains	1,02		EGY2016b
K-40	Egypt	Sandy Loam	Grains	1,24		EGY2016b
K-40	Egypt	Sandy Loam	Grains	1,3		EGY2016b
K-40	Egypt	Sandy Loam	Grains	1,1		EGY2016b
K-40	Egypt	Sandy Loam	Grains	1,42		EGY2016b
K-40	Egypt	Sandy Loam	Grains	1,21		EGY2016b
K-40	Egypt	Sandy Loam	Grains	1,12		EGY2016b
K-40	Egypt	Sandy Loam	Grains	2,31		EGY2016b
K-40	Egypt	Sandy Loam	Grains	1,68		EGY2016b
K-40	Egypt	Sandy Loam	Grains	1,29		EGY2016b
K-40	Egypt	Sandy Loam	Grains	1,16		EGY2016b
K-40	Egypt	Sandy Loam	Grains	1,11		EGY2016b
K-40	Egypt	Sandy Loam	Grains	1,03		EGY2016b
K-40	IRAQ	Sandy Loam	Grains	0,55		IRQ2022

K-40	IRAQ	Sandy Loam	Grains	0,55		IRQ2022
Ra-226	Yemen		Grains	0,0618		YEM2019
Ra-226	Yemen		Grains	0,1183		YEM2019
Ra-226	Yemen		Grains	0,1006		YEM2019
Ra-226	Yemen		Grains	0,1319		YEM2019
Ra-226	Egypt	Sandy Clay Loam	Grains	0,23		EGY2016b
Ra-226	Egypt	Sandy Clay Loam	Grains	0,77		EGY2016b
Ra-226	Egypt	Sandy Clay Loam	Grains	0,43		EGY2016b
Ra-226	Egypt	Sandy Clay Loam	Grains	0,37		EGY2016b
Ra-226	Egypt	Sandy Clay Loam	Grains	0,39		EGY2016b
Ra-226	Egypt	Sandy Clay Loam	Grains	0,52		EGY2016b
Ra-226	South Africa	Sandy Loam	Grains	0,09		ZAF2020
Ra-226	South Africa	Sandy Loam	Grains	0,18		ZAF2020
Ra-226	South Africa	Sandy Clay Loam	Grains	0,47		ZAF2020
Ra-226	South Africa	Sandy Clay Loam	Grains	0,68		ZAF2020
Ra-226	South Africa	Loam Sand	Grains	0,31		ZAF2020
Ra-226	South Africa	Loam Sand	Grains	0,25		ZAF2020
Ra-226	South Africa	Sandy Clay Löam	Grains	0,38		ZAF2020
Ra-226	South Africa	Sandy Clay Löam	Grains	0,41		ZAF2020
Ra-226	Egypt	Sandy Loam	Grains	0,23		EGY2016b
Ra-226	Egypt	Sandy Loam	Grains	0,77		EGY2016b
Ra-226	Egypt	Sandy Loam	Grains	0,43		EGY2016b
Ra-226	Egypt	Sandy Loam	Grains	0,37		EGY2016b
Ra-226	Egypt	Sandy Loam	Grains	0,39		EGY2016b
Ra-226	Egypt	Sandy Loam	Grains	0,52		EGY2016b
Ra-226	Egypt	Sandy Loam	Grains	0,85		EGY2016b
Ra-226	Egypt	Sandy Loam	Grains	0,4		EGY2016b
Ra-226	Egypt	Sandy Loam	Grains	0,73		EGY2016b
Ra-226	Egypt	Sandy Loam	Grains	0,63		EGY2016b
Ra-226	Egypt	Sandy Loam	Grains	0,61		EGY2016b
Ra-226	Egypt	Sandy Loam	Grains	0,32		EGY2016b
Ra-226	Egypt	Sandy Loam	Grains	0,59		EGY2016b
Ra-226	Egypt	Sandy Loam	Grains	0,62		EGY2016b
Ra-226	IRAQ	Sandy Loam	Grains	0,55		IRQ2022
Ra-226	IRAQ	Sandy Loam	Grains	0,49		IRQ2022
Sr-90	Syria	Aridisol	Grain	0,006	1,1	SYR2021a
Sr-90	Syria	Aridisol	Vegetation	0,38	1,1	SYR2021a
Sr-90	Syria	Inceptisol	Grain	0,005	1,2	SYR2021a
Sr-90	Syria	Inceptisol	Vegetation	0,21	1	SYR2021a
Th-232	Egypt	Sandy Clay Loam	Grains	0,6		EGY2016b
Th-232	Egypt	Sandy Clay Loam	Grains	0,82		EGY2016b
Th-232	Egypt	Sandy Clay Loam	Grains	0,33		EGY2016b
Th-232	Egypt	Sandy Clay Loam	Grains	0,56		EGY2016b
Th-232	Egypt	Sandy Clay Loam	Grains	0,77		EGY2016b
Th-232	Egypt	Sandy Clay Loam	Grains	0,45		EGY2016b
Th-232	Yemen		Grains	0,0233		YEM2019
Th-232	Yemen		Grains	0,0235		YEM2019
Th-232	Yemen		Grains	0,0202		YEM2019
Th-232	Yemen		Grains	0,0352		YEM2019
Th-232	South Africa	Sandy Loam	Grains	0,37		ZAF2020

Th-232	South Africa	Sandy Loam	Grains	0,19		ZAF2020
Th-232	South Africa	Sandy Clay Loam	Grains	0,06		ZAF2020
Th-232	South Africa	Sandy Clay Loam	Grains	0,23		ZAF2020
Th-232	South Africa	Loam Sand	Grains	0,17		ZAF2020
Th-232	South Africa	Loam Sand	Grains	0,11		ZAF2020
Th-232	South Africa	Sandy Clay Löam	Grains	0,35		ZAF2020
Th-232	South Africa	Sandy Clay Loam	Grains	0,69		ZAF2020
Th-232	Egypt	Sandy Loam	Grains	0,6		EGY2016b
Th-232	Egypt	Sandy Loam	Grains	0,82		EGY2016b
Th-232	Egypt	Sandy Loam	Grains	0,33		EGY2016b
Th-232	Egypt	Sandy Loam	Grains	0,56		EGY2016b
Th-232	Egypt	Sandy Loam	Grains	0,77		EGY2016b
Th-232	Egypt	Sandy Loam	Grains	0,45		EGY2016b
Th-232	Egypt	Sandy Loam	Grains	0,73		EGY2016b
Th-232	Egypt	Sandy Loam	Grains	0,55		EGY2016b
Th-232	Egypt	Sandy Loam	Grains	1,19		EGY2016b
Th-232	Egypt	Sandy Loam	Grains	0,83		EGY2016b
Th-232	Egypt	Sandy Loam	Grains	0,97		EGY2016b
Th-232	Egypt	Sandy Loam	Grains	0,5		EGY2016b
Th-232	Egypt	Sandy Loam	Grains	0,6		EGY2016b
Th-232	Egypt	Sandy Loam	Grains	0,64		EGY2016b
Th-232	IRAQ		Grains	0,39		IRQ2022
Th-232	IRAQ		Grains	0,36		IRQ2022

Oat

Element	Country	Soil Type	Plant comp.	TF AM/GM	SD	ID
Am-241	Kazakhstan	Clay loam	Grain	0,0019		KAZ2014a
Am-241	Kazakhstan	Clay loam	Glume	0,0029		KAZ2014a
Am-241	Kazakhstan	Clay loam	Stalks	0,0071		KAZ2014a
Am-241	Kazakhstan	Clay loam	Roots	0,031		KAZ2014a
Cr	Tunesia		Roots	0,22		TUN2018
Cr	Tunesia		Stems	0,22		TUN2018
Cs-137	Kazakhstan	Clay loam	Grain	0,0022		KAZ2014a
Cs-137	Kazakhstan	Clay loam	Glume	0,055		KAZ2014a
Cs-137	Kazakhstan	Clay loam	Stalks	0,027		KAZ2014a
Cs-137	Kazakhstan	Clay loam	Roots	0,091		KAZ2014a
Cu	Tunesia		Roots	0,51		TUN2018
Cu	Tunesia		Stems	0,32		TUN2018
Mn	Tunesia		Roots	0,58		TUN2018
Mn	Tunesia		Stems	1,05		TUN2018
Pu-239,240	Kazakhstan	Clay loam	Grain	0,0073		KAZ2014a
Pu-239,240	Kazakhstan	Clay loam	Glume	0,0014		KAZ2014a
Pu-239,240	Kazakhstan	Clay loam	Stalks	0,022		KAZ2014a
Pu-239,240	Kazakhstan	Clay loam	Roots	0,069		KAZ2014a
Sr-90	Kazakhstan	Clay loam	Grain	0,07		KAZ2014a
Sr-90	Kazakhstan	Clay loam	Stalks	0,16		KAZ2014a
Sr-90	Kazakhstan	Clay loam	Roots	0,16		KAZ2014a
Zn	Tunesia		Roots	0,76		TUN2018
Zn	Tunesia		Stems	0,95		TUN2018

Pearl millet

Element	Country	Soil Type	Plant comp.	TF AM/GM	STD/GSD	ID
K-40	Yemen		Grains	0,0939		YEM2019
K-40	Yemen		Grains	0,0619		YEM2019
K-40	Yemen		Grains	0,0657		YEM2019
K-40	Yemen		Grains	0,0833		YEM2019
Ra-226	Yemen		Grains	0,0786		YEM2019
Ra-226	Yemen		Grains	0,0658		YEM2019
Ra-226	Yemen		Grains	0,0889		YEM2019
Ra-226	Yemen		Grains	0,0852		YEM2019
Th-232	Yemen		Grains	0,0200		YEM2019
Th-232	Yemen		Grains	0,0186		YEM2019
Th-232	Yemen		Grains	0,0279		YEM2019
Th-232	Yemen		Grains	0,0200		YEM2019

Rice

Element	Country	Soil Type	Plant comp.	TF GM	GSD	TF AM	STD	ID
Cs-137	Egypt	Sandy clay loam	Roots	0,0051	1,1	0,0051	0,00036	EGY2021a
Cs-137	Egypt	Sandy clay loam	Shoots	0,023	1	0,023	0,00061	EGY2021a
Cs-137	Egypt	Sandy clay loam	Grain	0,003	1,2	0,003	0,0004	EGY2021a
K-40	IRAQ	Clay Loam	Grains			0,201	0,021	IRQ2019
K-40	IRAQ		Grains			0,36		IRQ2021
Ra-226	IRAQ	Clay Loam	Grains			0,031	0,009	IRQ2019
Sr-85	Egypt	Sandy clay loam	Roots	0,021	1,1	0,021	0,0014	EGY2021a
Sr-85	Egypt	Sandy clay loam	Shoots	0,088	1	0,088	0,0016	EGY2021a
Sr-85	Egypt	Sandy clay loam	Grain	0,0006	1,1	0,0004	0,000053	EGY2021a
Th-232	IRAQ	Clay Loam	Grains			0,011	0,023	IRQ2019
Th-232	IRAQ		Grains			0,04		IRQ2021

Sesame

Element	Country	Soil Type	Plant comp.	TF GM	GSD	TF AM	STD	ID
Cs-137	Egypt	Sandy clay loam	Roots	0,015	1	0,015	0,00026	EGY2021a
Cs-137	Egypt	Sandy clay loam	Shoots	0,048	1	0,048	0,00026	EGY2021a
Cs-137	Egypt	Sandy clay loam	Grain	0,0032	1,1	0,0032	0,00026	EGY2021a
K-40	Egypt	Clay Loam	Seeds			1,33	0,05	EGY2020a
Ra-226	Egypt	Clay Loam	Seeds			0,42	0,03	EGY2020a
Sr-85	Egypt	Sandy clay loam	Roots	0,05	1	0,05	0,0013	EGY2021a
Sr-85	Egypt	Sandy clay loam	Shoots	0,2	1	0,2	0,0024	EGY2021a
Sr-85	Egypt	Sandy clay loam	Grain	0,000069	1,2	0,00007	0,00001	EGY2021a
Th-232	Egypt	Clay Loam	Seeds			0,43	0,03	EGY2020a

Sorghum

Element	Country	Soil Type	Plant comp.	TF AM/GM	STD/GSD	ID
Co	Sudan	Sandy	Whole plant	0,066		SDN2013
Co	Sudan	Clay	Whole plant	0,023		SDN2013
Cr	Tunesia		Roots	0,17		TUN2018
Cr	Tunesia		Stems	0,09		TUN2018
Cr	Sudan	Sandy	Whole plant	0,19		SDN2013
Cr	Sudan	Clay	Whole plant	0,113		SDN2013
Cs-137	Syria	Aridisol: silty-loam	Grain	0,00330		SYR2006a
Cs-137	Syria	Aridisol: silty-loam	Stem	0,00550		SYR2006a
Cs-137	Syria	Aridisol: silty-loam	Grain	0,00320		SYR2006a
Cs-137	Syria	Aridisol: silty-loam	Stem	0,00900		SYR2006a
Cs-137	Syria	Inceptisol: silty-clay	Grain	0,00160		SYR2006a
Cs-137	Syria	Aridisol: silty-loam	Grain	0,00460		SYR2006a
Cs-137	Syria	Aridisol: silty-loam	Stem	0,00770		SYR2006a
Cs-137	Syria	Inceptisol: silty-clay	Grain	0,00220		SYR2006a
Cs-137	Syria	Inceptisol: silty-clay	Stem	0,00470		SYR2006a
Cs-137	Syria		Grain	0,01200	0,00050	SYR2021a
Cs-137	Syria	Aridisol	Grain	0,003	1,2	SYR2021a
Cs-137	Syria	Aridisol	Vegetation	0,013	1,2	SYR2021a
Cs-137	Syria	Inceptisol	Grain	0,002	1,1	SYR2021a
Cs-137	Syria	Inceptisol	Vegetation	0,009	1,6	SYR2021a
Cs-137	Syria		Grains	0,012	0,0005	SYR2021a
Cu	Tunesia		Roots	0,51		TUN2018
Cu	Tunesia		Stems	0,4		TUN2018
Cu	Sudan	Sandy	Whole plant	0,484		SDN2013
Cu	Sudan	Clay	Whole plant	0,033		SDN2013
Fe	Sudan	Sandy	Whole plant	0,022		SDN2013
Fe	Sudan	Clay	Whole plant	0,007		SDN2013
K-40	Yemen		Grains	0,0921		YEM2019
K-40	Yemen		Grains	0,1424		YEM2019
K-40	Yemen		Grains	0,0957		YEM2019
K-40	Yemen		Grains	0,1891		YEM2019
Mn	Tunesia		Roots	0,75		TUN2018
Mn	Tunesia		Stems	0,68		TUN2018
Mn	Sudan	Sandy	Whole plant	0,082		SDN2013
Mn	Sudan	Clay	Whole plant	0,053		SDN2013
Ni	Sudan	Sandy	Whole plant	0,111		SDN2013
Ni	Sudan	Clay	Whole plant	0,058		SDN2013
P	Sudan	Sandy	Whole plant	0,643		SDN2013
P	Sudan	Clay	Whole plant	0,521		SDN2013
Pb	Sudan	Sandy	Whole plant	0,073		SDN2013
Pb	Sudan	Clay	Whole plant	0,054		SDN2013
Ra-226	Yemen		Grains	0,0941		YEM2019
Ra-226	Yemen		Grains	0,0559		YEM2019
Ra-226	Yemen		Grains	0,0725		YEM2019
Ra-226	Yemen		Grains	0,0550		YEM2019
Sr-90	Syria	Aridisol	Grain	0,03	1,6	SYR2021a
Sr-90	Syria	Aridisol	Vegetation	0,58	1,2	SYR2021a

Sr-90	Syria	Inceptisol	Grain	0,04	1,1	SYR2021a
Sr-90	Syria	Inceptisol	Vegetation	0,38	1,4	SYR2021a
Th-232	Yemen		Grains	0,0193		YEM2019
Th-232	Yemen		Grains	0,0196		YEM2019
Th-232	Yemen		Grains	0,0190		YEM2019
Th-232	Yemen		Grains	0,0190		YEM2019
Zn	Tunesia		Roots	0,56		TUN2018
Zn	Tunesia		Stems	0,75		TUN2018
Zn	Sudan	Sandy	Whole plant	0,253		SDN2013
Zn	Sudan	Clay	Whole plant	0,256		SDN2013

Sunflower

Element	Country	Soil Type	Plant comp.	TF AM	SD	ID
Am-241	Kazakhstan	Clay loam	Inflorescence	0,002		KAZ2014a
Am-241	Kazakhstan	Clay loam	Leaves	0,004		KAZ2014a
Am-241	Kazakhstan	Clay loam	Stalks	0,001		KAZ2014a
Am-241	Kazakhstan	Clay loam	Roots	0,005		KAZ2014a
Cs-137	Kazakhstan	Clay loam	Inflorescence	0,015		KAZ2014a
Cs-137	Kazakhstan	Clay loam	Leaves	0,03		KAZ2014a
Cs-137	Kazakhstan	Clay loam	Stalks	0,01		KAZ2014a
Cs-137	Kazakhstan	Clay loam	Roots	0,03		KAZ2014a
K-40	Morocco	Sandy clay	Root	5,42		MAR2021
K-40	Morocco	Sandy clay	Stem	4,41		MAR2021
K-40	Morocco	Sandy clay	Flower head	5,66		MAR2021
K-40	Morocco	Sandy clay	Leaves	3,48		MAR2021
K-40	Morocco	Sandy clay	Seeds	4,09		MAR2021
Pb-210	Morocco	Sandy clay	Root	0,4		MAR2021
Pb-210	Morocco	Sandy clay	Stem	0,16		MAR2021
Pb-210	Morocco	Sandy clay	Flower head	0,1		MAR2021
Pb-210	Morocco	Sandy clay	Leaves	0,28		MAR2021
Pb-210	Morocco	Sandy clay	Seeds	0,15		MAR2021
Pu-239,240	Kazakhstan	Clay loam	Inflorescence	0,001		KAZ2014a
Pu-239,240	Kazakhstan	Clay loam	Leaves	0,001		KAZ2014a
Pu-239,240	Kazakhstan	Clay loam	Stalks	0,004		KAZ2014a
Pu-239,240	Kazakhstan	Clay loam	Roots	0,035		KAZ2014a
Ra-226	Morocco	Sandy clay	Root	0,34		MAR2021
Ra-226	Morocco	Sandy clay	Stem	0,16		MAR2021
Ra-226	Morocco	Sandy clay	Flower head	0,25		MAR2021
Ra-226	Morocco	Sandy clay	Leaves	0,23		MAR2021
Ra-226	Morocco	Sandy clay	Seeds	0,25		MAR2021
Sr-90	Kazakhstan	Clay loam	Inflorescence	0,64		KAZ2014a
Sr-90	Kazakhstan	Clay loam	Leaves	2		KAZ2014a
Sr-90	Kazakhstan	Clay loam	Stalks	0,73		KAZ2014a
Sr-90	Kazakhstan	Clay loam	Roots	0,21		KAZ2014a

Wheat

Element	Country	Soil Type	Plant comp.	TF GM	GSD	TF AM	SD	ID
Am-241	Kazakhstan	Clay loam	Grain			0,003		KAZ2014a
Am-241	Kazakhstan	Clay loam	Glume			0,006		KAZ2014a
Am-241	Kazakhstan	Clay loam	Stalks			0,006		KAZ2014a
Am-241	Kazakhstan	Clay loam	Roots			0,014		KAZ2014a
Cs-137	Syria	Silty-loam	Grain			0,002		SYR2006a
Cs-137	Syria	Silty-loam	Stem			0,003		SYR2006a
Cs-137	Syria	Silty-loam	Grain			0,002		SYR2006a
Cs-137	Syria	Silty-loam	Stem			0,010		SYR2006a
Cs-137	Syria	Silty-clay	Grain			0,010		SYR2006a
Cs-137	Syria	SYilty-clay	Stem			0,002		SYR2006a
Cs-137	Egypt	Sandy	Stem			0,990		EGY2008
Cs-137	Egypt	Sandy	Grain			0,170		EGY2008
Cs-137	Egypt	Sandy	Roots			4,300		EGY2008
Cs-137	Egypt	Sandy loam	Roots			1,080		EGY2008
Cs-137	Egypt	Sandy loam	Stem			0,240		EGY2008
Cs-137	Egypt	Sandy loam	Grain			0,041		EGY2008
Cs-137	Egypt	clayey	Roots			0,550		EGY2008
Cs-137	Egypt	clayey	Stem			0,080		EGY2008
Cs-137	Egypt	clayey	Grain			0,014		EGY2008
Cs-137	Egypt	Sandy clay loam	Roots	0,010	1,1	0,01	0,0013	EGY2021a
Cs-137	Egypt	Sandy clay loam	Shoots	0,033	1,1	0,033	0,0038	EGY2021a
Cs-137	Egypt	Sandy clay loam	Grain	0,006	1,2	0,0058	0,00072	EGY2021a
Cs-137	Jordan		Grains			0,082	0,015	JON2006
Cs-137	Kazakhstan	Clay loam	Grain			0,004		KAZ2014a
Cs-137	Kazakhstan	Clay loam	Glume			0,006		KAZ2014a
Cs-137	Kazakhstan	Clay loam	Stalks			0,028		KAZ2014a
Cs-137	Kazakhstan	Clay loam	Roots			0,099		KAZ2014a
K-40	Syria	Clay	Straw	2,000				SYR2007
K-40	Syria	Clay	Grain					SYR2007
K-40	Syria	Clay	Straw	1,200				SYR2007
K-40	Syria	Clay	Grain					SYR2007
K-40	Egypt	Sil Clay Loam	Grains			1,74		EGY2016a
K-40	Egypt	Sandy loam	Grains			2,79		EGY2016a
K-40	Egypt	Sandy Clay Loam	Grains			1,8		EGY2016a
K-40	Egypt	Clay Loam	Grains			1,98		EGY2016a
K-40	Jordan		Grains			1,329	0,001	JON2006
K-40	IRAQ	Silt Clay Loam	Grains			0,417	0,047	IRQ2019
K-40	IRAQ	Silt Clay Loam	Grains			0,674	0,096	IRQ2019
K-40	IRAQ	Silt Clay Loam	Grains			0,476	0,059	IRQ2019
K-40	IRAQ		Grains			0,73		IRQ2021
K-40	IRAQ		Grains			0,373		IRQ2019a
K-40	IRAQ		Grains			0,35		IRQ2022
K-40	IRAQ		Grains			0,23		IRQ2022
K-40	IRAQ		Grains			0,5		IRQ2022
K-40	IRAQ		Grains			0,38		IRQ2022
K-40	IRAQ		Grains			0,65		IRQ2022

K-40	IRAQ		Grains			0,44		IRQ2022
K-40	IRAQ		Grains			0,31		IRQ2022
K-40	IRAQ		Grains			0,14		IRQ2022
K-40	IRAQ		Grains			0,52		IRQ2022
K-40	Saudi Arabia		Grains			0,18		SAU2013
K-40	Saudi Arabia		Grains			0,15		SAU2013
K-40	Saudi Arabia		Grains			0,15		SAU2013
K-40	Saudi Arabia		Grains			0,16		SAU2013
K-40	Saudi Arabia		Grains			0,18		SAU2013
Pb-210	Syria	Clay	Straw	0,310				SYR2007
Pb-210	Syria	Clay	Grain	0,030				SYR2007
Pb-210	Syria	Clay	Straw	0,340				SYR2007
Pb-210	Syria	Clay	Grain	0,140				SYR2007
Po-210	Syria	Clay	Straw	0,380				SYR2007
Po-210	Syria	Clay	Grain					SYR2007
Po-210	Syria	Clay	Straw	0,330				SYR2007
Po-210	Syria	Clay	Grain					SYR2007
Pu-239,240	Kazakhstan	Clay loam	Grain			0,0027		KAZ2014a
Pu-239,240	Kazakhstan	Clay loam	Glume			0,0004		KAZ2014a
Pu-239,240	Kazakhstan	Clay loam	Stalks			0,0024		KAZ2014a
Pu-239,240	Kazakhstan	Clay loam	Roots			0,054		KAZ2014a
Ra-226	Egypt	Sil Clay Loam	Grains			0,38		EGY2016a
Ra-226	Egypt	Sandy loam	Grains			0,62		EGY2016a
Ra-226	Egypt	Sandy Clay Loam	Grains			0,41		EGY2016a
Ra-226	Egypt	Clay Loam	Grains			0,45		EGY2016a
Ra-226	IRAQ	Silt Clay Loam	Grains			0,028	0,011	IRQ2019
Ra-226	IRAQ	Silt Clay Loam	Grains			0,051	0,017	IRQ2019
Ra-226	IRAQ	Silt Clay Loam	Grains			0,032	0,011	IRQ2019
Ra-226	IRAQ		Grains			0,028		IRQ2019a
Ra-226	IRAQ		Grains			0,63		IRQ2022
Ra-226	IRAQ		Grains			0,58		IRQ2022
Ra-226	IRAQ		Grains			0,61		IRQ2022
Ra-226	IRAQ		Grains			0,97		IRQ2022
Ra-226	IRAQ		Grains			0,26		IRQ2022
Ra-226	IRAQ		Grains			0,42		IRQ2022
Ra-226	IRAQ		Grains			0,54		IRQ2022
Ra-226	IRAQ		Grains			0,56		IRQ2022
Ra-226	IRAQ		Grains			0,55		IRQ2022
Ra-226	Saudi Arabia	Silty Sand	Grains	0,09				SAU2016
Ra-226	Saudi Arabia	Silty Sand	Stems	0,42				SAU2016
Ra-226	Saudi Arabia	Silty Sand	Roots	0,52				SAU2016
Ra-226	Saudi Arabia		Grains			0,16		SAU2013
Ra-226	Saudi Arabia		Grains			0,15		SAU2013
Ra-226	Saudi Arabia		Grains			0,09		SAU2013
Ra-226	Saudi Arabia		Grains			0,1		SAU2013
Ra-226	Saudi Arabia		Grains			0,1		SAU2013

Ra-228	IRAQ		Grains			0,021		IRQ2019a
Se	Iran	Field	Grains			1,01		IRN2016
Sr-85	Egypt	Sandy clay loam	Roots	0,035	1,1	0,036	0,0035	EGY2021a
Sr-85	Egypt	Sandy clay loam	Shoots	0,150	1	0,15	0,0024	EGY2021a
Sr-85	Egypt	Sandy clay loam	Grain	0,001	1	0,00082	0,00025	EGY2021a
Sr-90	Egypt	Sandy	Roots			7,700		EGY2008
Sr-90	Egypt	Sandy	Stem			6,300		EGY2008
Sr-90	Egypt	Sandy	Grain			0,057		EGY2008
Sr-90	Egypt	sandy loam	Roots			1,000		EGY2008
Sr-90	Egypt	sandy loam	Stem			0,410		EGY2008
Sr-90	Egypt	sandy loam	Grain			0,004		EGY2008
Sr-90	Egypt	clayey	Roots			0,670		EGY2008
Sr-90	Egypt	clayey	Stem			0,140		EGY2008
Sr-90	Egypt	clayey	Grain			0,001		EGY2008
Sr-90	Kazakhstan	Clay loam	Grain			0,026		KAZ2014a
Sr-90	Kazakhstan	Clay loam	Glume			0,035		KAZ2014a
Sr-90	Kazakhstan	Clay loam	Stalks					KAZ2014a
Sr-90	Kazakhstan	Clay loam	Roots			0,11		KAZ2014a
Th-232	Egypt	Sil Clay Loam	Grains			0,6		EGY2016a
Th-232	Egypt	Sandy loam	Grains			0,81		EGY2016a
Th-232	Egypt	Sandy Clay Loam	Grains			0,49		EGY2016a
Th-232	Egypt	Clay Loam	Grains			0,83		EGY2016a
Th-232	Jordan		Grains			0,056	0,003	JON2006
Th-232	IRAQ	Silt Clay Loam	Grains			0,021	0,01	IRQ2019
Th-232	IRAQ	Silt Clay Loam	Grains			0,024	0,012	IRQ2019
Th-232	IRAQ	Silt Clay Loam	Grains			0,022	0,006	IRQ2019
Th-232	IRAQ		Grains			0,7		IRQ2021
Th-232	IRAQ		Grains			0,12		IRQ2022
Th-232	IRAQ		Grains			0,66		IRQ2022
Th-232	IRAQ		Grains			0,34		IRQ2022
Th-232	IRAQ		Grains			0,38		IRQ2022
Th-232	IRAQ		Grains			0,37		IRQ2022
Th-232	IRAQ		Grains			0,45		IRQ2022
Th-232	IRAQ		Grains			0,41		IRQ2022
Th-232	IRAQ		Grains			0,48		IRQ2022
Th-232	IRAQ		Grains			0,74		IRQ2022
U-234	Saudi Arabia	Silty Sand	Grains	0,07				SAU2016
U-234	Saudi Arabia	Silty Sand	Leaves/stems	0,28				SAU2016
U-234	Saudi Arabia	Silty Sand	Roots	0,27				SAU2016
U-238	Syria	Clay	Straw	0,012				SYR2007
U-238	Syria	Clay	Grain	0,050				SYR2007
U-238	Syria	Clay	Straw	0,009				SYR2007
U-238	Syria	Clay	Grain	0,050				SYR2007
U-238	Jordan		Grains			0,519	0,004	JOR2006
U-238	IRAQ		Grains			0,32		IRQ2021
U-238	Saudi Arabia	Silty Sand	Grains	0,07				SAU2016
U-238	Saudi Arabia	Silty Sand	Leaves/stems	0,29				SAU2016
U-238	Saudi Arabia	Silty Sand	Roots	0,28				SAU2016

8.3 Non-leafy vegetables

Carrots

Element	Country	Soil Type	Plant comp.	TF AM/GM	STD/GSD	ID
Am-241	Kazakhstan	Clay loam	Leaves	0,0017		KAZ2014a
Am-241	Kazakhstan	Clay loam	Roots	0,0016		KAZ2014a
Cs-137	Kazakhstan	Clay loam	Leaves	0,015		KAZ2014a
Cs-137	Kazakhstan	Clay loam	Roots	0,0067		KAZ2014a
Sr-90	Kazakhstan	Clay loam	Leaves	0,098		KAZ2014a
Sr-90	Kazakhstan	Clay loam	Roots	0,38		KAZ2014a
Pu-239,240	Kazakhstan	Clay loam	Leaves	<0,0013		KAZ2014a
Pu-239,240	Kazakhstan	Clay loam	Roots	0,03		KAZ2014a
U-238	Iraq		Fruits	0,56		IRQ2025

Chili pepper

Element	Country	Soil Type	Plant comp	TF AM/GM	STD/GSD	ID
K-40	IRAQ		Fruits	1,21		IRQ2021
Ra-226	Saudi Arabia	Silty Sand	leaves	0,21		SAU2016
Ra-226	Saudi Arabia	Silty Sand	Roots	0,53		SAU2016
U-234	Saudi Arabia	Silty Sand	Fruits	0,09		SAU2016
U-234	Saudi Arabia	Silty Sand	Leaves/stems	0,22		SAU2016
U-234	Saudi Arabia	Silty Sand	Roots	0,63		SAU2016
U-238	Saudi Arabia	Silty Sand	Fruits	0,09		SAU2016
U-238	Saudi Arabia	Silty Sand	Leaves/stems	0,2		SAU2016
U-238	Saudi Arabia	Silty Sand	Roots	0,63		SAU2016
	IRAQ	Sand Clay Loam	Pods	2,609	0,476	IRQ2019
Ra-226	IRAQ	Sand Clay Loam	Pods	0,032	0,476	IRQ2018
Th-232	IRAQ	Sand Clay Loam	Pods	0,019	0,009	IRQ2019

Cucumber

Element	Country	Soil Type	Plant comp.	TF GM	TF GSD	TF AM	STD	ID
Cs-134	Kuwait	Sandy	Fruits			0,14	0,06	KWT2020
Cs-137	Syria	Aridisol: silty-loam	Fruit			0,010		SYR2006a
Cs-137	Syria	Aridisol: silty-loam	Veg			0,054		SYR2006a
Cs-137	Syria	Inceptisol: silty-clay	Fruit			0,00740		SYR2006a
Cs-137	Syria	Inceptisol: silty-clay	Veg			0,046		SYR2006a
Cs-137	Syria	Aridisol	Fruit	0,01	1,4			SYR2021a
Cs-137	Syria	Aridisol	Vegetation	0,054	1,3			SYR2021a
Cs-137	Syria	Inceptisol	Fruit	0,007	1,1			SYR2021a
Cs-137	Syria	Inceptisol	Vegetation	0,056	1,4			SYR2021a

Eu-152	Egypt		Fruits			0,0086		EGY2019b
Eu-152	Egypt		Fruits			0,009		EGY2016c
K-40	Iraq	Clay, sand	Fruit			0,820		IRQ2014
K-40	Iraq	Clay, sand	Fruit			0,940		IRQ2014
K-40	Iraq	Clay, sand	Fruit			0,570		IRQ2014
K-40	Syria	Clay	Leaves	3,30				SYR2007
K-40	Syria	Clay	Fruit	1,10				SYR2007
K-40	Egypt		Fruits			0,043		EGY2019b
K-40	IRAQ	NA	Fruit			0,549		IRQ2018
K-40	IRAQ	NA	Fruit			0,614		IRQ2018
K-40	IRAQ		Fruits			0,216		IRQ2023b
K-40	IRAQ		Fruits			0,82		IRQ2014
K-40	IRAQ		Fruits			0,94		IRQ2014
K-40	IRAQ		Fruits			0,57		IRQ2014
K-40	IRAQ	Sand Clay Loam	Fruit			3,462	0,477	IRQ2019
K-40	Egypt		Fruits			0,043		EGY2016c
K-40	UAE	Sand	Fruits	4,94	1,3	5,03	1,11	UAE2024
Pb-210	Syria	Clay	Leaves	1,40				SYR2007
Pb-210	Syria	Clay	Fruit	0,050				SYR2007
Po-210	Syria	Clay	Leaves	0,520				SYR2007
Po-210	Syria	Clay	Fruit	0,080				SYR2007
Ra-226	Iraq	Clay, sand	Fruit			0,650		IRQ2014
Ra-226	Iraq	Clay, sand	Fruit			0,940		IRQ2014
Ra-226	Iraq	Clay, sand	Fruit			0,520		IRQ2014
Ra-226	Jordan		Fruit			0,060		JON2009
Ra-226	Jordan		Fruit			0,010		JON2009
Ra-226	Jordan		Fruit			0,020		JON2009
Ra-226	Jordan		Fruit			0,050		JON2009
Ra-226	IRAQ	NA	Fruits			0,503		IRQ2018
Ra-226	IRAQ	NA	Fruits			0,321		IRQ2018
Ra-226	IRAQ		Fruits			0,097		IRQ2023b
Ra-226	IRAQ		Fruits			0,65		IRQ2014
Ra-226	IRAQ		Fruits			0,19		IRQ2014
Ra-226	IRAQ		Fruits			0,52		IRQ2014
Ra-226	IRAQ	Sand Clay Loam	Fruits			0,022	0,012	IRQ2019
Ra-226	Saudi Arabia	Silty Sand	Fruits	0,05				SAU2016
Ra-226	Saudi Arabia	Silty Sand	leaves	0,13				SAU2016
Ra-226	Saudi Arabia	Silty Sand	Roots	0,29				SAU2016
Ra-226	UAE	Sand	Fruits			1,82	0,74	UAE2024
Ra-228	UAE	Sand	Fruits			2,78	1,53	UAE2024
Sr-85	Kuwait	Sandy	Fruits			3,99	1,16	KWT2020
Sr-90	Syria	Aridisol	Fruit	0,48	1			SYR2021a
Sr-90	Syria	Aridisol	Vegetation	5,17	1,2			SYR2021a
Sr-90	Syria	Inceptisol	Fruit	0,41	1			SYR2021a
Sr-90	Syria	Inceptisol	Vegetation	3,57	1,2			SYR2021a

Th-232	Iraq	Clay, sand	Fruit			0,610		IRQ2014
Th-232	Egypt		Fruits			0,037		EGY2019b
Th-232	IRAQ	NA	Fruits			0,525		IRQ2018
Th-232	IRAQ		Fruits			0,097		IRQ2023b
Th-232	IRAQ		Fruits			0,61		IRQ2014
Th-232	IRAQ	Sand Clay Loam	Fruits			0,02	0,009	IRQ2019
Th-232	Egypt		Fruits			0,037		EGY2016c
U-234	Saudi Arabia	Silty Sand	Fruits	0,03				SAU2016
U-234	Saudi Arabia	Silty Sand	Leaves/stems	0,11				SAU2016
U-234	Saudi Arabia	Silty Sand	Roots	0,19				SAU2016
U238	Syria	Clay	Leaves	0,039				SYR2007
U-238	Syria	Clay	Fruit	0,010				SYR2007
U-238	Egypt		Fruits			0,062		EGY2019b
U-238	Saudi Arabia	Silty Sand	Fruits	0,03				SAU2016
U-238	Saudi Arabia	Silty Sand	Leaves/stems	0,11				SAU2016
U-238	Saudi Arabia	Silty Sand	Roots	0,22				SAU2016
U-238	Egypt		Fruits			0,062		EGY2016c

Eggplant

Element	**Country**	**Soil Type**	**Plant comp.**	**TF AM/GM**	**STD/GSD**	**ID**
Am-241	Kazakhstan	Clay loam	Leaves	0,0068		KAZ2014a
Am-241	Kazakhstan	Clay loam	Stalk	0,001		KAZ2014a
Am-241	Kazakhstan	Clay loam	Roots	0,0026		KAZ2014a
Ba-133	Kuwait	Sandy	Fruits	0,1	0,09	KWT2020
Cs-134	Kuwait	Sandy	Fruits	0,13	0,07	KWT2020
Cs-137	Kazakhstan	Clay loam	Leaves	0,041		KAZ2014a
Cs-137	Kazakhstan	Clay loam	Stalk	0,0045		KAZ2014a
Cs-137	Kazakhstan	Clay loam	Roots	0,015		KAZ2014a
K-40	Syria	Clay	Leaves	3,300		SYR2007
K-40	Syria	Clay	Fruit	4,100		SYR2007
K-40	Iraq	Clay, sand	Fruit	0,390		IRQ2014
K-40	Iraq	Clay, sand	Fruit	0,580		IRQ2014
K-40	Iraq	Clay, sand	Fruit	0,510		IRQ2014
K-40	Syria	Clay	Leaves	3,500		SYR2007
K-40	Syria	Clay	Fruit	4,800		SYR2007
K-40	IRAQ	Sand Clay Loam	Fruit	2,67	0,498	IRQ2019
K-40	IRAQ	NA	Fruit	0,483		IRQ2018
K-40	IRAQ	NA	Fruit	0,494		IRQ2018
K-40	IRAQ	NA	Fruit	0,465		IRQ2018
K-40	IRAQ		Fruits	3,44		IRQ2021
K-40	IRAQ		Fruits	0,865		IRQ2023b
K-40	IRAQ		Fruits	0,39		IRQ2014
K-40	IRAQ		Fruits	0,58		IRQ2014
K-40	IRAQ		Fruits	0,51		IRQ2014

Pb-210	Syria	Clay	Leaves	0,610		SYR2007
Pb-210	Syria	Clay	Fruit	0,020		SYR2007
Pb-210	Syria	Clay	Leaves	0,590		SYR2007
Pb-210	Syria	Clay	Fruit	0,100		SYR2007
Po-210	Syria	Clay	Leaves	0,910		SYR2007
Po-210	Syria	Clay	Fruit	0,040		SYR2007
Po-210	Syria	Clay	Leaves	0,290		SYR2007
Po-210	Syria	Clay	Fruit	0,030		SYR2007
Pu-239,240	Kazakhstan	Clay loam	Fruits	0,055		KAZ2014a
Pu-239,240	Kazakhstan	Clay loam	Leaves	0,052		KAZ2014a
Pu-239,240	Kazakhstan	Clay loam	Stalk	0,0043		KAZ2014a
Pu-239,240	Kazakhstan	Clay loam	Roots	0,016		KAZ2014a
Ra-226	Iraq	Clay, sand	Fruit	0,440		IRQ2014
Ra-226	Jordan		Fruit	0,070		JOR2009
Ra-226	Jordan		Fruit	0,090		JOR2009
Ra-226	Iraq	Clay, sand	Fruit	0,450		IRQ2014
Ra-226	Iraq	Clay, sand	Fruit	0,580		IRQ2014
Ra-226	IRAQ	Sand Clay Loam	Fruits	0,053	0,01	IRQ2019
Ra-226	IRAQ	NA	Whole Plant	0,334		IRQ2018
Ra-226	IRAQ	NA	Whole Plant	0,526		IRQ2018
Ra-226	IRAQ	NA	Whole Plant	0,247		IRQ2018
Ra-226	IRAQ		Fruits	0,086		IRQ2023b
Ra-226	IRAQ		Fruits	0,45		IRQ2014
Ra-226	IRAQ		Fruits	0,19		IRQ2014
Ra-226	IRAQ		Fruits	0,44		IRQ2014
Ra-226	Saudi Arabia	Silty Sand	Fruits	0,11		SAU2016
Ra-226	Saudi Arabia	Silty Sand	leaves	0,21		SAU2016
Ra-226	Saudi Arabia	Silty Sand	Roots	0,42		SAU2016
Ra-226	Sudan	Clay	Fruits	1,82		SUN1995
Ra-226	Saudi Arabia	Silty Sand	Leaves/stems	0,15		SAU2016
Ra-226	Saudi Arabia	Silty Sand	Roots	0,53		SAU2016
Sr-85	Kuwait	Sandy	Fruits	1,6	0,74	KWT2020
Sr-90	Kazakhstan	Clay loam	Fruits	0,0043		KAZ2014a
Sr-90	Kazakhstan	Clay loam	Leaves	0,79		KAZ2014a
Sr-90	Kazakhstan	Clay loam	Stalk	0,82		KAZ2014a
Sr-90	Kazakhstan	Clay loam	Roots	0,3		KAZ2014a
Th-232	Iraq	Clay, sand	Fruit	0,300		IRQ2014
Th-232	Iraq	Clay, sand	Fruit	0,800		IRQ2014
Th-232	IRAQ	Sand Clay Loam	Fruits	0,035	0,011	IRQ2019
Th-232	IRAQ	NA	Fruits	0,384		IRQ2018
Th-232	IRAQ		Fruits	0,16		IRQ2021
Th-232	IRAQ		Fruits	0,086		IRQ2023b
Th-232	IRAQ		Fruits	0,3		IRQ2014

Th-232	IRAQ		Fruits	0,8		IRQ2014
U-234	Saudi Arabia	Silty Sand	Fruits	0,05		SAU2016
U-234	Saudi Arabia	Silty Sand	Leaves/stems	0,15		SAU2016
U-234	Saudi Arabia	Silty Sand	Roots	0,33		SAU2016
U-234	Saudi Arabia	Silty Sand	Leaves/stems	0,29		SAU2016
U-234	Saudi Arabia	Silty Sand	Roots	0,29		SAU2016
U-238	Syria	Clay	Leaves	0,053		IRQ2014
U-238	Syria	Clay	Fruit	0,010		SYR2007
U-238	Syria	Clay	Leaves	0,044		SYR2007
U-238	Syria	Clay	Fruit	0,050		SYR2007
U-238	Saudi Arabia	Silty Sand	Fruits	0,05		SAU2016
U-238	Saudi Arabia	Silty Sand	Leaves/stems	0,13		SAU2016
U-238	Saudi Arabia	Silty Sand	Roots	0,28		SAU2016
U-238	Saudi Arabia	Silty Sand	Leaves/stems	0,2		SAU2016
U-238	Saudi Arabia	Silty Sand	Roots	0,18		SAU2016

Bell pepper

Element	Country	Soil Type	Plant comp.	TF AM/GM	STD/GSD	ID
Am-241	Kazakhstan	Clay loam	Fruits	0,0007		KAZ2014a
Am-241	Kazakhstan	Clay loam	Leaves	0,0036		KAZ2014a
Am-241	Kazakhstan	Clay loam	Stalk	0,0025		KAZ2014a
Am-241	Kazakhstan	Clay loam	Roots	0,0022		KAZ2014a
Ba-133	Kuwait	Sandy	Fruits	0,53	0,48	KWT2020
Cd	Jordan	Clay	Fruits	0,170	0,038	JOR2015
Cr	Jordan	Clay	Fruits	0,060	0,014	JOR2015
Cs-134	Kuwait	Sandy	Fruits	0,11	0,05	KWT2020
Cs-137	Kazakhstan	Clay loam	Fruits	0,0021		KAZ2014a
Cs-137	Kazakhstan	Clay loam	Leaves	0,022		KAZ2014a
Cs-137	Kazakhstan	Clay loam	Stalk	0,012		KAZ2014a
Cs-137	Kazakhstan	Clay loam	Roots	0,018		KAZ2014a
K-40	Iraq	Clay, sand	Fruit	0,640		IRQ2014
K-40	Iraq	Clay, sand	Fruit	0,760		IRQ2014
K-40	Iraq	Clay, sand	Fruit	0,590		IRQ2014
K-40	Syria	Clay	Leaves	4,400		SYR2007
K-40	Syria	Clay	Fruit	4,800		SYR2007
K-40	Syria	Clay	Leaves	5,400		SYR2007
K-40	Syria	Clay	Fruit	4,400		SYR2007
K-40	IRAQ		Fruit	0,639		IRQ2018
K-40	IRAQ		Fruit	0,503		IRQ2018
K-40	IRAQ		Fruit	0,482		IRQ2018
K-40	IRAQ		Fruits	0,933		IRQ2023b
K-40	IRAQ	Sand Clay Loam	Fruits	2,621	0,378	IRQ2019

Pb	Jordan	Clay	Fruits	0,376	0,036	JOR2015
Pb-210	Syria	Clay	Leaves	0,690		SYR2007
Pb-210	Syria	Clay	Fruit	0,140		SYR2007
Pb-210	Syria	Clay	Leaves	0,380		SYR2007
Pb-210	Syria	Clay	Fruit	0,040		SYR2007
Po-210	Syria	Clay	Leaves	1,000		SYR2007
Po-210	Syria	Clay	Fruit	0,100		SYR2007
Po-210	Syria	Clay	Leaves	0,290		SYR2007
Po-210	Syria	Clay	Fruit	0,210		SYR2007
Pu-239,240	Kazakhstan	Clay loam	Fruits	0,0004		KAZ2014a
Pu-239,240	Kazakhstan	Clay loam	Leaves	0,011		KAZ2014a
Pu-239,240	Kazakhstan	Clay loam	Stalk	0,0018		KAZ2014a
Pu-239,240	Kazakhstan	Clay loam	Roots	0,012		KAZ2014a
Ra-226	Iraq	Clay, sand	Fruit	0,200		IRQ2014
Ra-226	Iraq	Clay, sand	Fruit	0,760		IRQ2014
Ra-226	Iraq	Clay, sand	Fruit	0,310		IRQ2014
Ra-226	Jordan		Fruit	0,040		JOR2009
Ra-226	Jordan		Fruit	0,030		JOR2009
Ra-226	Jordan		Fruit	0,030		JOR2009
Ra-226	Saudi Arabia	Silty Sand	Fruits	0,06		SAU2016
Ra-226	Saudi Arabia	Silty Sand	leaves	0,12		SAU2016
Ra-226	Saudi Arabia	Silty Sand	Roots	0,25		SAU2016
Ra-226	IRAQ	NA	Whole Plant	0,372		IRQ2018
Ra-226	IRAQ	NA	Whole Plant	0,459		IRQ2018
Ra-226	IRAQ	NA	Whole Plant	0,388		IRQ2018
Ra-226	IRAQ		Fruits	0,078		IRQ2023b
Ra-226	Saudi Arabia	Silty Sand	Leaves/stems	0,15		SAU2016
Ra-226	Saudi Arabia	Silty Sand	Roots	0,51		SAU2016
Ra-226	Saudi Arabia	Silty Sand	Fruit	0,04		SAU2016
Ra-226	Saudi Arabia	Silty Sand	Leaves/stems	0,16		SAU2016
Ra-226	Saudi Arabia	Silty Sand	Roots	0,59		SAU2016
Ra-226	IRAQ	Sand Clay Loam	Fruits	0,041	0,015	IRQ2019
Sr-85	Kuwait	Sandy	Fruits	1,43	0,24	KWT2020
Sr-90	Kazakhstan	Clay loam	Fruits	0,0014		KAZ2014a
Sr-90	Kazakhstan	Clay loam	Leaves	0,38		KAZ2014a
Sr-90	Kazakhstan	Clay loam	Stalk	0,65		KAZ2014a
Sr-90	Kazakhstan	Clay loam	Roots	0,23		KAZ2014a
Th-232	Iraq	Clay, sand	Fruit	0,630		IRQ2014
Th-232	Iraq	Clay, sand	Fruit	0,650		IRQ2014
Th-232	IRAQ	NA	Fruits	0,395		IRQ2018
Th-232	IRAQ		Fruits	0,078		IRQ2023b
Th-232	IRAQ	Sand Clay Loam	Fruits	0,021	0,005	IRQ2019
U-238	Syria	Clay	Leaves	0,041		SYR2007
U-238	Syria	Clay	Fruit	0,050		SYR2007
U-238	Syria	Clay	Leaves	0,059		SYR2007
U-238	Syria	Clay	Fruit	0,014		SYR2007
U-234	Saudi Arabia	Silty Sand	Fruits	0,04		SAU2016
U-234	Saudi Arabia	Silty Sand	Leaves/stems	0,14		SAU2016

U-234	Saudi Arabia	Silty Sand	Roots	0,29		SAU2016
U-234	Saudi Arabia	Silty Sand	Fruits	0,1		SAU2016
U-234	Saudi Arabia	Silty Sand	Leaves/stems	0,29		SAU2016
U-234	Saudi Arabia	Silty Sand	Roots	0,28		SAU2016
U-234	Saudi Arabia	Silty Sand	Fruits	0,02		SAU2016
U-234	Saudi Arabia	Silty Sand	Leaves/stems	0,09		SAU2016
U-234	Saudi Arabia	Silty Sand	Roots	0,15		SAU2016
U-238	Saudi Arabia	Silty Sand	Fruits	0,03		SAU2016
U-238	Saudi Arabia	Silty Sand	Leaves/stems	0,13		SAU2016
U-238	Saudi Arabia	Silty Sand	Roots	0,29		SAU2016
U-238	Saudi Arabia	Silty Sand	Fruits	0,06		SAU2016
U-238	Saudi Arabia	Silty Sand	Leaves/stems	0,2		SAU2016
U-238	Saudi Arabia	Silty Sand	Roots	0,18		SAU2016
U-238	Saudi Arabia	Silty Sand	Fruits	0,02		SAU2016
U-238	Saudi Arabia	Silty Sand	Leaves/stems	0,09		SAU2016
U-238	Saudi Arabia	Silty Sand	Roots	0,16		SAU2016
Zn	Jordan	Clay	Fruits	0,300	0,046	JOR2015

Potato

Element	**Country**	**Soil Type**	**Plant comp.**	**TF AM/GM**	**STD/GSD**	**ID**
Am-241	Kazakhstan	Clay loam	Leaves	0,0045		KAZ2014a
Am-241	Kazakhstan	Clay loam	Stalk	0,0006		KAZ2014a
Am-241	Kazakhstan	Clay loam	Roots	0,012		KAZ2014a
Am-241	Kazakhstan	Clay loam	Bulbs (aril)	0,0001		KAZ2014a
Am-241	Kazakhstan	Clay loam	Bulbs (pap)	0,0001		KAZ2014a
Be-7	Israel		Fruit	0,66000		ISR2006
Be-7	Israel		Fruit	0,38000		ISR2006
Cs	Syria	Aridisol: silty-loam	Fruit	0,02700		SYR2006a
Cs-137	Syria	Aridisol: silty-loam	Veg	0,02800		SYR2006a
Cs-137	Syria	Inceptisol: silty-clay	Fruit	0,01100		SYR2006a
Cs-137	Syria	Inceptisol: silty-clay	Veg	0,02000		SYR2006a
Cs-137	Israel		Fruit	0,07300		ISR2006
Cs-137	Kazakhstan	Clay loam	Leaves	0,094		KAZ2014a
Cs-137	Kazakhstan	Clay loam	Stalk	0,09		KAZ2014a
Cs-137	Kazakhstan	Clay loam	Roots	0,12		KAZ2014a
Cs-137	Kazakhstan	Clay loam	Bulbs (aril)	0,0028		KAZ2014a
Cs-137	Kazakhstan	Clay loam	Bulbs (pap)	0,0072		KAZ2014a
Cs-137	Syria	Aridisol	Tuber	0,027	1,2	SYR2021a
Cs-137	Syria	Inceptisol	Tuber	0,01	1,1	SYR2021a
Cs-137	Syria	Inceptisol	Vegetation	0,025	1,3	SYR2021a
K-40	Israel		Fruit	3,10000		ISR2006
K-40	Israel		Fruit	0,85000		ISR2006
K-40	IRAQ	Sand Clay Loam	Fruits	1,702	0,177	IRQ2019

K-40	South Africa	Sandy Loam	Tubers	0,43		ZAF2020
K-40	South Africa	Sandy Loam	Tubers	0,42		ZAF2020
K-40	South Africa	Sandy Clay Loam	Tubers	0,94		ZAF2020
K-40	South Africa	Sandy Clay Loam	Tubers	0,73		ZAF2020
K-40	South Africa	Loam Sand	Tubers	0,20		ZAF2020
K-40	South Africa	Loam Sand	Tubers	0,24		ZAF2020
K-40	South Africa	Sandy Clay Loam	Tubers	0,30		ZAF2020
K-40	South Africa	Sandy Clay Loam	Tubers	0,76		ZAF2020
Pu-239,240	Kazakhstan	Clay loam	Leaves	0,042		KAZ2014a
Pu-239,240	Kazakhstan	Clay loam	Stalk	0,026		KAZ2014a
Pu-239,240	Kazakhstan	Clay loam	Roots	0,5		KAZ2014a
Pu-239,240	Kazakhstan	Clay loam	Bulbs (aril)	0,0003		KAZ2014a
Pu-239,240	Kazakhstan	Clay loam	Bulbs (pap)	0,0006		KAZ2014a
Ra-226	IRAQ	Sand Clay Loam	Fruits	0,03	0,007	IRQ2019
Ra-226	Saudi Arabia	Silty Sand	Fruits	0,09		SAU2016
Ra-226	Saudi Arabia	Silty Sand	Leaves	0,1		SAU2016
Ra-226	Saudi Arabia	Silty Sand	Roots	0,12		SAU2016
Ra-226	South Africa	Sandy Loam	Tubers	0,11		ZAF2020
Ra-226	South Africa	Sandy Loam	Tubers	0,09		ZAF2020
Ra-226	South Africa	Sandy Clay Loam	Tubers	0,43		ZAF2020
Ra-226	South Africa	Sandy Clay Loam	Tubers	0,71		ZAF2020
Ra-226	South Africa	Loam Sand	Tubers	0,14		ZAF2020
Ra-226	South Africa	Loam Sand	Tubers	0,13		ZAF2020
Ra-226	South Africa	Sandy Clay Löam	Tubers	0,79		ZAF2020
Ra-226	South Africa	Sandy Clay Löam	Tubers	0,57		ZAF2020
Sr-90	Kazakhstan	Clay loam	Leaves	0,51		KAZ2014a
Sr-90	Kazakhstan	Clay loam	Stalk	1,1		KAZ2014a
Sr-90	Kazakhstan	Clay loam	Roots	1,1		KAZ2014a
Sr-90	Kazakhstan	Clay loam	Bulbs (aril)	0,007		KAZ2014a
Sr-90	Kazakhstan	Clay loam	Bulbs (pap)	0,036		KAZ2014a
Sr-90	Syria	Aridisol	Tuber	0,23	1,1	SYR2021a
Sr-90	Syria	Aridisol	Vegetation	2,38	1,1	SYR2021a
Sr-90	Syria	Inceptisol	Tuber	0,09	1,3	SYR2021a
Sr-90	Syria	Inceptisol	Vegetation	1,06	1,1	SYR2021a
Th-232	IRAQ	Sand Clay Loam	Fruits	0,022	0,006	IRQ2019
Th-232	South Africa	Sandy Loam	Tubers	0,09		ZAF2020
Th-232	South Africa	Sandy Loam	Tubers	0,09		ZAF2020
Th-232	South Africa	Sandy Clay Loam	Tubers	0,10		ZAF2020
Th-232	South Africa	Sandy Clay Loam	Tubers	0,12		ZAF2020
Th-232	South Africa	Loam Sand	Tubers	0,10		ZAF2020
Th-232	South Africa	Loam Sand	Tubers	0,08		ZAF2020
Th-232	South Africa	Sandy Clay Loam	Tubers	0,73		ZAF2020
Th-232	South Africa	Sandy Clay Loam	Tubers	0,16		ZAF2020
U-234	Saudi Arabia	Silty Sand	Fruits	0,11		SAU2016
U-234	Saudi Arabia	Silty Sand	Leaves/stems	0,25		SAU2016
U-234	Saudi Arabia	Silty Sand	Roots	0,25		SAU2016

U-238	Iraq		Fruits	0,43		IRQ2025
U-238	Saudi Arabia	Silty Sand	Fruits	0,08		SAU2016
U-238	Saudi Arabia	Silty Sand	Leaves/stems	0,19		SAU2016
U-238	Saudi Arabia	Silty Sand	Roots	0,2		SAU2016
U-238	Iraq	Aridisol	Fruits	0,43		IRQ2025

Pumpkin

Element	Country	Soil Type	Plant comp.	TF AM/GM	STD/GSD	ID
K-40	Morocco	Sandy clay	Whole plant	9,08		MAR2021
K-40	IRAQ		Fruits	0,59		IRQ2014
K-40	IRAQ		Fruits	0,51		IRQ2014
Pb-210	Morocco	Sandy clay	Whole plant	0,29		MAR2021
Ra-226	Morocco	Sandy clay	Whole plant	0,21		MAR2021
Ra-226	IRAQ		Fruits	0,61		IRQ2014
Ra-226	IRAQ		Fruits	0,42		IRQ2014
Th-232	IRAQ		Fruits	0,57		IRQ2014
Th-232	IRAQ		Fruits	0,15		IRQ2014

Radish

Element	Country	Soil Type	Plant comp.	TF AM/GM	STD/GSD	ID
Cs-137	Iraq		Leaves	0,88		IRQ2023a
K-40	Iraq		Leaves	1,05		IRQ2023a
K-40	Yemen		Fruit	0,1048		YEM2019
K-40	Yemen		Fruit	0,1056		YEM2019
K-40	Yemen		Fruit	0,0901		YEM2019
Ra-226	Yemen		Fruit	0,0235		YEM2019
Ra-226	Yemen		Fruit	0,0259		YEM2019
Ra-226	Yemen		Fruit	0,0211		YEM2019
Ra-226	Iraq		Leaves	0,9		IRQ2023a
Th-232	Iraq		Leaves	0,93		IRQ2023a
Th-232	Yemen		Fruit	0,0073		YEM2019
Th-232	Yemen		Fruit	0,0066		YEM2019
Th-232	Yemen		Fruit	0,0060		YEM2019

Squash

Element	Country	Soil Type	Plant comp.	TF AM/GM	STD/GSD	ID
K-40	Iraq	Clay, sand	Fruit	0,59000		IRQ2014
K-40	Iraq	Clay, sand	Fruit	0,51000		IRQ2014
K-40	Iraq	Clay, sand	Fruit	0,50000		IRQ2014
Ra-226	Iraq	Clay, sand	Fruit	0,61000		IRQ2014
Ra-226	Iraq	Clay, sand	Fruit	0,51000		IRQ2014
Ra-226	Iraq	Clay, sand	Fruit	0,49000		IRQ2014
Th-232	Iraq	Clay, sand	Fruit	0,57000		IRQ2014

Th-232	Iraq	Clay, sand	Fruit	0,15000		IRQ2014

Tomato

Element	Country	Soil Type	Plant comp.	TF AM/GM	STD/GSD	ID
Am-241	Kazakhstan	Clay loam	Fruits	0,0002		KAZ2014a
Am-241	Kazakhstan	Clay loam	Leaves	0,0045		KAZ2014a
Am-241	Kazakhstan	Clay loam	Stalk	0,0011		KAZ2014a
Am-241	Kazakhstan	Clay loam	Roots	0,0250		KAZ2014a
Cs-137	Syria		Fruit	0,0600		SYR1995
Cs-137	Syria		Fruit	0,0400		SYR1995
Cs-137	Syria		Fruit	0,0200	0,003	SYR1995
Cs-137	Kazakhstan	Clay loam	Fruits	0,0024		KAZ2014a
Cs-137	Kazakhstan	Clay loam	Leaves	0,0220		KAZ2014a
Cs-137	Kazakhstan	Clay loam	Stalk	0,0061		KAZ2014a
Cs-137	Kazakhstan	Clay loam	Roots	0,1000		KAZ2014a
K-40	Iraq	Clay, sand	Fruit	0,5900		IRQ2014
K-40	Iraq	Clay, sand	Fruit	0,3200		IRQ2014
K-40	Iraq	Clay, sand	Fruit	0,5500		IRQ2014
K-40	Syria	Clay	Leaves	0,9000		SYR2007
K-40	Syria	Clay	Fruit	4,9000		SYR2007
K-40	Syria	Clay	Leaves	2,9000		SYR2007
K-40	Syria	Clay	Fruit	7,8000		SYR2007
K-40	Morocco	Sandy clay	Whole plant	10,9600		MAR2021
K-40	IRAQ	Sand Clay Loam	Fruits	3,7230	0,479	IRQ2019
K-40	IRAQ	NA	Fruits	0,4730		IRQ2018
K-40	IRAQ		Fruits	0,5500		IRQ2018
K-40	IRAQ		Fruits	0,5900		IRQ2014
K-40	IRAQ		Fruits	0,3200		IRQ2014
K-40	IRAQ		Fruits	0,5500		IRQ2014
K-40	IRAQ		Fruits	0,7470		IRQ2023b
Pb-210	Syria	Clay	Leaves	1,0000		SYR2007
Pb-210	Syria	Clay	Fruit	0,1200		SYR2007
Pb-210	Syria	Clay	Leaves	0,4900		SYR2007
Pb-210	Syria	Clay	Fruit	0,5900		SYR2007
Pb-210	Morocco	Sandy clay	Whole plant	0,2200		MAR2021
Po-210	Syria	Clay	Leaves	0,4000		SYR2007
Po-210	Syria	Clay	Fruit	0,1500		SYR2007
Po-210	Syria	Clay	Leaves	0,8900		SYR2007
Pu-239,240	Kazakhstan	Clay loam	Fruits	0,0010		KAZ2014a
Pu-239,240	Kazakhstan	Clay loam	Leaves	0,0400		KAZ2014a
Pu-239,240	Kazakhstan	Clay loam	Stalk	0,0060		KAZ2014a
Pu-239,240	Kazakhstan	Clay loam	Roots	0,2900		KAZ2014a
Ra-226	Iraq	Clay, sand	Fruit	0,3200		IRQ2014
Ra-226	Iraq	Clay, sand	Fruit	0,3200		IRQ2014
Ra-226	Iraq	Clay, sand	Fruit	0,3700		IRQ2014
Ra-226	Jordan		Fruit	0,0100		JOR2009
Ra-226	Morocco	Sandy clay	Whole plant	0,2300		MAR2021
Ra-226	IRAQ	Sand Clay Loam	Fruits	0,0480	0,017	IRQ2019
Ra-226	IRAQ	NA	Fruits	0,3190		IRQ2018

Ra-226	IRAQ	NA	Fruits	0,2440		IRQ2018
Ra-226	IRAQ		Fruits	0,3200		IRQ2014
Ra-226	IRAQ		Fruits	0,5900		IRQ2014
Ra-226	IRAQ		Fruits	0,3700		IRQ2014
Ra-226	Saudi Arabia	Silty Sand	Fruits	0,0400		SAU2016
Ra-226	Saudi Arabia	Silty Sand	Leaves/stems	0,1500		SAU2016
Ra-226	Saudi Arabia	Silty Sand	Roots	0,4200		SAU2016
Ra-226	IRAQ		Fruits	0,1430		IRQ2023b
Sr-90	Kazakhstan	Clay loam	Fruits	0,0005		KAZ2014a
SR-90	Kazakhstan	Clay loam	Leaves	0,2400		KAZ2014a
Sr-90	Kazakhstan	Clay loam	Stalk	0,3800		KAZ2014a
Sr-90	Kazakhstan	Clay loam	Roots	0,2600		KAZ2014a
Th-232	IRAQ	Sand Clay Loam	Fruits	0,0280	0,008	IRQ2019
Th-232	IRAQ	NA	Fruits	0,3660		IRQ2018
Th-232	IRAQ		Fruits	0,1430		IRQ2023b
U-238	Syria	Clay	Leaves	0,0580		SYR2007
U-238	Syria	Clay	Fruit	0,0040		SYR2007
U-238	Syria	Clay	Leaves	0,0360		SYR2007
U-238	Syria	Clay	Fruit	0,0570		SYR2007
U-234	Saudi Arabia	Silty Sand	Fruits	0,0500		SAU2016
U-234	Saudi Arabia	Silty Sand	Leaves/stems	0,1100		SAU2016
U-234	Saudi Arabia	Silty Sand	Roots	0,2100		SAU2016
U-238	Saudi Arabia	Silty Sand	Fruits	0,0500		SAU2016
U-238	Saudi Arabia	Silty Sand	Leaves/stems	0,1200		SAU2016
U-238	Saudi Arabia	Silty Sand	Roots	0,2300		SAU2016

Turnip

Element	**Country**	**Soil Type**	**Plant comp.**	**TF AM**	**SD**	**ID**
Cs-137	Iraq		Leaves	0,9		IRQ2023a
K-40	Iraq		Leaves	0,943		IRQ2023a
Ra-226	Iraq		Leaves	0,95		IRQ2023a
Th-232	Iraq		Leaves	0,941		IRQ2023a
U-238	Iraq		Fruits	0,63		IRQ2025

Zucchini

Element	**Country**	**Soil Type**	**Plant comp.**	**TF AM/GM**	**STD/GSD**	**ID**
Eu-152	Egypt		Fruits	0,008		EGY2016c
K-40	IRAQ	Sand Clay Loam	Fruit	3,501	0,415	IRQ2019
K-40	IRAQ		Fruits	0,872		IRQ2023b
K-40	Egypt		Fruits	0,038		EGY2016c
K-40	Morocco	Sandy clay	Fruit	9,37		MAR2021
K-40	Morocco	Sandy clay	Fruit	7,45		MAR2021
Pb-210	Morocco	Sandy clay	Fruit	0,09		MAR2021
Pb-210	Morocco	Sandy clay	Fruit	0,2		MAR2021

Ra-226	IRAQ	Sand Clay Loam	Fruits	0,011	0,002	IRQ2019
Ra-226	IRAQ		Fruits	0,095		IRQ2023b
Ra-226	Saudi Arabia	Silty Sand	Leaves/stems	0,22		SAU2016
Ra-226	Saudi Arabia	Silty Sand	Roots	0,75		SAU2016
Ra-226	Morocco	Sandy clay	Fruit	0,15		MAR2021
Ra-226	Morocco	Sandy clay	Fruit	0,17		MAR2021
Th-232	IRAQ	Sand Clay Loam	Fruits	0,015	0,004	IRQ2019
Th-232	IRAQ		Fruits	0,095		IRQ2023b
Th-232	Egypt		Fruits	0,027		EGY2016c
U-234	JORDAN	NA	Fruit	0,011		JOR2008
U-234	Saudi Arabia	Silty Sand	Leaves/stems	0,1		SAU2016
U-234	Saudi Arabia	Silty Sand	Roots	0,18		SAU2016
U-238	Saudi Arabia	Silty Sand	Leaves/stems	0,11		SAU2016
U-238	JORDAN	NA	Fruits	0,0105		JOR2008
U-238	Saudi Arabia	Silty Sand	Roots	0,19		SAU2016
U-238	Egypt		Fruits	0,035		EGY2016c

8.4 Leguminous vegetables

Bean

Element	Country	Soil Type	Plant comp.	TF AM/GM	STD/GSD	ID
Am-241	Kazakhstan	Clay loam	Pods	0,002		KAZ2014a
Am-241	Kazakhstan	Clay loam	Leaves	0,007		KAZ2014a
Am-241	Kazakhstan	Clay loam	Stalks	0,004		KAZ2014a
Am-241	Kazakhstan	Clay loam	Roots	0,011		KAZ2014a
Cs-137	Egypt	Sandy clay loam	Roots	0,014	1,00	EGY2021a
Cs-137	Egypt	Sandy clay loam	Shoots	0,043	1,00	EGY2021a
Cs-137	Egypt	Sandy clay loam	Grain	0,008	1,10	EGY2021a
Cs-137	Syria		Grain	0,01	0,0006	SYR1995
Cs-137	Syria		Pods	0,014	0,001	SYR1995
Cs-137	Syria	Aridisol	Seed	0,011	1,8	SYR2021a
Cs-137	Syria	Aridisol	Vegetation	0,101	1,7	SYR2021a
Cs-137	Kazakhstan	Clay loam	Pods	0,0024		KAZ2014a
Cs-137	Kazakhstan	Clay loam	Leaves	0,033		KAZ2014a
Cs-137	Kazakhstan	Clay loam	Stalks	0,006		KAZ2014a
Cs-137	Kazakhstan	Clay loam	Roots	0,035		KAZ2014a
K-40	Morocco	Sandy clay	Root	2,07		MAR2021
K-40	Morocco	Sandy clay	Leaves/Stem	2,73		MAR2021
Pb-210	Morocco	Sandy clay	Root	0,16		MAR2021
Pb-210	Morocco	Sandy clay	Leaves/Stem	0,2		MAR2021
Pu-239,240	Kazakhstan	Clay loam	Pods	0,0005		KAZ2014a
Pu-239,240	Kazakhstan	Clay loam	Leaves	0,0012		KAZ2014a
Pu-239,240	Kazakhstan	Clay loam	Stalks	0,0018		KAZ2014a
Pu-239,240	Kazakhstan	Clay loam	Roots	0,0018		KAZ2014a
Ra-226	Morocco	Sandy clay	Root	0,16		MAR2021
Ra-226	Morocco	Sandy clay	Leaves/Stem	0,21		MAR2021
Ra-226	Saudi Arabia	Silty Sand	Pods	0,03		SAU2016
Ra-226	Saudi Arabia	Silty Sand	leaves	0,21		SAU2016
Ra-226	Saudi Arabia	Silty Sand	Roots	0,33		SAU2016
Sr-85	Egypt	Sandy clay loam	Roots	0,052	1,00	EGY2021a
Sr-85	Egypt	Sandy clay loam	Shoots	0,190	1,00	EGY2021a
Sr-85	Egypt	Sandy clay loam	Grain	0,003	1,00	EGY2021a
Sr-90	Syria	Aridisol	Seed	0,17	1,1	SYR2021a
Sr-90	Syria	Aridisol	Vegetation	3,06	1,3	SYR2021a
Sr-90	Kazakhstan	Clay loam	Pods	0,066		KAZ2014a
Sr-90	Kazakhstan	Clay loam	Leaves	0,67		KAZ2014a
Sr-90	Kazakhstan	Clay loam	Stalks	0,53		KAZ2014a

Sr-90	Kazakhstan	Clay loam	Roots	0,19		KAZ2014a
U-234	Saudi Arabia	Silty Sand	Fruits	0,16		SAU2016
U-234	Saudi Arabia	Silty Sand	Leaves/stems	0,22		SAU2016
U-234	Saudi Arabia	Silty Sand	Roots	0,59		SAU2016
U-238	Saudi Arabia	Silty Sand	pods	0,16		SAU2016
U-238	Saudi Arabia	Silty Sand	Leaves/stems	0,26		SAU2016
U-238	Saudi Arabia	Silty Sand	Roots	0,51		SAU2016

Broad bean

Element	Country	Soil Type	Plant comp.	TF AM/GM	STD/GSD	ID
Cs-137	Syria	Silty-clay	Pods	0,005		SYR2006
Cs-137	Syria	Silty-clay	Veg	0,011		SYR2006
Cs-137	Syria	Silty-clay	Pods	0,007		SYR2006
Cs-137	Syria	Silty-clay	Veg	0,025		SYR2006
Cs-137	Syria		Pods	0,050		SYR1995
Cs-137	Syria	Aridisol	Seed	0,007	1,3	SYR2021a
Cs-137	Syria	Aridisol	Pods	0,011	1,8	SYR2021a
Cs-137	Syria	Aridisol	Vegetation	0,027	1,1	SYR2021a
Cs-137	Syria	Inceptisol	Seed	0,005	1,1	SYR2021a
Cs-137	Syria	Inceptisol	Vegetation	0,027	1,1	SYR2021a
K-40	Syria	Clay	Leaves	2,600		SYR2007
K-40	Syria	Clay	Pods	2,000		SYR2007
Pb-210	Syria	Clay	Leaves	1,300		SYR2007
Pb-210	Syria	Clay	Pods	0,230		SYR2007
Po-210	Syria	Clay	Leaves	0,280		SYR2007
Po-210	Syria	Clay	Pods	0,050		SYR2007
Sr-90	Syria	Aridisol	Seed	0,09	1,6	SYR2021a
Sr-90	Syria	Aridisol	Pods	0,91	1,2	SYR2021a
Sr-90	Syria	Aridisol	Vegetation	1,45	1,1	SYR2021a
Sr-90	Syria	Inceptisol	Seed	0,05	1	SYR2021a
Sr-90	Syria	Inceptisol	Vegetation	1,2	1,1	SYR2021a
U-238	Syria	Clay	Leaves	0,021		SYR2007
U-238	Syria	Clay	Pods	0,005		SYR2007

Chickpea

Element	Country	Soil Type	Plant comp.	TF AM/GM	STD/GSD	ID
Cs-137	Syria	Aridisol	Seed	0,004	1,4	SYR2021a
Cs-137	Syria	Aridisol	Vegetation	0,073	1,7	SYR2021a
Cs-137	Syria		Grain	0,012	0,0006	SYR1995
Cs-137	Jordan		Pods	0,157	0,022	JOR2006
K-40	Syria	Clay	Straw	1,500		SYR2007
K-40	Syria	Clay	Pods	1,200		SYR2007

K-40	Syria	Clay	Pods	0,700		SYR2007
K-40	Syria	Clay	Straw	2,200		SYR2007
K-40	Jordan		Pods	1,895	0,001	JOR2006
Pb-210	Syria	Clay	Straw	1,800		SYR2007
Pb-210	Syria	Clay	Pods	0,010		SYR2007
Pb-210	Syria	Clay	Straw	0,740		SYR2007
Pb-210	Syria	Clay	Pods	0,130		SYR2007
Po-210	Syria	Clay	Straw	1,200		SYR2007
Po-210	Syria	Clay	Pods	0,040		SYR2007
Po-210	Syria	Clay	Straw	0,460		SYR2007
Po-210	Syria	Clay	Pods	0,120		SYR2007
Sr-90	Syria	Aridisol	Seed	0,19	1,3	SYR2021a
Sr-90	Syria	Aridisol	Vegetation	2,48	1,2	SYR2021a
Th-232	Jordan		Pods	0,091	0,003	JOR2006
U-238	Syria	Clay	Pods	0,050		SYR2007
U-238	Syria	Clay	Straw	0,012		SYR2007
U-238	Syria	Clay	Pods	0,003		SYR2007
U-238	Syria	Clay	Straw	0,024		SYR2007
U-238	Jordan		Pods	1,065	0,007	JOR2006

Cowpea

Element	Country	Soil Type	Plant comp.	TF AM/GM	STD/GSD	ID
K-40	South Africa	Sandy Loam	Pods	0,77		ZAF2020
K-40	South Africa	Sandy Loam	Pods	0,68		ZAF2020
K-40	South Africa	Sandy Clay Loam	Pods	0,80		ZAF2020
K-40	South Africa	Sandy Clay Loam	Pods	0,79		ZAF2020
K-40	South Africa	Loam Sand	Pods	0,40		ZAF2020
K-40	South Africa	Loam Sand	Pods	0,56		ZAF2020
K-40	South Africa	Sandy Clay Loam	Pods	0,86		ZAF2020
K-40	South Africa	Sandy Clay Loam	Pods	0,62		ZAF2020
K-40	Egypt	Clay Loam	Pods	1,36	0,01	EGY2020a
Ra-226	Sudan	Clay	Pods	0,28		SDN1995
Ra-226	South Africa	Sandy Loam	Pods	0,26		ZAF2020
Ra-226	South Africa	Sandy Loam	Pods	0,31		ZAF2020
Ra-226	South Africa	Sandy Clay Loam	Pods	0,40		ZAF2020
Ra-226	South Africa	Sandy Clay Loam	Pods	0,29		ZAF2020
Ra-226	South Africa	Loam Sand	Pods	0,32		ZAF2020
Ra-226	South Africa	Loam Sand	Pods	0,24		ZAF2020
Ra-226	South Africa	Sandy Clay Loam	Pods	0,56		ZAF2020
Ra-226	South Africa	Sandy Clay Loam	Pods	0,50		ZAF2020
Ra-226	Egypt	Clay Loam	Pods	0,51	0,02	EGY2020a
Th-232	South Africa	Sandy Loam	Pods	0,15		ZAF2020
Th-232	South Africa	Sandy Loam	Pods	0,14		ZAF2020
Th-232	South Africa	Sandy Clay Loam	Pods	0,05		ZAF2020

Th-232	South Africa	Sandy Clay Loam	Pods	0,35		ZAF2020
Th-232	South Africa	Loam Sand	Pods	0,16		ZAF2020
Th-232	South Africa	Loam Sand	Pods	0,18		ZAF2020
Th-232	South Africa	Sandy Clay Loam	Pods	0,32		ZAF2020
Th-232	South Africa	Sandy Clay Loam	Pods	0,09		ZAF2020
Th-232	Egypt	Clay Loam	Pods	0,53	0,04	EGY2020a

Lentil

Element	Country	Soil Type	Plant comp.	TF AM/GM	STD/GSD	ID
K-40	Syria	Clay	Straw	1,9		SYR2007
K-40	Syria	Clay	Pods	0,7		SYR2007
K-40	Syria	Clay	Straw	1,1		SYR2007
Pb-210	Syria	Clay	Straw	0,87		SYR2007
Pb-210	Syria	Clay	Pods	0,05		SYR2007
Pb-210	Syria	Clay	Straw	0,24		SYR2007
Pb-210	Syria	Clay	Pods	0,38		SYR2007
Po-210	Syria	Clay	Straw	0,53		SYR2007
Po-210	Syria	Clay	Pods	0,03		SYR2007
Po-210	Syria	Clay	Straw	0,37		SYR2007
Po-210	Syria	Clay	Pods	0,11		SYR2007
Ra-226	Sudan	Clay	Pods	0,14		SDN1995
U-238	Syria	Clay	Straw	0,044		SYR2007
U-238	Syria	Clay	Pods	0,02		SYR2007
U-238	Syria	Clay	Straw	0,026		SYR2007
U-238	Syria	Clay	Pods	0,064		SYR2007

Okra

Element	Country	Soil Type	Plant comp.	TF AM/GM	STD/GSD	ID
K-40	Iraq		Fruit	0,538		IRQ2018
K-40	Iraq		Fruit	0,397		IRQ2018
K-40	Iraq		Fruit	0,572		IRQ2018
K-40	Iraq		Pods	3,17		IRQ2021
K-40	Iraq		Pods	0,54		IRQ2023b
K-40	Iraq		Pods	0,58		IRQ2014
K-40	Iraq		Pods	0,85		IRQ2014
K-40	Iraq		Pods	0,6		IRQ2014
Ra-226	Iraq		Whole Plant	0,389		IRQ2018
Ra-226	Iraq		Whole Plant	0,398		IRQ2018
Ra-226	Iraq		Whole Plant	0,361		IRQ2018
Ra-226	Iraq		Pods	0,108		IRQ2023b
Ra-226	Iraq		Pods	0,67		IRQ2014
Ra-226	Iraq		Pods	0,11		IRQ2014
Ra-226	Iraq		Pods	0,53		IRQ2014

Ra-226	Sudan	Clay	Pods	0,63		SDN1995
Ra-226	Iraq	Clay, sand	Fruit	0,350		IRQ2014
Ra-226	Iraq	Clay, sand	Fruit	0,590		IRQ2014
Ra-226	Iraq	Clay, sand	Fruit	0,420		IRQ2014
Th-232	Iraq		Fruits	0,376		IRQ2018
Th-232	Iraq		Fruits	0,303		IRQ2018
Th-232	Iraq		Pods	0,24		IRQ2021
Th-232	Iraq		Pods	0,108		IRQ2023b
Th-232	Iraq		Pods	0,4		IRQ2014
Th-232	Iraq		Pods	0,45		IRQ2014

Red bean

Element	Country	Soil Type	Plant comp.	TF AM/GM	STD/GSD	ID
Eu-152	Egypt		Pods	0,018		EGY2016c
K-40	Egypt		Pods	0,04		EGY2016c
Th-232	Egypt		Pods	0,065		EGY2016c
U-238	Egypt		Pods	0,089		EGY2016c

Soybean

Element	Country	Soil Type	Plant comp.	TF AM/GM	STD/GSD	ID
K-40	Egypt	Clay	Pods	1,57	0,22	EGY2020b
K-40	Egypt	Sandy clay	Pods	1,98	0,27	EGY2020b
K-40	Egypt	Silt	Pods	1,11	0,16	EGY2020b
Ra-226	Egypt	Clay	Pods	0,33	0,05	EGY2020b
Ra-226	Egypt	Sandy clay	Pods	0,34	0,03	EGY2020b
Ra-226	Egypt	Silt	Pods	0,38	0,05	EGY2020b
Th-232	Egypt	Clay	Pods	0,038	0,05	EGY2020b
Th-232	Egypt	Sandy clay	Pods	0,45	0,06	EGY2020b
Th-232	Egypt	Silt	Pods	0,48	0,07	EGY2020b

White bean

Element	Country	Soil Type	Plant comp.	TF AM/GM	STD/GSD	ID
Eu-152	Egypt		Pods	0,027		EGY2016c
K-40	Egypt		Pods	0,052		EGY2016c
K-40	Turkey	Clay	Pods	0,51		TUR2024a
Pb-210	Turkey	Clay	Pods	0,012		TUR2024a
Th-232	Egypt		Pods	0,066		EGY2016c
Th-232	Turkey	Clay	Pods	0,0014		TUR2024a
U-238	Egypt		Pods	0,098		EGY2016c
U-238	Turkey	Clay	Pods	0,0031		TUR2024a

8.5 Leafy vegetables

Cabbage

Element	Country	Soil Type	Plant comp.	TF AM/GM	STD/GSD	ID
Am-241	Kazakhstan	Clay loam	Leaves	0,001		KAZ2014a
Am-241	Kazakhstan	Clay loam	Stalk	0,003		KAZ2014a
Am-241	Kazakhstan	Clay loam	Roots	0,012		KAZ2014a
Cs	Syria	Silty-loam	Leaves	0,016		SYR2006a
Cs-137	Syria	Aridisol	Leaves	0,016	1,4	SYR2021a
Cs-137	Syria	Inceptisol	Leaves	0,007	1,3	SYR2021a
Cs-137	Kazakhstan	Clay loam	Leaves	0,008		KAZ2014a
Cs-137	Kazakhstan	Clay loam	Stalk	0,014		KAZ2014a
Cs-137	Kazakhstan	Clay loam	Roots	0,059		KAZ2014a
K-40	Ethiopia	Clay	Leaves	1,800		ETH2020
K-40	Morocco	Sandy clay	Fruit	10,370		MAR2021
Pb-210	Morocco	Sandy clay	Fruit	0,060		MAR2021
Pu-239,240	Kazakhstan	Clay loam	Leaves	0,001		KAZ2014a
Pu-239,240	Kazakhstan	Clay loam	Stalk	0,022		KAZ2014a
Pu-239,240	Kazakhstan	Clay loam	Roots	0,056		KAZ2014a
Ra-226	Saudi Arabia		Leaves	0,560	0,05	SAU2018
Ra-226	Saudi Arabia		Leaves	0,820	0,07	SAU2018
Ra-226	Saudi Arabia		Leaves	1,250	0,08	SAU2018
Ra-226	Saudi Arabia		Leaves	2,170	0,2	SAU2018
Ra-226	Saudi Arabia		Leaves	1,650	0,15	SAU2018
Ra-226	Saudi Arabia		Leaves	1,640	0,1	SAU2018
Ra-226	Saudi Arabia		Leaves	1,130	0,08	SAU2018
Ra-226	Morocco	Sandy clay	Fruit	0,150		MAR2021
Sr-90	Syria	Aridisol	Leaves	2,350	1,5	SYR2021a
Sr-90	Syria	Inceptisol	Leaves	1,940	1,3	SYR2021a
Sr-90	Kazakhstan	Clay loam	Leaves	0,430		KAZ2014a
Sr-90	Kazakhstan	Clay loam	Stalk	0,033		KAZ2014a
Sr-90	Kazakhstan	Clay loam	Roots	0,059		KAZ2014a
Th-232	Ethiopia	Clay	Leaves	3,770		ETH2020
U-238	Ethiopia	Clay	Leaves	0,660		ETH2020

Chard

Element	Country	Soil Type	Plant comp.	TF AM	SD	ID
K-40	IRAQ		leaves	0,535		IRQ2018
K-40	IRAQ		leaves	0,425		IRQ2018
Ra-226	IRAQ		leaves	0,328		IRQ2018
Ra-226	IRAQ		leaves	0,376		IRQ2018
Th-232	IRAQ		Leaves	0,378		IRQ2018

Th-232	IRAQ		Leaves	0,467		IRQ2018

Chives

Element	Country	Soil Type	Plant comp.	TF AM/GM	STD/GSD	ID
Se	Iran	Field	Leaves	1,35		IRN2016

Celery

Element	Country	Soil Type	Plant comp.	TF AM/GM	STD/GSD	ID
Cs-137	IRAQ		Root	0,139		IRQ2020b
Cs-137	IRAQ		Stalk	0,135		IRQ2020b
Cs-137	IRAQ		Leaves	0,12		IRQ2020b
K-40	IRAQ		leaves	0,552		IRQ2018
K-40	IRAQ		Leaves&stems	1,76		IRQ2021
K-40	IRAQ		Root	0,903		IRQ2020b
K-40	IRAQ		Stalk	0,509		IRQ2020b
K-40	IRAQ		Leaves	0,395		IRQ2020b
Ra-226	IRAQ		leaves	0,396		IRQ2018
Th-232	IRAQ		Leaves	0,394		IRQ2018
Th-232	IRAQ		Leaves&stems	0,13		IRQ2021
Th-232	IRAQ		Root	1,061		IRQ2020b
Th-232	IRAQ		Stalk	0,88		IRQ2020b
Th-232	IRAQ		Leaves	0,615		IRQ2020b
U-238	IRAQ		Root	0,372		IRQ2020b
U-238	IRAQ		Stalk	0,272		IRQ2020b
U-238	IRAQ		Leaves	0,142		IRQ2020b

Eruca Sativa

Element	Country	Soil Type	Plant comp.	TF AM/GM	STD/GSD	ID
Ra-226	Sudan	Clay	Leaves	0,41		SDN1995

Jew's Mallow

Element	Country	Soil Type	Plant comp.	TF GM	GSD	TF AM	STD	ID
Cs-137	Syria	Aridisol	Leaves	0,25	1,3			SYR2021a
Cs-137	Syria	Inceptisol	Leaves	0,11	1,4			SYR2021a
K-40	Egypt	Clay	Leaves	0,010		0,018	0,010	EGY2017
K-40	Yemen		Leaves			0,0708		YEM2019
K-40	Yemen		Leaves			0,0704		YEM2019
K-40	Yemen		Leaves			0,0881		YEM2019
K-40	Egypt	Sandy loam	Leaves			0,032		EGY2019a
K-40	Egypt	Sandy loam	Leaves			0,0334		EGY2019a

K-40	Morocco	Sandy clay	Root			4,98		MAR2021
K-40	Morocco	Sandy clay	Leaves+Stem			6,56		MAR2021
Pb-210	Morocco	Sandy clay	Root			0,47		MAR2021
Pb-210	Morocco	Sandy clay	Leaves+Stem			0,3		MAR2021
Ra-226	Egypt	Clay	Leaves	0,019		0,033	0,016	EGY2017
Ra-226	Yemen		Leaves			0,0272		YEM2019
Ra-226	Yemen		Leaves			0,0348		YEM2019
Ra-226	Yemen		Leaves			0,0292		YEM2019
Ra-226	Egypt	Sandy loam	Leaves			0,016		EGY2019a
Ra-226	Egypt	Sandy loam	Leaves			0,018		EGY2019a
Ra-226	Morocco	Sandy clay	Root			0,09		MAR2021
Ra-226	Morocco	Sandy clay	Leaves+Stem			0,09		MAR2021
Sr-90	Syria	Aridisol	Leaves	3,03	1,1			SYR2021a
Sr-90	Syria	Inceptisol	Leaves	2,44	1,1			SYR2021a
Th-232	Yemen		Leaves			0,0055		YEM2019
Th-232	Yemen		Leaves			0,0075		YEM2019
Th-232	Egypt	Sandy loam	Leaves			0,0038		EGY2019a
Th-232	Egypt	Sandy loam	Leaves			0,0042		EGY2019a
U-238	Egypt	Clay	Leaves	0,006		0,007		EGY2017
U-238	Egypt	Sandy loam	Leaves			0,0064		EGY2019a
U-238	Egypt	Sandy loam	Leaves			0,0065		EGY2019a

Leek

Element	Country	Soil Type	Plant comp.	TF AM/GM	STD/GSD	ID
K-40	IRAQ	NA	Leaves	0,433	0,01	IRQ2019
Ra-226	IRAQ	NA	Whole Plant	0,523		IRQ2018
Th-232	IRAQ	NA	Fruits	0,271		IRQ2018

Lettuce

Element	Country	Soil Type	Plant comp.	TF AM/GM	STD/GSD	ID
Ba-133	Kuwait	Sandy	Leaves	3,59	1,81	KWT2020
Cs-134	Kuwait	Sandy	Leaves	0,16	0,04	KWT2020
Cs-137	Syria	Inceptisol	Leaves	0,114	1,2	SYR2021a
Cs-137	Iraq		Leaves	0,85		IRQ2023a
K-40	Iraq		Leaves	1,08		IRQ2023a
Ra-226	Saudi Arabia		Leaves	3,89	0,25	SAU2018
Ra-226	Saudi Arabia		Leaves	0,32	0,04	SAU2018
Ra-226	Saudi Arabia		Leaves	1,1	0,1	SAU2018
Ra-226	Saudi Arabia		Leaves	1,39	0,1	SAU2018
Ra-226	Saudi Arabia		Leaves	0,5	0,05	SAU2018
Ra-226	Saudi Arabia		Leaves	1,76	0,14	SAU2018
Ra-226	Saudi Arabia		Leaves	4	0,3	SAU2018
Ra-226	Iraq		Leaves	0,76		IRQ2023a
Sr-85	Kuwait	Sandy	Leaves	24,65	10,06	KWT2020

Sr-90	Syria	Inceptisol	Leaves	0,98	1,2	SYR2021a
Th-232	Iraq		Leaves	0,964		IRQ2023a

Onion

Element	**Country**	**Soil Type**	**Plant comp.**	**TF AM/GM**	**STD/GSD**	**ID**
Am-241	Kazakhstan	Clay loam	Leaves	0,0015		KAZ2014a
Am-241	Kazakhstan	Clay loam	Bulb	0,002		KAZ2014a
Am-241	Kazakhstan	Clay loam	Leaves	0,035		KAZ2014a
Am-241	Kazakhstan	Clay loam	Bulb	0,012		KAZ2014a
Cs-137	Iraq		Leaves	0,14		IRQ2023a
Cs-137	Kazakhstan	Clay loam	Leaves	0,0075		KAZ2014a
Cs-137	Kazakhstan	Clay loam	Bulb	0,011		KAZ2014a
Cs-137	Kazakhstan	Clay loam	Leaves	0,055		KAZ2014a
Cs-137	Kazakhstan	Clay loam	Bulb	0,042		KAZ2014a
K	Iraq	Clay, sand	Fruit	0,570		IRQ2014
K-40	Ethiopia	Clay	Leaves	1,3		ETH2020
K-40	IRAQ		Fruits	0,358		IRQ2023b
K-40	IRAQ		Fruits	0,46		IRQ2014
K-40	IRAQ		Fruits	0,59		IRQ2014
K-40	IRAQ	Sand Clay Loam	Fruit	1,141	0,152	IRQ2019
K-40	Iraq		Leaves	0,944		IRQ2023a
K-40	Yemen		Fruit	0,1044		YEM2019
K-40	Yemen		Fruit	0,0966		YEM2019
K-40	Yemen		Fruit	0,1003		YEM2019
Pu-239,240	Kazakhstan	Clay loam	Leaves	0,0049		KAZ2014a
Pu-239,240	Kazakhstan	Clay loam	Bulb	0,0092		KAZ2014a
Pu-239,240	Kazakhstan	Clay loam	Leaves	0,012		KAZ2014a
Pu-239,240	Kazakhstan	Clay loam	Bulb	0,0067		KAZ2014a
Ra-226	IRAQ		Fruits	0,104		IRQ2023b
Ra-226	IRAQ		Fruits	0,35		IRQ2014
Ra-226	IRAQ		Fruits	0,35		IRQ2014
Ra-226	IRAQ	Sand Clay Loam	Fruits	0,042	0,014	IRQ2019
Ra-226	Saudi Arabia	Silty Sand	Fruits	0,03		KSA2016
Ra-226	Saudi Arabia	Silty Sand	Leaves&stems	0,15		KSA2016
Ra-226	Saudi Arabia	Silty Sand	Roots	0,19		KSA2016
Ra-226	Iraq		Leaves	0,9		IRQ2023a
Ra-226	Iraq	Clay, sand	Fruit	0,420		IRQ2014
Ra-226	Yemen		Fruit	0,0320		YEM2019
Ra-226	Yemen		Fruit	0,0317		YEM2019
Ra-226	Yemen		Fruit	0,0319		YEM2019
Sr-90	Kazakhstan	Clay loam	Leaves	0,1		KAZ2014a
Sr-90	Kazakhstan	Clay loam	Bulb	0,47		KAZ2014a
Sr-90	Kazakhstan	Clay loam	Leaves	0,71		KAZ2014a
Sr-90	Kazakhstan	Clay loam	Bulb	0,3		KAZ2014a
Th-232	Ethiopia	Clay	Leaves	2,75		ETH2020
Th-232	IRAQ		Fruits	0,104		IRQ2023b
Th-232	IRAQ		Fruits	0,83		IRQ2014
Th-232	IRAQ	Sand Clay Loam	Fruits	0,014	0,005	IRQ2019

Th-232	Iraq		Leaves	0,93		IRQ2023a
Th-232	Yemen		Fruit	0,0091		YEM2019
Th-232	Yemen		Fruit	0,0068		YEM2019
Th-232	Yemen		Fruit	0,0078		YEM2019
U-234	Saudi Arabia	Silty Sand	Fruits	0,07		KSA2016
U-234	Saudi Arabia	Silty Sand	Leaves&stems	0,28		KSA2016
U-234	Saudi Arabia	Silty Sand	Roots	0,28		KSA2016
U-238	Ethiopia	Clay	Leaves	1,02		ETH2020
U-238	Iraq	Aridisols	Fruits	0,45		IRQ2025
U-238	Saudi Arabia	Silty Sand	Fruits	0,07		KSA2016
U-238	Saudi Arabia	Silty Sand	Leaves&stems	0,27		KSA2016
U-238	Saudi Arabia	Silty Sand	Roots	0,28		KSA2016
U-238	Iraq		Fruits	0,45		IRQ2025

Purslane (*Portulaca oleracea*)

Element	Country	Soil Type	Plant comp.	TF AM/GM	STD/GSD	ID
Ra-226	Sudan	Clay	Leaves	3,31		SDN1995

Rachad (*Cress*)

Element	Country	Soil Type	Plant comp.	TF AM/GM	STD/GSD	ID
Cs-137	Iraq		Leaves	0,68		IRQ2023a
K-40	Iraq		Leaves	1,2		IRQ2023a
Ra-226	Iraq		Leaves	1,14		IRQ2023a
Th-232	Iraq		Leaves	0,98		IRQ2023a

Spinach

Element	Country	Soil Type	Plant comp.	TF AM/GM	STD/GSD	ID
Ba-133	Kuwait	Sandy	Leaves	1,05	0,37	KWT2020
Cs	Syria		Leaves	0,014		SYR1995
Cs-134	Kuwait	Sandy	Leaves	0,13	0,03	KWT2020
Cs-137	Syria		Leaves	0,014		SYR1995
Cs-137	Syria	Aridisol	Leaves	0,014	1,1	SYR2021a
Cs-137	Syria	Inceptisol	Leaves	0,011	1,1	SYR2021a
Cs-137	Iraq		Leaves	0,89		IRQ2023a
K-40	Iraq		Leaves	1,04		IRQ2023a
Ra-226	Iraq		Leaves	0,74		IRQ2023a
Sr-85	Kuwait	Sandy	Leaves	7,7	2,08	KWT2020
Sr-90	Syria	Aridisol	Leaves	1,04	1	SYR2021a
Sr-90	Syria	Inceptisol	Leaves	0,83	1,1	SYR2021a
Th-232	Iraq		Leaves	0,95		IRQ2023a

Vine leaves

Element	Country	Soil Type	Plant comp.	TF AM/GM	STD/GSD	ID
Cs-137	Syria		Leaves	0,04		SYR1995
Cs-137	Syria		Leaves	0,013		SYR1995

Watercress

Element	Country	Soil Type	Plant comp.	TF AM/GM	STD/GSD	ID
Cs-137	Iraq		Leaves	0,824		IRQ2023a
K-40	Iraq		Leaves	0,95		IRQ2023a
Ra-226	Iraq		Leaves	0,85		IRQ2023a
Th-232	Iraq		Leaves	0,867		IRQ2023a

8.6 Grass and herbs

Mixed pasture grass

Element	Country	Soil Type	Plant comp.	TF GM	TF GSD	TF AM	SD	ID
Am-241	Kazakhstan	Clay	Stem	0,006	4,200	0,025	0,086	KAZ2018
Am-241	Kazakhstan	Clay	Stem	0,001	3,800	0,002	0,008	KAZ2018
Cs-137	Kazakhstan	Clay		0,034	2,600	0,052	0,050	KAZ2018
Cs-137	Kazakhstan	Clay		0,003	3,600	0,006	0,010	KAZ2018
Cs-137	Kazakhstan	Clay		0,020	3,100	0,042	0,068	KAZ2018
Cs-137	Kazakhstan	Clay		0,063	2,800	0,100	0,100	KAZ2018
Cs-137	Iraq					0,025		IRQ2017a
Cs-137	Kazakhstan	Clay		0,200	7,300	1,070	2,400	KAZ2018
Cs-137	Kazakhstan	Clay		0,014	2,600	0,020	0,016	KAZ2018
Cs-137	Egypt	Sandy clay loam	Stem	0,021	1,100	0,021	0,001	EGY2021a
Cs-137	Egypt	Sandy clay loam	Stem	0,028	1,100	0,028	0,001	EGY2021a
Cs-137	Egypt	Sandy clay loam	Stem	0,015	1,000	0,015	0,001	EGY2021a
Cs-137	Egypt	Sandy clay loam	Roots	0,010	1,100	0,010	0,001	EGY2021a
Cs-137	Palestine	Clay	Stems			0,560		PSE2014
Cs-137	Palestine	Clay	Stems			0,280		PSE2014
Cs-137	Palestine	Clay	Stems			0,360		PSE2014
Cs-137	Palestine	Clay	Stems			0,080		PSE2014
K-40	Iraq					2,577		IRQ2017a
K-40	Iraq					3,406		IRQ2017a
K-40	Iraq					1,510		IRQ2017a
K-40	Iraq					1,007		IRQ2017a
K-40	Iraq					1,615		IRQ2017a
K-40	Iraq					2,155		IRQ2017a
K-40	Iraq					4,921		IRQ2017a
K-40	Iraq					5,172		IRQ2017a
K-40	Iraq					0,942		IRQ2017a
K-40	Iraq					1,154		IRQ2017a
K-40	Egypt	Loamy clay				1,060		EGY2014
K-40	Palestine	Clay	Stems			1,340		PSE2014
K-40	Palestine	Clay	Stems			0,610		PSE2014
K-40	Palestine	Clay	Stems			0,360		PSE2014
K-40	Palestine	Clay	Stems			0,590		PSE2014
K-40	Palestine	Clay	Stems			0,960		PSE2014
K-40	Palestine	Clay	Stems			1,930		PSE2014
K-40	Palestine	Clay	Stems			0,770		PSE2014

K-40	Palestine	Clay	Stems			0,660		PSE2014
K-40	Palestine	Clay	Stems			2,900		PSE2014
K-40	Palestine	Clay	Stems			1,880		PSE2014
Pu-239,240	Kazakhstan	Clay		0,018	3,600	0,031	0,031	KAZ2018
Pu-239,240	Kazakhstan	Clay		0,007	6,600	0,024	0,051	KAZ2018
Pu-239,240	Kazakhstan	Clay		0,024	2,100	0,033	0,031	KAZ2018
Pu-239,240	Kazakhstan	Clay		0,001	5,600	0,006	0,018	KAZ2018
Pu-239,240	Kazakhstan	Clay		0,006	5,900	0,021	0,034	KAZ2018
Pu-239,240	Kazakhstan	Clay		0,018	4,100	0,042	0,060	KAZ2018
Ra-226	Libya			1,506		1,632	0,612	
Ra-226	Egypt	Loamy clay				0,430	0,016	EGY2014
Ra-226	Egypt	Loamy clay				0,320		EGY2014
Ra-226	Palestine	Clay	Stems			0,540		PSE2014
Ra-226	Palestine	Clay	Stems			0,290		PSE2014
Ra-226	Palestine	Clay	Stems			2,150		PSE2014
Ra-226	Palestine	Clay	Stems			0,270		PSE2014
Ra-226	Palestine	Clay	Stems			0,660		PSE2014
Ra-226	Palestine	Clay	Stems			2,120		PSE2014
Ra-226	Palestine	Clay	Stems			1,870		PSE2014
Ra-226	Palestine	Clay	Stems			1,810		PSE2014
Ra-226	Palestine	Clay	Stems			0,820		PSE2014
Ra-226	Palestine	Clay	Stems			2,100		PSE2014
Sr-85	Egypt	Sandy clay loam	Stem	0,098	1,000	0,098	0,003	EGY2021a
Sr-85	Egypt	Sandy clay loam	Stem	0,120	1,100	0,120	0,003	EGY2021a
Sr-85	Egypt	Sandy clay loam	Roots	0,007	1,000	0,007	0,000	EGY2021a
Sr-86	Egypt	Sandy clay loam	Stem	0,014	1,100	0,015	0,001	EGY2021a
Sr-90	Kazakhstan	Clay		1,700	2,100	2,300	2,800	KAZ2018
Sr-90	Kazakhstan	Clay		0,023	3,600	0,065	0,160	KAZ2018
Sr-90	Kazakhstan	Clay		0,026	2,700	0,040	0,041	KAZ2018
Sr-90	Kazakhstan	Clay		0,530	3,400	0,810	0,820	KAZ2018
Sr-90	Kazakhstan	Clay		0,220	0,220	0,390	0,290	KAZ2018
Th232	Palestine	Clay	Stems			2,220		PSE2014
Th232	Palestine	Clay	Stems			4,970		PSE2014
Th232	Palestine	Clay	Stems			0,100		PSE2014
Th232	Palestine	Clay	Stems			0,350		PSE2014
Th232	Palestine	Clay	Stems			0,210		PSE2014
Th232	Palestine	Clay	Stems			0,930		PSE2014
Th232	Palestine	Clay	Stems			0,140		PSE2014
Th232	Palestine	Clay	Stems			0,170		PSE2014
Th232	Palestine	Clay	Stems			1,710		PSE2014
Th232	Palestine	Clay	Stems			0,570		PSE2014
Th-232	Iraq					1,250		IRQ2017a

Th-232	Iraq					0,120		IRQ2017a
Th-232	Iraq					0,100		IRQ2017a
Th-232	Iraq					0,120		IRQ2017a
Th-232	Iraq					1,250		IRQ2017a
Th-232	Iraq					0,110		IRQ2017a
Th-232	Iraq					0,170		IRQ2017a
Th-232	Iraq					0,140		IRQ2017a
Th-232	Iraq					1,250		IRQ2017a
Th-232	Iraq					0,170		IRQ2017a
Th-232	Egypt	Loamy clay				0,310		EGY2014
Th-232	Libya			2,214		2,263	0,497	
U-235	Palestine	Clay	Stems			1,170		PSE2014
U-235	Palestine	Clay	Stems			0,630		PSE2014
U-235	Palestine	Clay	Stems			1,620		PSE2014
U-235	Palestine	Clay	Stems			0,360		PSE2014
U-235	Palestine	Clay	Stems			0,650		PSE2014
U-235	Palestine	Clay	Stems			1,590		PSE2014
U-235	Palestine	Clay	Stems			1,390		PSE2014
U-235	Palestine	Clay	Stems			1,030		PSE2014
U-238	Iraq	sand				0,001		IRQ2017a
U-238	Iraq	sand				0,000		IRQ2017a
U-238	Iraq	sand				0,002		IRQ2017a
U-238	Iraq	sand				0,005		IRQ2017a
U-238	Iraq	sand				0,244		IRQ2017a
U-238	Iraq	sand				0,026		IRQ2017a
U-238	Iraq	sand				0,001		IRQ2017a
U-238	Iraq	sand				0,000		IRQ2017a
U-238	Iraq	sand				0,009		IRQ2017a
U-238	Iraq	sand				0,217		IRQ2017a
U-238	Libya	Clay		1,521		1,630	0,584	

Coriander

Element	**Country**	**Soil Type**	**Plant comp.**	**TF AM/GM**	**TF STD/GSD**	**ID**
Pb-210	Syria	Clay	Leaves	0,07	1,06	SYR2021b
Pb-237	Syria		Oil	0,363		SYR2015a
Po-210	Syria		Oil	0,34		SYR2015a
Po-210	Syria	Clay	Leaves	0,08	1,39	SYR2021b
Ra-226	Syria	Clay	Leaves	0,27	1,09	SYR2021b
Rn-220	Morocco	Clay Loam Sand	Root	0,0042		MAR2013
Rn-220	Morocco	Clay Loam Sand	Stem	0,0027		MAR2013
Rn-220	Morocco	Clay Loam Sand	Leaf	0,00131		MAR2013

Rn-220	Morocco	Clay Loam Sand	Seed	0,00087		MAR2013
Rn-222	Morocco	Clay Loam Sand	Root	0,065		MAR2013
Rn-222	Morocco	Clay Loam Sand	Stem	0,0341		MAR2013
Rn-222	Morocco	Clay Loam Sand	Leaf	0,0193		MAR2013
Rn-222	Morocco	Clay Loam Sand	Seed	0,0112		MAR2013
Th-232	Morocco	clay loam Sand	Root	0,182		MAR2011
Th-232	Morocco	clay loam Sand	Stem	0,118		MAR2011
Th-232	Morocco	clay loam Sand	Leaf	0,141		MAR2011
Th-232	Morocco	clay loam Sand	Seed	0,083		MAR2011
Th234	Syria	Clay	Leaves	1,14	1,58	SYR2021b
U-238	Syria	Clay	Leaves	2,5	1,33	SYR2021b
U-238	Morocco	clay loam Sand	Root	0,086		MAR2011
U-238	Morocco	clay loam Sand	Stem	0,0513		MAR2011
U-238	Morocco	clay loam Sand	Leaf	0,0615		MAR2011
U-238	Morocco	clay loam Sand	Seed	0,0433		MAR2011

Mint

Element	Country	Soil Type	Plant comp.	TF AM/GM	TF STD/GSD	ID
Rn-220	Morocco	Clay Loam Sand	Root	0,00476		MAR2013
Rn-220	Morocco	Clay Loam Sand	Stem	0,00198		MAR2013
Rn-220	Morocco	Clay Loam Sand	Leaf	0,00137		MAR2013
Rn-222	Morocco	Clay Loam Sand	Root	0,0631		MAR2013
Rn-222	Morocco	Clay Loam Sand	Stem	0,0321		MAR2013
Rn-222	Morocco	Clay Loam Sand	Leaf	0,0187		MAR2013
Th-232	Morocco		Whole plant	0,74		MAR2000
Th-232	Morocco	clay loam Sand	Root	0,182		MAR2011
Th-232	Morocco	clay loam Sand	Stem	0,118		MAR2011
Th-232	Morocco	clay loam Sand	Leaf	0,142		MAR2011
U-238	Morocco		Whole plant	0,76		MAR2000
U-238	Morocco	clay loam Sand	Root	0,0861		MAR2011
U-238	Morocco	clay loam Sand	Stem	0,0512		MAR2011
U-238	Morocco	clay loam Sand	Leaf	0,0617		MAR2011

Oregano

Element	Country	Soil Type	Plant comp.	TF AM/GM	TF STD/GSD	ID
Th-232	Morocco	clay loam Sand	Root	0,181	0,014	MAR2011
Th-232	Morocco	clay loam Sand	Stem	0,117	0,008	MAR2011
Th-232	Morocco	clay loam Sand	Leaf	0,14	0,01	MAR2011
Th-232	Morocco	Calcareous	flower	0,09		MAR2009
Th-232	Morocco	Calcareous	nectar solution	0,71		MAR2009
Th-232	Morocco	Calcareous	Honey	0,93		MAR2009
Th-232	Morocco		Whole plant	0,61		MAR2000
U-238	Morocco	clay loam Sand	Root	0,086	0,0052	MAR2011

U-238	Morocco	clay loam Sand	Stem	0,051	0,0034	MAR2011
U-238	Morocco	clay loam Sand	Leaf	0,0616	0,0054	MAR2011
U-238	Morocco	Calcareous	flower	0,06		MAR2009
U-238	Morocco	Calcareous	nectar solution	0,57		MAR2009
U-238	Morocco	Calcareous	Honey	0,9		MAR2009
U-238	Morocco		Whole plant	0,51		MAR2000

Parsley

Element	**Country**	**Soil Type**	**Plant comp.**	**TF AM/GM**	**STD/GSD**	**ID**
Am-241	Kazakhstan	Clay loam	Leaves	0,0038		KAZ2014a
Am-241	Kazakhstan	Clay loam	Roots	0,0018		KAZ2014a
Ba-133	Kuwait	Sandy	Leaves	4,58	2,27	KWT2020
Cs-134	Kuwait	Sandy	Leaves	0,31	0,15	KWT2020
Cs-137	Iraq		Leaves	0,75		IRQ2023a
Cs-137	Kazakhstan	Clay loam	Leaves	0,022		KAZ2014a
Cs-137	Kazakhstan	Clay loam	Roots	0,012		KAZ2014a
K-40	IRAQ	NA	leaves	0,496		IRQ2018
K-40	Iraq		Leaves	0,99		IRQ2023a
Pb-210	Syria	Clay	Leaves	0,03	4,85	SYR2021b
Po-210	Syria		Leaves	0,2	0,08	SYR2010
Po-210	Syria		Leaves	0,3	0,08	SYR2010
Po-210	Syria		Stems	0,26	0,01	SYR2010
Po-210	Syria		Stems	0,5	0,14	SYR2010
Po-210	Syria	Clay	Leaves	0,02	2,83	SYR2021b
Ra-226	Syria	Clay	Leaves	0,13	2,61	SYR2021b
Ra-226	IRAQ	NA	Leaves	0,4		IRQ2018
Ra-226	Iraq		Leaves	0,91		IRQ2023a
Rn-220	Morocco	Clay Loam Sand	Root	0,00469		MAR2013
Rn-220	Morocco	Clay Loam Sand	Stem	0,00285		MAR2013
Rn-220	Morocco	Clay Loam Sand	Leaf	0,00127		MAR2013
Rn-220	Morocco	Clay Loam Sand	Seed	0,00102		MAR2013
Rn-222	Morocco	Clay Loam Sand	Root	0,0661		MAR2013
Rn-222	Morocco	Clay Loam Sand	Stem	0,0331		MAR2013
Rn-222	Morocco	Clay Loam Sand	Leaf	0,02		MAR2013
Rn-222	Morocco	Clay Loam Sand	Seed	0,0129		MAR2013
Sr-85	Kuwait	Sandy	Leaves	18,31	5,26	KWT2020
Sr-90	Kazakhstan	Clay loam	Leaves	0,15		KAZ2014a
Sr-90	Kazakhstan	Clay loam	Roots	0,05		KAZ2014a
Th-232	Iraq		Leaves	0,77		IRQ2023a
Th-232	Morocco	clay loam Sand	Root	0,183		MAR2011
Th-232	Morocco	clay loam Sand	Stem	0,116		MAR2011
Th-232	Morocco	clay loam Sand	Leaf	0,141		MAR2011
Th-232	Morocco	clay loam Sand	Seed	0,083		MAR2011
Th234	Syria	Clay	Leaves	3,81	1,8	SYR2021b

U-238	Syria	Clay	Leaves	3,23	2,11	SYR2021b
U-238	Morocco	clay loam Sand	Root	0,0865		MAR2011
U-238	Morocco	clay loam Sand	Stem	0,0516		MAR2011
U-238	Morocco	clay loam Sand	Leaf	0,062		MAR2011
U-238	Morocco	clay loam Sand	Seed	4,3		MAR2011

Rosemary

Element	Country	Soil Type	Plant comp.	TF AM/GM	STD/GSD	ID
Rn-220	Morocco	Clay Loam Sand	Root	0,00487		MAR2013
Rn-220	Morocco	Clay Loam Sand	Stem	0,00286		MAR2013
Rn-220	Morocco	Clay Loam Sand	Leaf	0,00135		MAR2013
Rn-222	Morocco	Clay Loam Sand	Root	0,0662		MAR2013
Rn-222	Morocco	Clay Loam Sand	Stem	0,0365		MAR2013
Rn-222	Morocco	Clay Loam Sand	Leaf	0,0251		MAR2013
Th-232	Morocco	clay loam Sand	Root	0,181		MAR2011
Th-232	Morocco	clay loam Sand	Stem	0,118		MAR2011
Th-232	Morocco	clay loam Sand	Leaf	0,142		MAR2011
Th-232	Morocco	Calcareous	Flower	0,08		MAR2009
Th-232	Morocco	Calcareous	Nectar solution	0,78		MAR2009
Th-232	Morocco	Calcareous	Honey	0,95		MAR2009
U-238	Morocco	clay loam Sand	Root	0,0863		MAR2011
U-238	Morocco	clay loam Sand	Stem	0,0512		MAR2011
U-238	Morocco	clay loam Sand	Leaf	0,0615		MAR2011
U-238	Morocco	Calcareous	Flower	0,076		MAR2009
U-238	Morocco	Calcareous	Nectar solution	0,71		MAR2009
U-238	Morocco	Calcareous	Honey	0,95		MAR2009

Thyme

Element	Country	Soil Type	Plant comp.	TF AM/GM	STD/GSD	ID
Cs-137	Palestine	Clay	Leaves	0,77		PSE2014
Cs-137	Palestine	Clay	Leaves	0,33		PSE2014
Cs-137	Palestine	Clay	Leaves	0,07		PSE2014
K-40	Palestine	Clay	Leaves	13,8		PSE2014
K-40	Palestine	Clay	Leaves	16,3		PSE2014
K-40	Palestine	Clay	Leaves	1,7		PSE2014
Ra-226	Palestine	Clay	Leaves	0,8		PSE2014
Ra-226	Palestine	Clay	Leaves	0,96		PSE2014
Ra-226	Palestine	Clay	Leaves	0,68		PSE2014
Rn-220	Morocco	Clay Loam Sand	Root	0,0045		MAR2013
Rn-220	Morocco	Clay Loam Sand	Stem	0,0025		MAR2013

Rn-220	Morocco	Clay Loam Sand	Leaf	0,0013		MAR2013
Rn-222	Morocco	Clay Loam Sand	Root	0,0617		MAR2013
Rn-222	Morocco	Clay Loam Sand	Stem	0,0336		MAR2013
Rn-222	Morocco	Clay Loam Sand	Leaf	0,0183		MAR2013
Th-232	Palestine	Clay	Leaves	0,31		PSE2014
Th-232	Palestine	Clay	Leaves	0,35		PSE2014
Th-232	Palestine	Clay	Leaves	0,31		PSE2014
Th-232	Morocco	clay loam Sand	Root	0,183		MAR2011
Th-232	Morocco	clay loam Sand	Stem	0,117		MAR2011
Th-232	Morocco	clay loam Sand	Leaf	0,141		MAR2011
U-238	Palestine	Clay	Leaves	0,65		PSE2014
U-238	Palestine	Clay	Leaves	0,98		PSE2014
U-238	Palestine	Clay	Leaves	0,55		PSE2014
U-238	Morocco	clay loam Sand	Root	0,086		MAR2011
U-238	Morocco	clay loam Sand	Stem	0,0515		MAR2011
U-238	Morocco	clay loam Sand	Leaf	0,0615		MAR2011

8.7 Medicinal plants

Element	**Country**	**Soil Type**	***Plant Name***	**Plant comp.**	**TF AM/GM**	**STD/GSD**	**ID**
U-238	Morocco	Calcareous	*Ammi Visnaga*	flower	5,23E-05		MAR2009
Th-232	Morocco	Calcareous	*Ammi Visnaga*	flower	8,48E-05		MAR2009
Rn-222	Morocco	Calcareous	*Ammi Visnaga*	flower	5,23E-05		MAR2009
Rn-220	Morocco	Calcareous	*Ammi Visnaga*	flower	8,45E-05		MAR2009
U-238	Morocco	Argillous	*Ammi Visnaga*	nectar solution	2,89E-05		MAR2009
Th-232	Morocco	Argillous	*Ammi Visnaga*	nectar solution	6,01E-05		MAR2009
Rn-222	Morocco	Argillous	*Ammi Visnaga*	nectar solution	2,89E-05		MAR2009
Rn-220	Morocco	Argillous	*Ammi Visnaga*	nectar solution	5,98E-05		MAR2009
U-238	Morocco	Calcareous	*Ammi Visnaga*	Honey	0,000022		MAR2009
Th-232	Morocco	Calcareous	*Ammi Visnaga*	Honey	0,000053		MAR2009
Rn-222	Morocco	Calcareous	*Ammi Visnaga*	Honey	0,000022		MAR2009
Rn-220	Morocco	Calcareous	*Ammi Visnaga*	Honey	5,28E-05		MAR2009
U-238	Morocco		*Verbena officinalis*	Whole plant	0,81		MAR2000
Th-232	Morocco		*Verbena officinalis*	Whole plant	0,78		MAR2000
U-238	Morocco		*Artemisia*	Whole plant	0,48		MAR2000
Th-232	Morocco		*Artemisia*	Whole plant	0,71		MAR2000
U-238	Morocco	clay loam Sand	*Artemisia absinthium*	Root	0,0863		MAR2011
Th-232	Morocco	clay loam Sand	*Artemisia absinthium*	Root	0,181		MAR2011
U-238	Morocco	clay loam Sand	*Artemisia absinthium*	Stem	0,0512		MAR2011
Th-232	Morocco	clay loam Sand	*Artemisia absinthium*	Stem	0,118		MAR2011
U-238	Morocco	clay loam Sand	*Artemisia absinthium*	Leaf	0,061		MAR2011
Th-232	Morocco	clay loam Sand	*Artemisia absinthium*	Stem	0,142		MAR2011
U-238	Morocco		*Artemisia absinthium*	Whole plant	0,65		MAR2000
Th-232	Morocco		*Artemisia absinthium*	Whole plant	0,54		MAR2000
Rn-222	Morocco	Clay Loam Sand	*Artemisia absinthium L.*	Leaf	0,0241		MAR2013

Rn-220	Morocco	Clay Loam Sand	*Artemisia absinthium L.*	Leaf	0,00134		MAR2013
Rn-220	Morocco	Clay Loam Sand	*Artemisia absinthium L.*	Root	0,00477		MAR2013
Rn-222	Morocco	Clay Loam Sand	*Artemisia absinthium L.*	Root	0,0651		MAR2013
Rn-222	Morocco	Clay Loam Sand	*Artemisia absinthium L.*	Stem	0,036		MAR2013
U-238	Morocco	clay loam Sand	*Artemisia herba-alba Asso*	Root	0,0861		MAR2011
Th-232	Morocco	clay loam Sand	*Artemisia herba-alba Asso*	Root	0,182		MAR2011
U-238	Morocco	clay loam Sand	*Artemisia herba-alba Asso*	Stem	0,0511		MAR2013
Th-232	Morocco	clay loam Sand	*Artemisia herba-alba Asso*	Stem	0,114		MAR2013
U-238	Morocco	clay loam Sand	*Artemisia herba-alba Asso*	Leaf	0,0615		MAR2013
Th-232	Morocco	clay loam Sand	*Artemisia herba-alba Asso*	Leaf	0,141		MAR2013
U-238	Morocco	Argillous	*Calendula officinalis*	flower	5,12E-05		MAR2009
Th-232	Morocco	Argillous	*Calendula officinalis*	flower	7,51E-05		MAR2009
Rn-222	Morocco	Argillous	*Calendula officinalis*	flower	5,11E-05		MAR2009
Rn-220	Morocco	Argillous	*Calendula officinalis*	flower	7,49E-05		MAR2009
U-238	Morocco	Argillous	*Calendula officinalis*	nectar solution	2,71E-05		MAR2009
Th-232	Morocco	Argillous	*Calendula officinalis*	nectar solution	5,26E-05		MAR2009
U-238	Morocco	Argillous	*Calendula officinalis*	Honey	2,26E-05		MAR2009
Th-232	Morocco	Argillous	*Calendula officinalis*	Honey	4,13E-05		MAR2009
U-238	Morocco	clay loam Sand	*Chenopodium ambrosioides L.*	Root	0,0861		MAR2011
Th-232	Morocco	clay loam Sand	*Chenopodium ambrosioides L.*	Root	0,181		MAR2011
U-238	Morocco	clay loam Sand	*Chenopodium ambrosioides L.*	Stem	0,0517		MAR2011
Th-232	Morocco	clay loam Sand	*Chenopodium ambrosioides L.*	Stem	0,117		MAR2011
U-238	Morocco	clay loam Sand	*Chenopodium ambrosioides L.*	Leaf	0,0614		MAR2011
Th-232	Morocco	clay loam Sand	*Chenopodium ambrosioides L.*	Leaf	0,142		MAR2011
Rn-222	Morocco	Clay Loam Sand	*Chenopodium ambrosioides L.*	Root	0,0651		MAR2013
Rn-220	Morocco	Clay Loam Sand	*Chenopodium ambrosioides L.*	Root	0,00471		MAR2013
Rn-222	Morocco	Clay Loam Sand	*Chenopodium ambrosioides L.*	Stem	0,038		MAR2013
Rn-220	Morocco	Clay Loam Sand	*Chenopodium ambrosioides L.*	Stem	0,00224		MAR2013

Rn-222	Morocco	Clay Loam Sand	*Chenopodium ambrosioides L.*	Leaf	0,0244		MAR2013
Rn-220	Morocco	Clay Loam Sand	*Chenopodium ambrosioides L.*	Leaf	0,00137		MAR2013
U-238	Morocco	clay loam Sand	*Citrullus colocynthis (L.)*	Root	0,086		MAR2011
Th-232	Morocco	clay loam Sand	*Citrullus colocynthis (L.)*	Root	0,183		MAR2011
U-238	Morocco	clay loam Sand	*Citrullus colocynthis (L.)*	Stem	0,0513		MAR2011
Th-232	Morocco	clay loam Sand	*Citrullus colocynthis (L.)*	Stem	0,118		MAR2011
U-238	Morocco	clay loam Sand	*Citrullus colocynthis (L.)*	Leaf	0,0615		MAR2011
U-238	Morocco	clay loam Sand	*Citrullus colocynthis (L.)*	Fruit	0,04321		MAR2011
Th-232	Morocco	clay loam Sand	*Citrullus colocynthis (L.)*	Fruit	0,083		MAR2011
Rn-222	Morocco	Clay Loam Sand	*Citrullus colocynthis (L.)*	Root	0,0641		MAR2011
Rn-220	Morocco	Clay Loam Sand	*Citrullus colocynthis (L.)*	Root	0,0044		MAR2011
Rn-222	Morocco	Clay Loam Sand	*Citrullus colocynthis (L.)*	Stem	0,035		MAR2011
Rn-220	Morocco	Clay Loam Sand	*Citrullus colocynthis (L.)*	Stem	0,0029		MAR2011
Rn-222	Morocco	Clay Loam Sand	*Citrullus colocynthis (L.)*	Leaf	0,0212		MAR2011
Rn-220	Morocco	Clay Loam Sand	*Citrullus colocynthis (L.)*	Leaf	0,00134		MAR2011
Rn-222	Morocco	Clay Loam Sand	*Citrullus colocynthis (L.)*	Fruit	0,0121		MAR2011
Rn-220	Morocco	Clay Loam Sand	*Citrullus colocynthis (L.)*	Fruit	0,00106		MAR2011
Rn-222	Morocco	Clay Loam Sand	*Dysphania ambrosioides*	Root	0,0651		MAR2013
Rn-220	Morocco	Clay Loam Sand	*Dysphania ambrosioides*	Root	0,00425		MAR2013
Rn-222	Morocco	Clay Loam Sand	*Dysphania ambrosioides*	Stem	0,0342		MAR2013
Rn-220	Morocco	Clay Loam Sand	*Dysphania ambrosioides*	Stem	0,00268		MAR2013
Rn-222	Morocco	Clay Loam Sand	*Dysphania ambrosioides*	Leaf	0,0223		MAR2013
Rn-220	Morocco	Clay Loam Sand	*Dysphania ambrosioides*	Leaf	0,0013		MAR2013
U-238	Morocco	Phosphatic	*Eucalyptus*	flower	0,05		MAR2009
Th-232	Morocco	Phosphatic	*Eucalyptus*	flower	0,07		MAR2009
U-238	Morocco	Phosphatic	*Eucalyptus*	nectar solution	0,5		MAR2009

Th-232	Morocco	Phosphatic	*Eucalyptus*	nectar solution	0,73		MAR2009
U-238	Morocco	Phosphatic	*Eucalyptus*	Honey	0,86		MAR2009
Th-232	Morocco	Phosphatic	*Eucalyptus*	Honey	0,86		MAR2009
U-238	Morocco	Calcareous	*Euphorbe cactoide*	flower	0,08		MAR2009
Th-232	Morocco	Calcareous	*Euphorbe cactoide*	flower	0,08		MAR2009
U-238	Morocco	Calcareous	*Euphorbe cactoide*	nectar solution	0,71		MAR2009
Th-232	Morocco	Calcareous	*Euphorbe cactoide*	nectar solution	0,77		MAR2009
U-238	Morocco	Calcareous	*Euphorbe cactoide*	Honey	0,9		MAR2009
Th-232	Morocco	Calcareous	*Euphorbe cactoide*	Honey	0,93		MAR2009
U-238	Morocco	Calcareous	*Euphorbe resinefere*	nectar solution	0,08		MAR2009
Th-232	Morocco	Calcareous	*Euphorbe resinefere*	nectar solution	0,08		MAR2009
U-238	Morocco	Calcareous	*Euphorbe resinefere*	Honey	0,74		MAR2009
Th-232	Morocco	Calcareous	*Euphorbe resinefere*	Honey	0,79		MAR2009
U-238	Morocco	Calcareous	*Euphorbe resinefereya*	flower	0,95		MAR2009
Th-232	Morocco	Calcareous	*Euphorbe resinefereya*	flower	0,95		MAR2009
U-238	Morocco	Argillous	*Feuilno*	flower	0,08		MAR2009
Th-232	Morocco	Argillous	*Feuilno*	flower	0,08		MAR2009
U-238	Morocco	Argillous	*Feuilno*	nectar solution	0,77		MAR2009
Th-232	Morocco	Argillous	*Feuilno*	nectar solution	0,76		MAR2009
U-238	Morocco	Argillous	*Feuilno*	Honey	0,89		MAR2009
Th-232	Morocco	Argillous	*Feuilno*	Honey	0,95		MAR2009
U-238	Morocco	Calcareous	*Lemon tree*	flower	0,06		MAR2009
Th-232	Morocco	Calcareous	*Lemon tree*	flower	0,08		MAR2009
U-238	Morocco	Calcareous	*Lemon tree*	nectar solution	0,85		MAR2009
Th-232	Morocco	Calcareous	*Lemon tree*	nectar solution	0,88		MAR2009
U-238	Morocco	Calcareous	*Lemon tree*	Honey	0,66		MAR2009
Th-232	Morocco	Calcareous	*Lemon tree*	Honey	0,79		MAR2009
U-238	Morocco	clay loam Sand	*Lippia citrodora L.*	Root	0,0861		MAR2011
Th-232	Morocco	clay loam Sand	*Lippia citrodora L.*	Root	0,18		MAR2011
U-238	Morocco	clay loam Sand	*Lippia citrodora L.*	Stem	0,0513		MAR2011
Th-232	Morocco	clay loam Sand	*Lippia citrodora L.*	Stem	0,116		MAR2011
U-238	Morocco	clay loam Sand	*Lippia citrodora L.*	Leaf	0,0612		MAR2011
Th-232	Morocco	clay loam Sand	*Lippia citrodora L.*	Leaf	0,141		MAR2011
U-238	Morocco	clay loam Sand	*Marrubium vulgare*	Root	0,0861		MAR2011

Th-232	Morocco	clay loam Sand	*Marrubium vulgare*	Root	0,181		MAR2011
U-238	Morocco	clay loam Sand	*Marrubium vulgare*	Stem	0,0512		MAR2011
Th-232	Morocco	clay loam Sand	*Marrubium vulgare*	Stem	0,117		MAR2011
U-238	Morocco	clay loam Sand	*Marrubium vulgare*	Leaf	0,0616		MAR2011
Th-232	Morocco	clay loam Sand	*Marrubium vulgare*	Leaf	0,14		MAR2011
Rn-222	Morocco	Clay Loam Sand	*Marrubium vulgare*	Root	0,0663		MAR2013
Rn-220	Morocco	Clay Loam Sand	*Marrubium vulgare*	Root	0,00485		MAR2013
Rn-222	Morocco	Clay Loam Sand	*Marrubium vulgare*	Stem	0,0357		MAR2013
Rn-220	Morocco	Clay Loam Sand	*Marrubium vulgare*	Stem	0,263		MAR2013
Rn-222	Morocco	Clay Loam Sand	*Marrubium vulgare*	Leaf	0,0207		MAR2013
Rn-220	Morocco	Clay Loam Sand	*Marrubium vulgare*	Leaf	0,00136		MAR2013
U-238	Morocco	clay loam Sand	*Nerium oleander L.*	Root	0,086	0,0051	MAR2011
0,014	Morocco	clay loam Sand	*Nerium oleander L.*	Root	0,181	0,014	MAR2011
U-238	Morocco	clay loam Sand	*Nerium oleander L.*	Stem	0,051	0,0031	MAR2011
Th-232	Morocco	clay loam Sand	*Nerium oleander L.*	Stem	0,118	0,009	MAR2011
U-238	Morocco	clay loam Sand	*Nerium oleander L.*	Leaf	0,0615	0,0053	MAR2011
Th-232	Morocco	clay loam Sand	*Nerium oleander L.*	Leaf	0,141	0,011	MAR2011
U-238	Morocco	Argillous	*Nigella sativa*	flower	0,05		MAR2009
Th-232	Morocco	Argillous	*Nigella sativa*	flower	0,08		MAR2009
U-238	Morocco	Argillous	*Nigella sativa*	nectar solution	0,48		MAR2009
Th-232	Morocco	Argillous	*Nigella sativa*	nectar solution	0,7		MAR2009
U-238	Morocco	Argillous	*Nigella sativa*	Honey	0,87		MAR2009
Th-232	Morocco	Argillous	*Nigella sativa*	Honey	0,87		MAR2009
Rn-222	Morocco	Clay Loam Sand	*Peganum harmala*	Root	0,0623		MAR2011
Rn-220	Morocco	Clay Loam Sand	*Peganum harmala*	Root	0,00457		MAR2011
Rn-222	Morocco	Clay Loam Sand	*Peganum harmala*	Stem	0,034		MAR2011
Rn-220	Morocco	Clay Loam Sand	*Peganum harmala*	Stem	0,00271		MAR2011
Rn-222	Morocco	Clay Loam Sand	*Peganum harmala*	Leaf	0,0232		MAR2011
Rn-220	Morocco	Clay Loam Sand	*Peganum harmala*	Leaf	0,00127		MAR2011
Rn-222	Morocco	Clay Loam Sand	*Peganum harmala*	Seed	0,014		MAR2011
Rn-220	Morocco	Clay Loam Sand	*Peganum harmala*	Seed	0,00104		MAR2011
U-238	Morocco	clay loam Sand	*Peganum harmala*	Root	0,0863		MAR2011
Th-232	Morocco	clay loam Sand	*Peganum harmala*	Root	0,182		MAR2011
U-238	Morocco	clay loam Sand	*Peganum harmala*	Stem	0,0512		MAR2011
Th-232	Morocco	clay loam Sand	*Peganum harmala*	Stem	0,117		MAR2011
U-238	Morocco	clay loam Sand	*Peganum harmala*	Leaf	0,0615		MAR2011
Th-232	Morocco	clay loam Sand	*Peganum harmala*	Leaf	0,141		MAR2011
U-238	Morocco	clay loam Sand	*Peganum harmala*	Seed	0,0431		MAR2011
Th-232	Morocco	clay loam Sand	*Peganum harmala*	Seed	0,083		MAR2011
Rn-222	Morocco	Clay Loam Sand	*Retama sphaerocarpa L.*	Root	0,0661		MAR2013
Rn-220	Morocco	Clay Loam Sand	*Retama sphaerocarpa L.*	Root	0,00453		MAR2013

Rn-222	Morocco	Clay Loam Sand	*Retama sphaerocarpa L.*	Stem	0,0365		MAR2013
Rn-220	Morocco	Clay Loam Sand	*Retama sphaerocarpa L.*	Stem	0,00274		MAR2013
Rn-222	Morocco	Clay Loam Sand	*Retama sphaerocarpa L.*	Leaf	0,0234		MAR2009
Rn-220	Morocco	Clay Loam Sand	*Retama sphaerocarpa L.*	Leaf	0,00138		MAR2009
U-238	Morocco	Calcareous	*Rue ousoudab*	flower	0,07		MAR2009
Th-232	Morocco	Calcareous	*Rue ousoudab*	flower	0,08		MAR2009
U-238	Morocco	Calcareous	*Rue ousoudab*	nectar solution	0,72		MAR2009
Th-232	Morocco	Calcareous	*Rue ousoudab*	nectar solution	0,72		MAR2009
U-238	Morocco	Calcareous	*Rue ousoudab*	Honey	0,81		MAR2009
Th-232	Morocco	Calcareous	*Rue ousoudab*	Honey	0,96		MAR2009
U-238	Morocco		*Salvia officinalis*	Whole plant	0,8		MAR2000
Th-232	Morocco		*Salvia officinalis*	Whole plant	0,79		MAR2000
U-238	Morocco		*Satureja*	Whole plant	0,62		MAR2000
Th-232	Morocco		*Satureja*	Whole plant	0,68		MAR2000
U-238	Morocco	clay loam Sand	*Sidr tree (Ziziphus spina-christi)*	Root	0,086		MAR2011
Th-232	Morocco	clay loam Sand	*Sidr tree (Ziziphus spina-christi)*	Root	0,18		MAR2011
U-238	Morocco	clay loam Sand	*Sidr tree (Ziziphus spina-christi)*	Stem	0,0042		MAR2011
Th-232	Morocco	clay loam Sand	*Sidr tree (Ziziphus spina-christi)*	Stem	0,117		MAR2011
U-238	Morocco	clay loam Sand	*Sidr tree (Ziziphus spina-christi)*	Leaf	0,0614		MAR2011
Th-232	Morocco	clay loam Sand	*Sidr tree (Ziziphus spina-christi)*	Leaf	0,14		MAR2011
U-238	Morocco	clay loam Sand	*Sidr tree (Ziziphus spina-christi)*	Fruit	0,043		MAR2011
Th-232	Morocco	clay loam Sand	*Sidr tree (Ziziphus spina-christi)*	Fruit	0,083		MAR2011
U-238	Morocco	Argillous	*Thuya*	flower	0,06		MAR2009
Th-232	Morocco	Argillous	*Thuya*	flower	0,08		MAR2009
U-238	Morocco	Argillous	*Thuya*	nectar solution	0,59		MAR2009
Th-232	Morocco	Argillous	*Thuya*	nectar solution	0,7		MAR2009
U-238	Morocco	Argillous	*Thuya*	Honey	0,91		MAR2009
Th-232	Morocco	Argillous	*Thuya*	Honey	0,95		MAR2009
Rn-222	Morocco	Clay Loam Sand	*Ziziphus Lotus*	Root	0,0633		MAR2013
Rn-220	Morocco	Clay Loam Sand	*Ziziphus Lotus*	Root	0,00463		MAR2013

Rn-222	Morocco	Clay Loam Sand	*Ziziphus Lotus*	Stem	0,0355		MAR2013
Rn-220	Morocco	Clay Loam Sand	*Ziziphus Lotus*	Stem	0,00226		MAR2013
Rn-222	Morocco	Clay Loam Sand	*Ziziphus Lotus*	Leaf	0,0196		MAR2013
Rn-220	Morocco	Clay Loam Sand	*Ziziphus Lotus*	Leaf	0,00122		MAR2013
Rn-222	Morocco	Clay Loam Sand	*Ziziphus Lotus*	Fruit	0,014		MAR2013
Rn-220	Morocco	Clay Loam Sand	*Ziziphus Lotus*	Fruit	0,00092		MAR2013

9 Annex:

Food Consumption Rates and Habits, Agricultural Practices in Arid and Semi-arid Countries

Report of the IUR Task Group “Radioecology in Arid Regions”

MODARIA Working Group 4

Food Consumption Rates and Habits, Agricultural Practices in Arid and Semi-arid Countries

Review

N. Semioshkina, G. Voigt (r.e.m. GbR)

2020

Contents

1. Introduction

The knowledge of agricultural praxis and of consumption habits of the local population is one of the most important parameters when estimating radiation exposure by radioactive materials. Contamination of agricultural products leads to internal exposure through ingestion. Depending on the agricultural practices in the area of contamination and the stage of growing or harvest season at the time of the deposition, grains, root crops, other produce, and animal-derived food products may become contaminated directly or/and at a later stage. Food intake rates will determine internal radiation exposures essentially.

2. Nutrition of Population of Arid Zones

(From: Food of people, Andrej Koslov, Book, ISBN: 5-85099-155-7, 2005, https://www.livelib.ru/book/1000112572-pischa-lyudej-andrej-kozlov)

The territory is defined as arid when the evaporation of moisture from its surface exceeds the amount of precipitation. There are various variants of arid biota: tropical and extratropical deserts, semi-deserts and steppes, arid savannahs. Each of them is characterized by a specific amount of precipitation, the ratio of dry and wet seasons, biomass, etc. The influence of high temperatures, increased ultraviolet irradiation, significant diurnal temperature changes, dry air, severe wind regime affects the peculiarities of the energy balance of the indigenous population.

A particular threat in the desert is the lack or scarcity of water. High dryness of air leads to rapid dehydration of the body. The average relative air humidity in the deserts is about 30% (in the tropical rain forest it reaches 80 - 100%). The effect on the body of dry air is exacerbated by constant winds. Desert winds are often combined with a significant increase in air temperature and, therefore, lead not only to additional loss of moisture, but also to overheating of the organism (a known expression - "the wind in the desert does not bring coolness"). Physiological adaptation to acute dehydration in humans is not produced, and the main way to combat the lack of moisture remains the choice of behavioural strategies and types of nutrition that allow to save water.

The predominantly carbohydrate diet reduces urination, hence, reduces moisture loss. Protein food, by contrast, increases thirst. This feeling can be dulled if the necessary amount of animal proteins and fats will come in the form of liquid food. One of the optimal products in this situation is the milk of domestic animals, which provides the body not only with water, but also with fats, carbohydrates and the most "high-grade" proteins.

Fats, in addition to performing the energy function, participate in the mechanisms of water exchange. In particular, during their oxidation, metabolic water is released, which partially satisfies the body's needs for liquid. Thus, fats are one of the most important components of nutrition in tropical desert conditions. However, the availability of concentrated animal fats in the desert is low, and their digestibility in the gastrointestinal tract is somewhat reduced because of the heat.

Many species of desert animals "store" fats in their bodies (these are well-known sheepskin and jerboa, camel humpbacks, fatty fibre of the tail of lizards and lizards), spending them for obtaining metabolic water. Examples of such adaptation options are also known in man. The indigenous population of the deserts of South-West Africa (Bushmen) is characterized by a significant development of adipose tissue in the buttocks: in medicine, this phenomenon is called steatopygia.

3. Dietary habits of the people in the Arab world

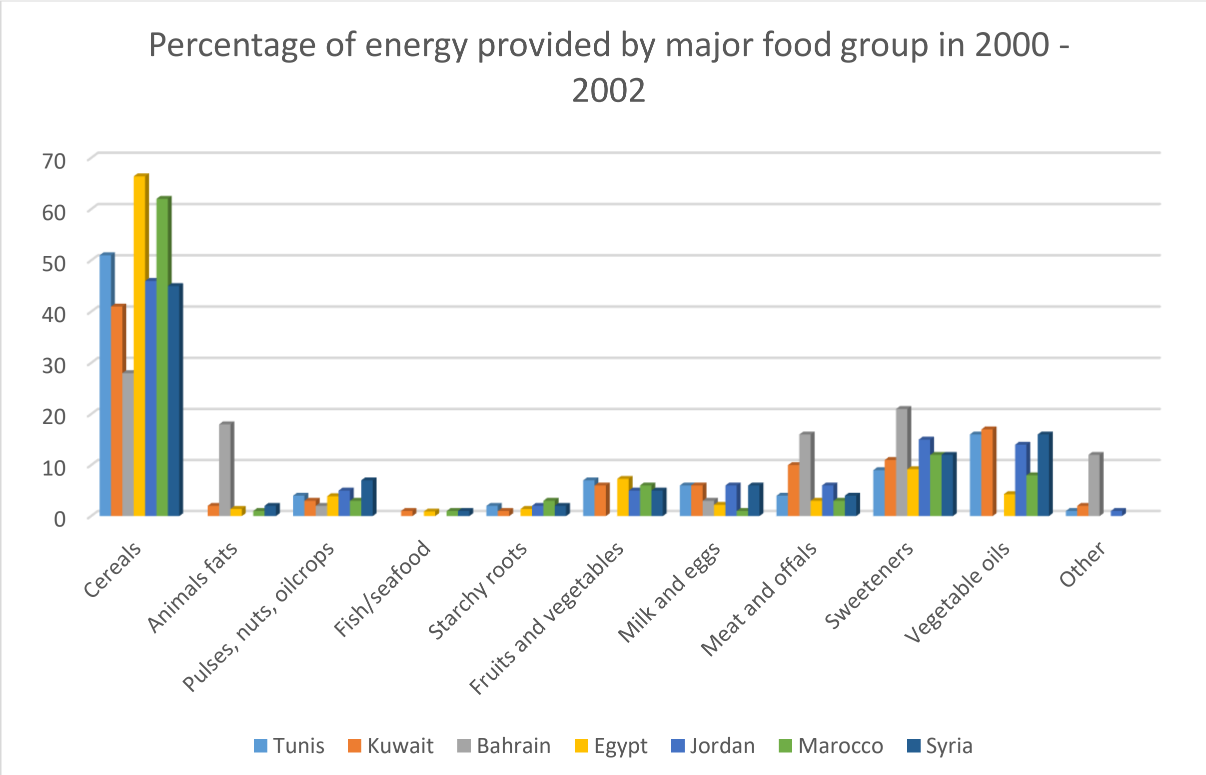
Several factors have been found to determine the dietary habits of the people in the Arab world. Food consumption pattern has dramatically changed in some Arab countries as a result of sudden increase in income from oil revenue. It is believed that food subsidy policy has adversely affected the food habits in the Gulf states by encouraging the intake of fat, sugar, rice, wheat flour and meat. Socio-cultural factors such as religion, beliefs, food preferences, gender discrimination, education and women's' employment all have a noticeable influence on food consumption patterns in this region. Mass media, especially televised food advertisements, play an important role in modifying the dietary habits. The migration movement, particularly that which was carried out during the 70s has a great impact on the food practices in many Arab countries (A.O.Musaiger, 1993).

The Arab region covers 21 countries extending from the Gulf in the East to Morocco in the West. These countries are varied in geography, climate, population, economic and health status. Economically they can be divided into 3 categories, high per capita income group such as oil-producing countries (Gulf countries) which are also characterized by low infant mortality and higher health standards; and middle per capita income such as Iraq, Jordan, Syria, Tunisia and Lebanon and low per capita income group which include Egypt, Yemen, Somalia, Sudan, Djibouti and Mauritania.

The high-income countries showed a marked rise in the consumption of meat, milk, eggs and cereals during 1976- 1980. The change in meat consumption exceeded 200% during this period. In Saudi Arabia, the change reached almost 500%. In other countries, the rise in meat consumption ranged from 12% in the North part of Yemen (formerly Yemen Peoples Democratic Republic) to 97 % in Jordan. Milk showed a similar trend, but the percentage change was lower than that of meat. The change in the consumption of milk in high-income countries ranged from 155% in Kuwait to 350% in Saudi Arabia whereas the average change in other countries ranged from 85 % in Jordan to 18% in Lebanon. Although the high-income countries had the highest growth rates in egg consumption, other countries, such as Syria and Tunisia, also experienced a

rapid growth of egg consumption, mainly due to the development of their poultry industries. The consumption of cereal was also highest in the high-income group [*Khaldi, 1984*].
At low-income levels, the cheap foods such as potatoes, bread, sugar and rice are the main source of energy. As incomes rise, people switch to more expensive foods such as meat, poultry, fruits and luxury foods (Tangerman, 1986). A recent study in Kuwait showed that, as household income increased, the availability of meat, fish, milk, eggs, fruits and vegetables increased (Kamel and Martinez, 1984). Analysis of the situation, however, is more complex because the income distribution within the population is unequal.
Unlike in urban areas, the food consumption patterns in rural areas are less varied and depend largely on food locally produced. The difference between the dietary habits of rural and urban populations can be seen in many parts of the region. In Egypt, for example, wheat bread is consumed mostly in urban areas, while bread made from a mixture of wheat and maize flours is consumed in rural areas (Ramadan, 1986). Fresh milk is consumed more frequently by urban families and fermented milk is used more by rural families (El-Nockrashy et al,1986). It was reported that 98% of the rural households in Lebanon made their own bread compared to only 10% of the urban ones. Most of the rural families ate meals together and all meals started earlier in the day as compared to those of urban dwellers (Al-Isi et all 1975). In Jordan, the consumption of milk and milk products, meat, fruit and sugar was found to be less among refugee families than other families living in cities (Patwardhan and Darby, 1972).

Religion has a greater impact on the food habits of the people than economic or other factors. Every religion in the world exhibits some food restrictions and preferences. The majority (more than 90%) of the people in the Arab countries are Muslim, the rest being Christian, Jewish, or members of African tribal cults (as in southern Sudan) (Moore, 1970). Islam forbids the consumption of pork which is rarely found in the region, and is not available in some countries, such as in Saudi Arabia and Kuwait. However, pork is marketed in the countries with native Christian populations such as Egypt, Lebanon and Tunisia, and, to some extent, Syria and Iraq.



References

EL-NOCKRASHY A S, GALAL O and DAVENPORT J (1986). More and better food, an Egyptian demonstration project. Cairo: Academy of Scientific Research and Technology

KAMEL B S and MARTINEZ O B (1984). Food availability for Kuwait and non-Kuwaiti households. Ecol Food Nutr 15, 191-201

KHALDI N (1984). Evolving food gaps in the Middle East/North Africa: prospects policy implications. Washington DC: International Food Policy Research Institute

MOORE F W (1970). Food habits in non-industrial societies. In: Dupont J, (ed). Dimension of nutrition. Colorado: Colorado Associated University Press 181-222

MUSAIGER A.O., J. Roy. Soc. Health, April 1993, 68-74

PATWARDHAN V N and DARBY W J (1972). The state of nutrition on the Arab Middle East. Nashville: Vanderbilt University

RAMADAN A A S (1986). Some characteristics of Egyptian baladly bread as affected by partial substitution of maize flour in relation to economic state. Egypt J Food Sci 14, 237-240

TANGERMAN S (1986). Economic factors influencing food choice. In: Ritson C, Gofton L, McKenzie J, (eds). The food consumer. London: Wiley & Sons Ltd 61-83

4. Countries

http://www.fao.org/faostat/en/#data/FBS

4.1 KINGDOM OF BAHRAIN

Agriculture

Despite the difficulties faced by agriculture in Bahrain because of infertile soils, scarcity of irrigation water, and a limited supply of skilled workers, production has increased due to growth of cultivated areas and irrigation. This growth occurred as the Ministry of Municipalities and Agricultural Affairs adopted different strategies such as providing farmers with mechanical equipment and seeds at low prices. The Directorate of Agriculture also provides training to farmers for better production, focusing mainly on overcoming problems related to water scarcity and soil quality. In order to develop the poultry industry, the Ministry also established a shareholding company which produces poultry and eggs. Many private sector farmers are working in this field (CIO, 2003). Nevertheless, the food production of Bahrain fulfils only a small fraction of the country's food needs.

Table 2: Land use and irrigation

Type of area	Estimate	Unit	Reference period	Source
Total Land Area	72	1000 Ha	2004	HID
Agricultural Area	14	%	2002	FAO
Arable lands & Permanent Crops	8	%	2002	FAO
Permanent Crops	6	%	2002	FAO
Permanent Pasture	6	%	2002	FAO
Forested land areas	n.a.	-	-	-
Irrigated agricultural land	6	%	2002	FAO
Arable & Permanent cropland	<1	Ha per agricultural inhabitant	2002	FAO

N.B. Percents are calculated on the total land area.
n.a.: not available

Main crops, agricultural calendar, seasonal food shortage

In 2002, the major food commodities produced in Bahrain were cow milk, dates, fresh fruits, tomatoes and eggs (FAO, Statistics Division). Tomato production increased from 2 048 tons in 2001/2002 to 3 067 in 2002/2003. Cabbage production increased in the same period from 677 to 842 tons. Similar increases were achieved in the production of lettuce, green onions, okra, cantaloupes and cow milk (CIO, 2003).

Crop Calendar

Foods are usually available all year around. However, for many locally produced vegetables, prices fluctuate throughout the year.

Livestock production and fishery

Industrial and non-industrial fisheries are the main source of local fish supply. This has allowed Bahrain to become self-sufficient in fishery products and to develop exports of sea products. The

Directorate of Fisheries provides fishermen with training and essential support such as low profit financial loans, suitable seaports, and safe shelter for boat keeping (CIO, 2003).

Table 3: Livestock and fishery statistics

Livestock production and fishery	Estimate	Unit	Reference period	Source
Cattle	11 000	number of heads	2003	FAO
Sheep and Goats	59 000	number of heads	2003	FAO
Poultry Birds	470	thousands	2003	FAO
Fish catch and aquaculture	13 641	tons	2003	FAO

Food consumption patterns

Traditional staple foods of the Bahraini diet are rice and other cereals accompanied by fish, meat and poultry. Large scale changes in foods patterns have occurred in the last 30 years. There has been a massive “westernization” of dietary patterns due to the recent economic development of the country. Consumption of rice and other cereals, as well as fish, appear to have decreased while the intake of red meat, chicken, eggs and milk has increased. These changes are due to income growth and improved standards of living as well as to the increasing urbanization and rapid development of the food processing industry. Processed foods are more available than before and snacking is becoming very common. Fast-food consumption has increased, even in families where a domestic helper is available. Also, eating out has become a common habit, particularly during week-ends and holidays, as it is a pleasant way of socializing. To a large extent, these changes are considered to be making food habits unhealthy. There is much discussion about the role played by fast food and take-away restaurants in changing food habits of Bahrainis. Food served in these restaurants, which are rapidly multiplying, is relatively cheap. However there hasn’t been any specific assessment of their contribution to overall energy and fat intakes in Bahrain. Soft drinks are also very cheap and are frequently considered as contributing to excess energy intake. Larger portions and loss of control over the composition of meals are other issues considered as potential contributing factors to increased fat and energy intake. There are no major differences in food habits between urban and rural areas. In addition, Bahrain has no food availability or food access problem and all types of food and international cooking are available. Bahrainis still enjoy sharing meals with the whole family. The average number of meals is 2-3 per day, with 2-3 additional unhealthy snacks (deep fried stuffed pastry, soft drinks, traditional sweets like *halwa*, *baklawa*, dumplings, etc). Most families join their relatives for a weekly meal, which is longer and richer both in quantities and quality of food than regular everyday meals and therefore leads to an increased food intake.

Adolescents are at high risk of overnutrition as their food habits are becoming unhealthy. Girls are more aware of their body image, and this can lead them to adopt risky dietary patterns, such as unbalanced restrictive diets (e.g. low carbohydrate/high protein diets, very low calorie diets) without medical supervision.

Supply of major food groups

No data are available on supply of major food groups at national level. Consequently, statistics regarding the per capita dietary energy supply are not available. At national level, energy requirements are estimated at 2230 kcal per capita per day1.

Food imports and exports

In Bahrain, less than 10% of the food consumed by the population is locally produced and most of the food imports are under government control.

References

CIO. 2003. *2002 Statistical Yearbook, edition number 36*. Central Informatics Organization,

Directorate of Statistics. Kingdom of Bahrain.

CIO. 2002. *Bahrain in Figures, 2001*. Central Informatics Organization, Directorate of Statistics.

Kingdom of Bahrain.

CIO. *Statistical Reports*. Central Informatics Organization (available at http://www.bahrain.gov.bh/sa.php). Accessed March 2006

4.2 EGYPT

Agricultural production, land use and food security

Agriculture remains one of Egypt's most important economic sectors. However, the sector's contribution to GDP shrank from 20% in 1986/87 to 17% in 1998/99. The number of Egyptians employed in the agricultural sector also fell from 50% of the total labour force to the current level of 32%. Despite productivity gains since the mid-1980s, Egypt remains one of the world's largest food importers (AAFC, 2001).

In Egypt, farming is confined to less than 4% of the total land area because the country falls within arid and hyper-arid zones. About 90% of the agricultural area is concentrated in the Nile delta and the rest is located within a narrow ribbon along the Nile between Aswan and Cairo (Upper Egypt) and a strip along the Mediterranean. In 2000, agricultural land represented 0.049 ha per person and 0.049 ha per person as arable and permanent cropland.

Cultivated lands in the desert and along the coast increased by 43% from 1986 to 1993, due to reclamation of desert and coastal lands. Nevertheless, the relative scarcity of arable land, coupled with, among other factors, high population growth, makes Egypt dependent on external sources for about half of its food supply (U.S. Department of State, 2000).

As part of a national land reclamation project, the government started one of the world's largest planned agricultural developments in Toshka in January 1997. The project aims to double the size of Egypt's arable land in fifteen years' time. The project's estimated cost is around $86.5 billion over the coming 20 years until 2017 (U.S. Department of State, 2001).

By the end of the 1980's, the self-sufficiency ratio was only around 20% for wheat, lentils and edible oil. The major basic staple for which Egypt did not rely on external supply sources was rice. The country also produced most of its poultry and eggs requirements. On the whole, it imported more than one-half (65%) of the food consumed and food imports made up about one-quarter of total imports.

Egypt continues to espouse a policy of self-sufficiency in wheat production by encouraging the expansion of acreage and the use of newly developed high-yielding wheat varieties. The present status is much better, almost reaching 55% self-sufficiency. A contributing factor is mixing of corn (20%) with wheat for subsidized balady bread (Ministry of Supply 2001). Although total planted area did not increase in 1999, the production of wheat is estimated to be higher than 1998 (U.S. Department of State, 2001).

In recent years, Egypt's farmers have realized major increases in the exports of high value crops such as grapes, melons, strawberries and potatoes. USAID programs have supported specialization in the agricultural sector and export expansion through technological assistance, managerial training, and the dissemination of market information to farmers. These activities have contributed significantly to increased productivity, employment generation, rural income growth and poverty alleviation (USAID, 2001).

The food and nutrition situation

Dietary pattern

Different types of bread were consumed daily by almost 100% of the households. The most commonly used was the subsidized wheat bread, followed by wheat-maize home backed bread in rural areas. However, consumption of home-made bread decreased from 81% in 1981 to 29% in 2000 among rural families. Also, it decreased among urban families from 40% to 3% within 19 years' period (Aly et al., 1981).

Food items consumed daily by more than 50% of total households were: wheat bread (97% of households), tea (99%), ghee or butter (97%), sugar (91%), milk (58%), powdered milk (61%) and vegetables (52%).

Almost all families in both urban and rural areas consume 3 meals daily. Lunch was the main meal for the majority of urban households (88%) and for 57% of rural households. Table shows mean per caput daily intake of different food groups in the study governorates as obtained by the quantitative food frequency method (Hassanyn, 2000). Mean per caput daily intake of cereals in the total sample was 434.3 g, with higher intake among rural (488.3 g) areas. The highest intake of cereals was in Fayoum rural areas (513.1 g) and the lowest was in Cairo governorate (385.9 g). Mean per caput daily intake of roots and tubers was 215.4 g in the total sample. Also consumption of roots and tubers was higher in rural areas, compared to urban areas (227.5 g and 208.5 g) respectively. The lowest intake was in Cairo governorate (197.1 g) and it increased gradually in other governorates to reach 247.2 g in rural area of Souhag governorate. For pulses, the mean intake was 54.5g in total rural areas and 52.7 g in total urban areas. Variation in pulses consumption was minimal within different governorates and ranged from 50.6 g in Sharkia rural areas to 63.5 g in urban areas of Souhag governorate. Consumption of fruits and vegetables was higher in rural (142.0 g) than in urban areas (119.5 g), with a mean intake of 128.2 g for the whole of the sample. Mean fat and oils intake was 39.7 g for the total sample, with a slightly higher intake among urban than rural areas (40.5 g, 38.5 g) respectively. Mean meat intake was higher among rural (102.9 g) areas, compared to urban areas (80.9 g). The mean intake was 89.4 g for the whole of the sample (Hassanyn, 2000).

References

Agriculture and Agri-Food Canada (AAFC). 2001. *Egypt Agri-food Country Profile. August 2001*. Agricultural Overview (available at: http://ats.agr.ca/ public/ htmldocs/e3221.htm#B)

Aly, H., Dakraury, A., Said, A., Moussa, W., Shaheen, F., Ghoneme, F., Hussanein, M., Hathout, M., Shehata M. & Gomaa H. 1981*. ARE National Food Consumption Study, final report.* Nutrition Institute, Ministry of Health, Cairo, ARE.

FAOSTAT. 2002. FAO Web page. Statistics database . FAO, Rome *Nutrition Country Profiles* – EGYPT 50

Hassanyn, A. S. 2000. *Food Consumption Pattern and Nutrients Intake Among Different Population Groups in Egypt*. Final Report (part I), Nutrition Institute, Egypt, WHO/EMRO.

U.S. Agency for International Development. 2001. (available at: http://www.usaid-eg.org/ detail.asp?id=14).

U.S. Department of State. 2000. *U.S. Department of State Country Commercial Guides for FY 2000.* Egypt; (available at: http://www.state.gov/www/about_state/business/com_guides).

U.S. Department of State. 2001. *U.S. Department of State Country Commercial Guide for FY 2001.* Cairo, Egypt. (available at: http://www.state.gov/www/about_state/business/com_guides).

Food Consumption

Source/ Year of survey	Location	Sample: Number households	Sample: Number individuals	Sex	Age Years	Average food intake: Cereals	Roots/ Tubers	Pulses	Fruits/ Vege-tables	Oils/ Fats	Meat	Poultry	Fish	Milk prod.	Sweet-eners
						Major Food Groups (kg/caput/year)									
Hassanyn	Cairo	510	2608	M/F	All	140.6	72.0	18.7	41.3	15.3	29.3	39.4	20.4	20.2	13.5
2000	Alexandria	270	1418	"	"	158.3	79.8	19.2	43.6	14.5	28.2	40.3	17.3	19.7	14.3
	Sharkia														
	Urban	60	238	"	"	164.3	76.8	18.8	47.0	15.4	27.4	39.9	19.0	20.6	16.6
	Rural	210	993	"	"	180.6	79.4	18.5	53.9	22.7	33.8	38.4	15.0	23.1	16.5
	Total	270	1231	"	"	174.0	78.3	18.6	51.0	19.6	31.3	39.1	17.0	21.9	16.6
	Beheira														
	Urban	60	304	"	"	145.1	87.0	20.5	56.7	14.5	35.8	40.6	19.5	25.5	14.0
	Rural	180	1182	"	"	171.8	81.9	20.0	59.8	13.8	40.1	39.2	18.5	24.0	12.0
	Total	240	1486	"	"	166.2	93.1	20.1	59.1	13.9	39.1	39.6	18.4	24.4	12.4
	Fayoum														
	Urban	45	311	"	"	154.3	78.2	20.9	45.9	11.9	31.1	41.3	18.4	23.1	10.5
	Rural	1564	1030	"	"	187.3	80.6	18.8	45.5	13.3	35.4	36.9	16.7	23.6	10.5
	Total	199	1341	"	"	177.5	79.9	19.4	45.6	13.0	34.4	38.0	17.1	23.5	10.5
	Souhag														
	Urban	30	153	"	"	142.4	81.3	23.2	45.4	14.8	33.0	39.7	17.6	25.7	10.7
	Rural	150	897	"	"	176.1	90.2	21.7	47.4	12.2	38.3	36.4	17.5	21.7	10.7
	Total	180	1050	"	"	170.4	88.5	22.0	47.0	12.6	37.4	36.9	17.5	22.5	10.7
	Total														
	Urban	975	5032	"	"	147.8	76.1	19.2	43.6	14.8	29.5	39.9	19.1	20.8	13.6
	Rural	694	4102	"	"	178.2	83.0	19.9	51.8	14.1	37.6	37.7	17.4	23.2	11.7
	Total	1669	9134	"	"	158.5	78.6	19.5	46.8	14.5	32.6	39.0	18.5	21.6	12.9
						Major Food Groups (g/caput/day)									
						Cereals	Roots/ Tubers	Pulses	Fruits/ Vege-tables	Oils/ Fats	Meat	Poultry	Fish	Milk Products	Sweet-eners
Hassanyn	Cairo	510	2608	M/F	All	385.9	197.1	51.3	113.2	41.9	80.2	107.8	55.9	55.4	37.0
2000	Alexandria	270	1418	"	"	433.7	218.6	52.6	119.5	39.8	77.3	110.4	47.5	54.0	39.1
	Sharkia														
	Urban	60	238	"	"	450.0	210.5	51.5	128.8	42.3	75.0	109.4	52.1	56.4	45.5
	Rural	210	993	"	"	494.9	217.5	50.6	147.5	62.1	92.5	105.3	42.6	63.2	45.3
	Total	270	1231	"	"	476.6	214.5	51.0	139.8	53.7	85.7	107.0	46.5	60.0	45.4
	Beheira														
	Urban	60	304	"	"	397.5	238.3	56.1	155.3	39.7	98.0	111.3	53.5	69.7	38.4
	Rural	180	1182	"	"	470.7	224.4	54.7	163.9	37.8	109.8	107.5	50.8	65.8	32.8
	Total	240	1486	"	"	452.6	227.7	55.1	162.0	38.2	107.0	108.4	51.4	66.9	34.1
	Fayoum														
	Urban	45	311	"	"	422.8	214.1	57.3	125.7	32.6	85.1	113.1	50.4	63.3	28.7
	Rural	1564	1030	"	"	513.1	220.8	51.6	124.8	36.5	97.1	101.1	45.7	64.7	28.7
	Total	199	1341	"	"	486.2	219.0	53.0	125.0	35.5	94.1	104.1	46.9	64.3	28.7
	Souhag														
	Urban	30	153	"	"	390.2	222.6	63.5	124.4	40.4	90.4	108.8	48.3	70.3	29.4
	Rural	150	897	"	"	482.6	247.2	59.0	129.7	33.3	105.0	99.7	47.9	59.4	29.4
	Total	180	1050	"	"	466.9	242.5	60.0	128.8	34.6	102.6	101.2	48.0	61.7	29.4
	Total														
	Urban	975	5032	"	"	405.0	208.5	52.7	119.5	40.5	80.9	109.2	52.4	56.9	37.3
	Rural	694	4102	"	"	488.3	227.5	54.5	142.0	38.5	102.9	103.4	47.7	63.6	32.1
	Total	1669	9134	"	"	434.3	215.4	53.4	128.2	39.7	89.4	107.0	50.6	59.1	35.3

4.3 THE HASHEMITE KINGDOM OF JORDAN

Agricultural praxis

Observers expected food imports to remain necessary into the indefinite future. Much of Jordan's soil was not arable even if water were available; by several estimates, between 6 percent and 7 percent of Jordan's territory was arable, a figure that was being revised slowly upward as dry-land farming techniques became more sophisticated. In 1989 the scarcity of water, the lack of irrigation, and economic problems, rather than the lack of arable land set a ceiling on agricultural potential. Only about 20 percent of Jordan's geographic area received more than 200 millimetres of rainfall per year, the minimum required for rain-fed agriculture. Much of this land was otherwise unsuitable for agriculture. Moreover, rainfall varied greatly from year to year, so crops were prone to be ruined by periodic drought.

In 1986 only about 5.5 percent (about 500,000 hectares), of the East Bank's 9.2 million hectares (230 million acres) were under cultivation. Fewer than 40,000 hectares (100,000 acres) were irrigated, almost all in the Jordan River valley.[1] Because arable, rain-fed land was exploited extensively, future growth of agricultural production depended on increased irrigation. Estimates of the additional area that could be irrigated were Jordan to maximize its water resources ranged between 65,000 and 100,000 hectares (160,000 and 250,000 acres).

Most agricultural activity was concentrated in two areas. In rain-fed northern and central areas of higher elevation, wheat, barley, and other field crops such as tobacco, lentils, barley, and chick peas were cultivated; olives also were produced in these regions.[1] Because of periodic drought and limited area, the rain-fed uplands did not support sufficient output of cereal crops to meet domestic demand.

In the more fertile Jordan River valley, fruits and vegetables including cucumbers, tomatoes, eggplants, melons, bananas, and citrus crops often were produced in surplus amounts.[1] The Jordan River Valley received little rain, and the main source of irrigation water was the East Ghor Canal, which was built in 1963 with United States aid.

Jordan had about 35,000 head of cattle but more than 1 million sheep and 500,000 goats, and the government planned to increase their numbers. In the late 1980s, annual production of red meat ranged between 10,000 and 15,000 metric tons, less than 33 percent of domestic consumption. A major impediment to increased livestock production was the high cost of imported feed. Jordan imported cereals at high cost for human consumption, but imported animal feed was a much lower priority. Likewise, the arid, rain-fed land that could have been used for grazing or for fodder production was set aside for wheat production. Jordan was self-sufficient, however, in poultry meat production (about 35,000 metric tons) and egg production (about 400,000 eggs), and exported these products to neighbouring countries.

(https://en.wikipedia.org/wiki/Agriculture_in_Jordan)

Characteristics of national food production

Jordan can be divided into four physiographic regions starting from the West and running from North to South: the Jordan Rift Valley which is the food bowl of Jordan for fruit and vegetables (Alqaisi et al., 2009), the Highlands where agriculture is mostly rainfed, the plains, and the Badia desert region in the east, which represents about 80% of the total country area (FAO, AQUASTAT, 2008). Jordan is one of the ten most water-poor countries in the world (IFAD, 2007). Only about 4% of the total land area is arable, mostly in the northwest and central areas; about 84% of this is rainfed and the rest is irrigated (UNDP, 2010a). The major share of local agricultural production consists of fruit and vegetables (tomatoes, cucumber, citrus fruits, bananas, etc.), which is the production that receives the most support from the Government. Potatoes and olives are also produced in rather large quantities. Local production of cereals has decreased considerably since the early 1960s while that of starchy roots, animal products and fruit/vegetables has increased substantially over the same period (FAO, FAOSTAT, 2011). Smallholder agriculture still suffers from poor market linkages and limited marketing facilities (IFAD, 2007).

Livestock-keeping (mainly sheep and goats) is an important activity in the rainfed, semi-desert areas (IFAD, 2007). However, production of meat is limited, though the production of poultry is active. Local production of milk is not sufficient to meet local demand (FAO, FAOSTAT, 2011). The marine fishing industry in Jordan is small and artisanal, while aquaculture production is expanding (FAO, Fisheries and Aquaculture Department, no date).

Jordan is dependent on food imports and thus particularly vulnerable to international food price shocks. The total food import bill has more than tripled between 1995 and 2008 (FAO, 2010).

Table A.1: Food consumption data

Survey name and date (Reference)	Region	Survey population: households/ individuals	Sample characteristics			Average food consumption								
			Age (years)	Sex	Sample size									
						Major food groups (g/person/day)								
Household Expenditure and Income Survey 2008 (Mar. 2008-Feb. 2009) (DoS, 2009)						Cereals	Starchy roots	Pulses, nuts & oilcrops	Fruit & vegetables[1]	Oils & fats	Meat & offals	Fish & seafood	Milk, dairy products & eggs	Sugar & derived products
	Total	Households	All	M/F	12768	483	67	n.a.	412	40	150	11	n.a.	n.a.
	Urban	Households	All	M/F	n.a.	471	65	n.a.	447	41	150	12	n.a.	n.a.
	Rural	Households	All	M/F	n.a.	538	73	n.a.	368	34	151	8	n.a.	n.a.
						Nutrient intake (per person/day)								
						Energy (kcal)	% from protein	% from lipid		Protein (g)	% protein from animal origin		Lipid (g)	% lipid from animal origin
						n.a.	n.a.	n.a.		n.a.	n.a.		n.a.	n.a.
						Percentage of energy intake provided by								
						Cereals	Starchy roots	Pulses, nuts & oilcrops	Fruit & vegetables	Oils & fats	Meat & offals	Fish & seafood	Milk, dairy products & eggs	Sugar & derived products
						n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

n.a.: not available (methodological issues)

[1]: Canned fruits, canned vegetables, lettuce and parsley mint are not taken into account in this food group as they were expressed in piece. Their quantity is however limited.

References

Alqaisi, O., Ndambi, O.A. and Hemme, T. 2009*. Development of milk production and the dairy industry in Jordan*. Livestock Research for Rural Development 21 (7). (available at http://www.lrrd.org/lrrd21/7/alqa21107.htm)

FAO. 2011a. *The State of Food Insecurity in the World 2011*. Food and Agriculture Organization of the United Nations. Rome. (available at http://www.fao.org/publications/sofi/en/)

FAO. 2011b. *Country brief - Jordan*. Policy and Programme Development Support Division, Technical Cooperation Department, Food and Agriculture Organization of the United Nations. Rome.

FAO. 2010. *Jordan country brief report – Agriculture growth rates, export, imports and undernourishment*. Food and Agriculture Organization of the United Nations. Rome.

FAO. 2004. *Calculating population energy requirements and food needs. Software application*. Accompanying: FAO Food and Nutrition Technical Report Series No. 1. Food and Agriculture Organization of the United Nations. Rome.

FAO, FAOSTAT. 2011. *Statistical databases*. Food and Agriculture Organization of the United Nations. Rome. (available at http://faostat.fao.org/) Accessed in 2011.

FAO, Fisheries and Aquaculture Department. No date. *Fishery and Aquaculture Country Profile – Jordan*. Fisheries and Aquaculture Department. Food and Agriculture Organization of the United Nations. Rome. (available at http://www.fao.org/fishery/countrysector/FI-CP_JO/en)

IFAD. 2007. *Country strategic opportunities programme*. International Fund for Agriculture Development. Rome (available at http://www.ifad.org/gbdocs/eb/92/e/EB-2007-92-R-16.pdf)

UNDP. 2010a. *Government of the Hashemite Kingdom of Jordan – Project document (Food and Nutrition Security in Jordan towards poverty alleviation).* United Nations Development Programme. (available at http://www.undp-jordan.org/uploads/projects/pd_1293615331.pdf)

UNDP. 2010b. *Human Development Report 2010.* United Nations Development Programme. New York. USA. (availble at http://hdr.undp.org/en/reports/global/hdr2010/)

4.4 ROYAUME DU MAROC

Agriculture praxis

Morocco is endowed with numerous exploitable resources. With approximately 33,000 square miles (85,000 square km) of arable land (one-seventh of which can be irrigated) and its generally temperate Mediterranean climate, Morocco's agricultural potential is matched by few other Arab or African countries. It is one of the few Arab countries that has the potential to achieve self-sufficiency in food production. In a normal year Morocco produces two-thirds of the grains (chiefly wheat, barley, and corn [maize]) needed for domestic consumption. The country exports citrus fruits and early vegetables to the European market; its wine industry is developed, and production of commercial crops (cotton, sugarcane, sugar beets, and sunflowers) is expanding. Newer crops such as tea, tobacco, and soybeans have passed the experimental stage, the fertile Gharb plain being favourable for their cultivation. The country is actively developing its irrigation potential that ultimately will irrigate more than 2,500,000 acres (10,000 km^2).

Agriculture in Morocco employs about 40% of the nation's workforce. Thus, it is the largest employer in the country. In the rainy sections of the northwest, barley, wheat, and other cereals can be raised without irrigation. On the Atlantic coast, where there are extensive plains, olives, citrus fruits, and wine grapes are grown, largely with water supplied by artesian wells. Morocco also produces a significant amount of illicit hashish, much of which is shipped to Western Europe. Livestock are raised and forests yield cork, cabinet wood, and building materials. Part of the maritime population fishes for its livelihood. Agadir, Essaouira, El Jadida, and Larache are among the important fishing harbors.

Moroccan agricultural production also consists of orange, tomatoes, potatoes, olives, and olive oil. High quality agricultural products are usually exported to Europe. Morocco produces enough food for domestic consumption except for grains, sugar, coffee and tea. More than 40% of Morocco's consumption of grains and flour is imported from the United States and France.

Agriculture industry in Morocco enjoyed a complete tax exemption until 2013. Many Moroccan critics said that rich farmers and large agricultural companies were taking too much benefit of not paying the taxes and that poor farmers were struggling with high costs and are receiving very poor support from the state. In 2014, as part of the Finance Law, it was decided that agricultural companies with a turnover of greater than MAD 5 million would pay progressive corporate income taxes.

Nevertheless, the danger of drought is ever present. Especially at risk are the cereal-growing lowlands, which are subject to considerable variation in annual precipitation. On average, drought occurs in Morocco every third year, creating a volatility in agricultural production that is the main constraint on expansion in the sector.

Droughts are most commonly the main concern for farmers in Morocco due to the major agricultural production that is a massive part of Morocco's economy.

(https://en.wikipedia.org/wiki/Agriculture_in_Morocco)

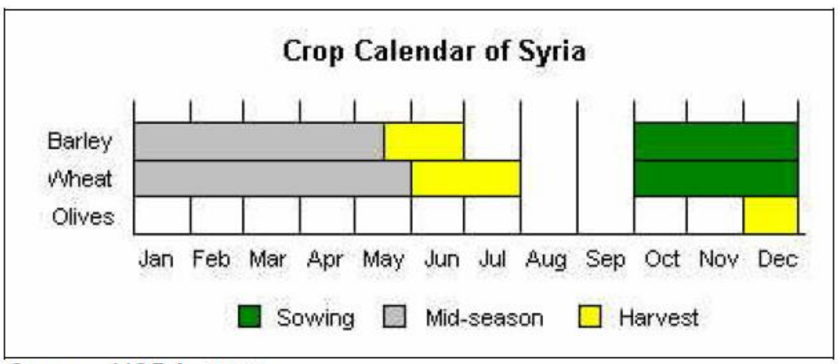
Tableau 2: Données de consommation alimentaire

Nom et date de l'enquête (Référence)	Région	Population d'étude: ménages/ individus	Caractéristiques de l'échantillon			Consommation alimentaire moyenne									
			Age (années)	Sexe	Effectif										
Enquête nationale sur la consommation et les dépenses des ménages 2000/2001 (Nov. 2000-oct. 2001) (RdM/HCP, 2005)						**Principaux groupes d'aliments (g/personne/jour)**									
						Céréales et produits à base de céréales (en équivalents grains)	Pommes de terre	Légumineuses, noix, oléagineux	Fruits/ légumes	Huiles/beurre/ autres corps gras	Viande et abats	Poisson et fruits de mer	Lait et produits laitiers (en équivalent lait frais) (beurre exclu)	Œufs	Sucre
	Total	ménages	_	_	14240	507	86	24	374	49	50	25	103	11	66
	Urbain	ménages	_	_	7864	478	93	27	421	53	61	32	145	15	63
	Rural	ménages	_	_	6376	544	78	20	314	44	37	16	50	6	71
						Apports nutritionnels (par personne/jour)									
						Energie (kcal)	% provenant des protéines	% provenant des lipides		Protéines (g)	% protéines d'origine animale		Lipides (g)	% lipides d'origine animale	
	Total	ménages	_	_	14240	3019	12	24		88	21		82	22	
	Urbain	ménages	_	_	7864	3043	12	27		92	25		91	25	
	Rural	ménages	_	_	6376	2988	11	21		83	14		70	17	
						Pourcentage de l'apport énergétique provenant des									
						Céréales et produits à base de céréales	Légumineuses, noix et oléagineux	Fruits, légumes et tubercules	Huile/beurre/ autres corps gras	Viande et abats	Poisson et fruits de mer	Lait et produits laitiers	Œufs	Sucre	Autres
	Total	ménages	_	_	14240	53	3	12	14	4	1	3	1	8	2
	Urbain	ménages	_	_	7864	49	3	13	15	5	1	3	1	8	2
	Rural	ménages	_	_	6376	58	2	10	13	3	1	1	0	9	2

Note: source RdM/HCP 2005 et analyses complémentaires.

4.5 SYRIAN ARAB REPUBLIC

Agriculture
In the past decades until the outbreak of the Syrian civil war, the agricultural sector has been the focus of the efforts of the Syrian government. Nearly one third of the country is cultivated, of which a third is irrigated (SCBS, 2004). The barren nature of much of the land and the scarcity of water resources, including low rainfall, hinder agricultural development (IFAD, 2004). Syria achieved self-sufficiency in the food sector in the early 1990s, and is now able to export fruit and vegetables. Another promising agricultural product is olive oil. In 2000, the olive crop showed a fourfold increase over the yield of 1991. In 2003, the production of cereals and dry legumes showed a four-fold increase over the yield of 1999 (SCBS, 2004). The government aims at expanding and diversifying food production and thus supports irrigated agriculture, in addition to encouraging the practice of double cropping. Syria's agro-business sector can benefit from an influx of modern farming technology and effective de-rocking techniques (IFAD, 2004).
The 5 major food and agricultural commodities produced by Syria in 2002 were wheat, sugar beets, cow milk, olives and barley (FAO, Statistics Division). Wheat and cow milk are mainly destined to local human consumption, sugar beets are used as animal feed and in the food industry. Olives are mainly destined to food industries, and barley is mainly used as animal feed (FAO, FAOSTAT Database).



Source: USDA, 2002.

Due to the diversification in food production, there is no food shortage throughout the year.

Agricultural development in Aleppo province, Syria (Ecology of food and Nutrition, V. 20, pp.197-210 (1985)

Crop	High rainfall Zone			Low rainfall Zone		
	N	Area (ha)	Yield (ton/ha)	N	Area (ha)	Yield (ton/ha)
Wheat	23	4.6	1.7	17	1.9	0.4
Barley	26	3.1	1.3	31	3.5	0.4
Lentils	25	1.9	0.7	-	-	-
Chickpeas	3	1.2	0.6	-	-	-
Faba beans	4	0.6	0.9	-	-	-

Livestock production and fishery

Syria has a large livestock production. Livestock is raised by both settled farmers and nomadic herders (IFAD, 2004). Dairy cattle represent the main share of livestock and are mainly kept close to towns where prices of dairy products are good and where water is available for forage production. Sheep, raised in the steppe, and goats, raised in the mountain ranges close to forested areas, are also an important part of the country's livestock resources (FAO, 2001).

Table 3: Livestock and fishery statistics

Livestock production and fishery	Estimate	Unit	Reference period	Source
Cattle	866 675	number of heads	2002	FAO
Sheep and Goats	14 429 367	number of heads	2002	FAO
Poultry Birds	28 969	thousands	2002	FAO
Fish catch and aquaculture	15 166	tons	2002	FAO

Food consumption

National level surveys Food consumption data are not available. Household income and expenditure surveys have been conducted in Syria but intake of food is not documented. According to the household income and expenditure survey of 1996/97, food expenditure represented 57% of total expenditures, with an equal share in urban and rural areas. Overall, high expenditures were for meat, fish and eggs (21%) followed by vegetables (17%) and cereals (16%). In urban areas, the highest expenditures were for meat, fish and eggs (23%) while in rural areas they were for cereals (19%) (SCBS, 1997).

References

FAO. 2001. *Country Pasture/Forage Resource Profiles, Syria*. By Abdalla Masri, Grassland and Pasture Crops Group, Crop and Grassland Service, AGP Plant production and protection division, Agriculture Department. Food and Agriculture Organization of the United Nations. Rome. (available at http://www.fao.org/ag/agp/agpc/doc/Counprof/syria.htm).

FAO. *FAOSTAT Database*. Statistical Database of the Food and Agriculture Organization of the United Nations. Rome. (available at http://faostat.external.fao.org/faostat). Accessed May 2005.

IFAD. 2004. *IFAD in Syria*. International Fund for Agricultural Development of the United Nations. Rome.

(available at: http://www.ifad.org/operations/projects/regions/PN/factsheets/sy.pdf). Syrian Arab Republic Nutrition Profile – Food and Nutrition Division, FAO, 2005 35

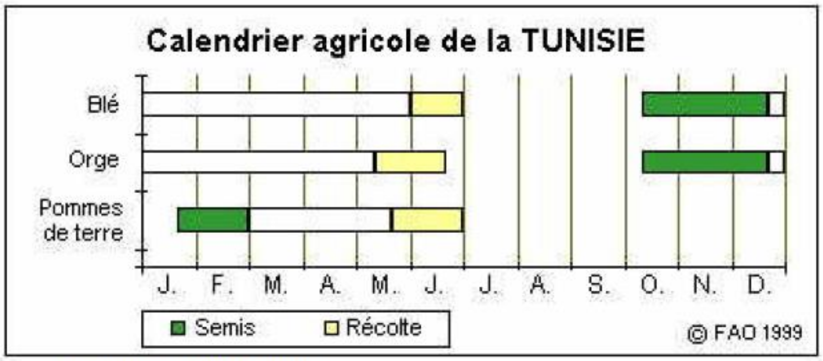
SCBS. 2004. *The statistical abstracts*, 2004. Syrian Central Bureau of Statistics. Damascus. (available at http://www.cbssyr.org/eindex.htm).

SCBS. 1997. *Household Budget Survey 1996/97.* Syrian Central Bureau of Statistics. Damascus. (available at http://www.cbssyr.org/eindex.htm).

4.6 RÉPUBLIQUE TUNISIENNE

Agricultural praxis

Tunisia produces mainly cereals (15% of total agricultural production), olive oil (10% of total agricultural production), citrus fruits and dates, mainly for export. The production of vegetables (mainly tomatoes and potatoes) is mainly for local consumption.



Source : SMIAR/FAO

Animal production and fishing

Approximately 71% of farmers use livestock in different forms: 55% practice sheep farming, 32% breed cattle and 29% goat farming. Self-sufficiency in milk and derivatives, chicken meat and eggs has been achieved, thanks in particular to efforts to control animal health and to improve the conservation of products.

Fish and livestock production is increasing to meet increased domestic demand. Export, processing and marketing of fish and seafood products is growing.

http://www.fao.org/faostat/en/#data/FBS

Food supply quantity (kg/capita/year)		
Wheat and products	2013	197.5
"Cereals	2013	0.78
Potatoes and products	2013	30.97
"Sweeteners	2013	0.68
Other and products"	2013	6.51
Nuts and products	2013	5.86
Olives (including preserved)	2013	2.35
Olive Oil	2013	3.15
"Vegetables	2013	154.64
"Fruits	2013	32.1
Mutton & Goat Meat	2013	5.34
Poultry Meat	2013	18.5
"Meat/offals	2013	2.3
"Butter Ghee"	2013	0.64
Animals fats	2013	0.5
Eggs	2013	7.67
Milk - Excluding Butter	2013	114.47

Tableau 13 : Données de consommation alimentaire

Nom et date de l'enquête (Référence)	Région	Population d'étude: ménages/ individus	Effectif	Consommation alimentaire moyenne – Principaux groupes d'aliments (g/personne/jour)								
				Céréales	Tuber-cules	Légumi-neuses, noix & oléagineux	Fruits/ Légumes	Huiles/ Graisses	Viande & abats	Poisson & fruits de mer	Lait, produits laitiers & oeufs	Sucre et dérivés
Enquête Nationale sur le Budget, la Consommation et le Niveau de Vie des Ménages, 2000 (INS, 2004)	Total	Ménages	5 928	494	56	28	470	66	68	18	138	48
	Urbain	"	3 635	442	59	30	506	67	80	24	162	49
	Rural	"	2 293	582	50	23	409	65	47	9	99	47
	Grand Tunis	"	1 003	434	60	34	533	66	85	20	189	52
	Nord Est	"	829	457	73	29	448	70	67	16	142	47
	Nord Ouest	"	825	578	56	32	443	66	63	6	149	52
	Centre Est	"	195	457	61	24	510	71	78	40	131	43
	Centre Ouest	"	836	591	37	23	426	57	46	7	90	47
	Sud Est	"	618	463	42	18	416	64	56	12	109	46
	Sud Ouest	"	622	550	51	32	397	64	58	6	113	50
Enquête Nationale sur le Budget, la Consommation et le Niveau de Vie des Ménages, 1990 (INS, 1993)	Total	Ménages	3 852	538	56	25	455	69	55	19	119	48
	Urbain	"	2 219	465	65	22	494	72	67	27	142	49
	Rural	"	1 633	646	42	28	404	64	36	8	87	46
	Grand Tunis	"	651	473	72	34	495	63	72	20	172	53
	Nord Est	"	493	510	71	23	492	74	54	17	132	46
	Nord Ouest	"	705	612	45	24	342	58	47	3	121	47
	Centre Est	"	704	478	60	21	505	87	59	48	59	43
	Centre Ouest	"	547	670	31	26	468	61	30	6	28	43
	Sud	"	752	523	50	16	390	67	56	12	65	53
Enquête Nationale sur le Budget, la Consommation et le Niveau de Vie des Ménages, 1980 (INS, 1983)	Total	Ménages	2 948	576	53	29	345	43	46	15	121	40
	Urbain	"	1 304	490	60	31	381	44	62	24	135	39
	Rural	"	1 644	670	44	26	311	43	29	5	105	40
	Grand Tunis	"	445	480	58	31	390	44	66	15	180	42
	Nord Est	"	410	566	74	35	345	45	49	12	128	42
	Nord Ouest	"	589	648	39	26	286	34	38	2	149	41
	Centre Est	"	580	538	77	32	354	56	49	41	74	31
	Centre Ouest	"	481	686	28	22	352	38	28	3	110	35
	Sud	"	441	571	45	24	352	39	44	9	70	42

4.7 STATE OF KUWAIT

Agriculture

Due to soil infertility, water scarcity, unfavourable climate and lack of trained labour force, the agricultural sector plays a minor role in the Kuwaiti economy. Out of 17 818 km² of national territory, only 1 538 km² are used for pasture, trees and crops. With the exception of fishery products, Kuwait is totally dependent on imports for its food supply (MOP, 2004a).

The government has been carefully managing farms and experimenting hydroponic systems. However, most of the soil which was suitable for farming in south central Kuwait was heavily polluted during the 1991 Gulf war, when the destruction of oil wells in the area created vast "oil lakes".

The main food and agricultural commodities produced in Kuwait in 2002 were fresh vegetables, cow milk and poultry meat (FAO, Statistics Division). All these commodities were destined to local human consumption (FAO, FAOSTAT).

Winter, summer and semi-perennial crops include fruits, leafy vegetables, tubers and pulses. Vegetables such as tomatoes, cucumbers, lettuce, bell peppers, etc. and fruit such as strawberries are grown in green houses and in some cases exported to neighbouring countries. The food processing industry is well developed but the domestic production remains small in comparison with the volume of food imports (MOP, 2004a).

Livestock production and fishery

Livestock production is an important component of the agricultural sector and contributes about 67 percent to total agricultural GDP, as compared to 23 percent for plant production and 10 percent for fisheries.

The Persian Gulf is a rich fishing area. Kuwait uses the latest technologies for the development of this important resource. Fish and crustaceans are plentiful in territorial waters, and large-scale commercial fishing is undertaken locally and in the Indian Ocean (MOP, 2004a).

Food consumption

Community based surveys on dietary intake are urgently needed to provide valid estimates of energy and nutrient intake of the Kuwaiti population.

Due to the discovery of oil and gas resources, Kuwait showed rapid changes in the lifestyle and standard of living within the span of one generation. The changes in food patterns were due to increased family income, availability of various foods in local markets, food advertisements and lack of proper nutrition education and knowledge. Increase in the local production and imports of various foods from all over the world made available a great abundance and variety of foods in local markets at reasonable prices. According to a survey investigating food consumption patterns and dietary habits in Kuwait (Al-Awadi et al., 1997), illiterate mothers cook food themselves while graduate mothers depend on their parents and maids to cook for them. Fast foods - such as hamburgers, fried chicken and onion rings - are frequently consumed by educated families.

National level surveys

A Kuwait Nutrition survey has been approved by the Kuwait Institute for Advancement of Sciences and initiated in August 2006. It consists in a cross sectional survey including 1 600 households (10 000 Kuwaiti subjects). Food consumption data are collected using the 24 hour recall and a food frequency questionnaire. The objectives are to assess prevalence of micronutrient deficiencies (of iron, folate, iodine, vitamin A and vitamin D), to identify contributing factors to specific nutrition related health problems and to enable the government to develop policies and implement intervention programmes. Results have not yet been published.

Other surveys

A study based on a semi quantitative food frequency questionnaire was conducted in 2003-2004. It included 152 food items and the participants, aged between 18 and 65 years, reported their frequency of food intake over the past year. The reported average intake was 2.8 servings per day for fruits and 3.2 servings per day for vegetables. Participants reported eating cereals 5.3 times per day (Dehghan et al., 2005). Intake of fruit and vegetables are insufficient and need to be increased substantially to comply with recommendations (WHO/FAO, 2003).

Food	Consumption rates (g/person/day)
Cereals - Excluding Beer	**395**
Oil crops	**11**
Vegetable Oils	**42**
Vegetables	**471**
Starchy Roots	**55**
Treenuts	**6**
Pulses	**19**
Spices	**8**
Meat	**227**
Animal Fats	**11**
Offals	**9**
Eggs (Food Groups)	**35**
Milk - Excluding Butter	**274**
Fruits - Excluding Wine	**151**
Sugar & Sweeteners	**98**
Stimulants	**11**

https://knoema.com/atlas/Kuwait/topics/Food-Security/Food-Consumption/Fish-Seafood; 2007

References

Dehghan, M., Al Hamad, N., Yusufali, A.H., Nusrath, F., Yusuf, S. & Merchant, A.T. 2005. Development of a semi-quantitative food frequency questionnaire for use in United Arab Emirates and Kuwait based on local foods. *Nutrition Journal*, 4:18. (available at: http://www.nutritionj.com/content/4/1/18)

FAO. *FAOSTAT Database*. Food and Agriculture Organization of the United Nations. Rome. (available at http://faostat.external.fao.org/faostat). Accessed in 2006.

FAO. *Statistics Division*. *Database on Major Food and Agricultural Commodities and Producers: commodities by country.* Food and Agriculture Organization of the United Nations. Rome. (available at http://www.fao.org/es/ess/top/country.jsp). Accessed in 2006.

MOP. 2004a. *Annual Statistical Abstract, 2004, Edition 41*. Ministry of Planning, Statistical and Information Sector, State of Kuwait. March 2004. Kuwait Nutrition Profile – Nutrition and Consumer Protection Division, FAO, 2006 33

WHO/FAO. 2003. *Diet, Nutrition and the Prevention of Chronic Diseases*. WHO Technical Report Series 916. Report of a Joint WHO/FAO Expert Consultation, Food and Agriculture Organization and World Health Organization of the United Nations, Geneva. (available at http://www.fao.org/docrep/005/AC911E/AC911E00.HTM)

4.8 PALESTINIAN WEST BANK

(Below is the except of a publication which summarizes the food consumption patterns in the Palestinian West Bank population)

Food consumption patterns in a Palestinian West Bank population

LCM Stene[1]*, R Giacaman[2], H Abdul-Rahim[2], A Husseini[2], KR Norum[1] and G Holmboe-Ottesen[3]

[1]*Institute for Nutrition Research, University of Oslo, Oslo, Norway;* [2]*Institute of Community and Public Health, Birzeit University, Birzeit; and* [3]*Department of Preventive Medicine, Institute of General Practice and Community Medicine, University of Oslo, Oslo, Norway*

Table 1 Mean (s.d.) household consumption of 25 selected foods, by wealth status[a]

	Mean (s.d.) (kg/consumption unit/y)				
Food item	*Poor (n = 95)*	*Middle (n = 224)*	*Wealthy (n = 48)*	*Test for trend*[b]	*Overall (n = 367)*
Olive oil	17.4 (10.0)	18.6 (10.3)	19.3 (9.8)	$P = 0.2$	18.4 (10.1)
Vegetable oil	3.2 (5.7)	3.1 (4.9)	3.8 (6.6)	$P = 0.9$[c]	3.2 (5.3)
Margarine	5.0 (3.2)	5.3 (4.0)	5.1 (5.1)	$P = 0.7$[c]	5.2 (4.0)
Sum fats/oils	25.7 (11.2)	27.1 (11.3)	28.1 (13.4)	$P = 0.2$	26.9 (11.6)
Red meat	9.1 (8.6)	10.3 (8.6)	16.0 (13.6)	$P < 0.001$	10.8 (9.6)
Cold cuts	3.1 (4.0)	4.8 (4.6)	5.5 (5.6)	$P = 0.002$[c]	4.4 (4.7)
Chicken	48.9 (33.2)	55.1 (29.5)	61.1 (27.1)	$P = 0.02$	54.3 (30.3)
Fish	5.8 (4.9)	6.8 (5.7)	7.3 (6.6)	$P = 0.009$	6.6 (5.6)
Eggs	15.2 (12.2)	15.1 (8.2)	17.0 (9.7)	$P = 0.4$	15.3 (9.5)
Sum	82.1 (44.5)	92.1 (37.1)	107.0 (37.6)	$P < 0.001$	91.5 (39.8)
Milk, fresh	6.4 (11.0)	8.6 (17.2)	7.7 (16.0)	$P = 0.9$[c]	7.9 (15.6)
Dried milk	0.7 (2.0)	1.5 (3.5)	3.9 (10.5)	$P = 0.06$[c]	1.6 (4.8)
Labaneh[d]	6.0 (7.1)	6.8 (7.0)	10.1 (8.3)	$P < 0.001$[c]	7.1 (7.3)
Yoghurt	9.8 (11.8)	12.3 (10.9)	10.6 (10.2)	$P = 0.4$	11.4 (11.1)
White cheese	2.0 (2.9)	2.8 (4.1)	4.8 (9.0)	$P < 0.001$[c]	2.8 (4.9)
Yellow cheese	0.9 (1.7)	1.3 (2.3)	2.5 (3.2)	$P = 0.1$	1.3 (2.3)
Sum dairy produce	25.8 (21.8)	33.4 (25.2)	39.6 (31.5)	$P < 0.001$	32.3 (25.6)
Lentils	4.2 (4.5)	2.9 (5.8)	2.0 (1.9)	$P < 0.001$[c]	3.1 (5.1)
Chick peas	1.7 (2.4)	1.2 (2.0)	1.8 (2.7)	$P = 0.2$[c]	1.4 (2.2)
Fava beans	1.8 (2.0)	2.2 (2.9)	2.4 (2.3)	$P = 0.2$[c]	2.1 (2.6)
Peas	3.0 (3.6)	3.7 (4.4)	3.8 (4.8)	$P = 0.5$[c]	3.5 (4.3)
Sum legumes	10.8 (8.4)	10.0 (8.7)	10.0 (7.2)	$P = 0.5$[c]	10.2 (8.4)
White flour	67.9 (68.4)	69.9 (64.0)	54.3 (53.8)	$P = 0.4$[c]	67.3 (64.0)
Brown flour	25.6 (31.6)	25.9 (28.9)	21.6 (24.9)	$P = 0.7$[c]	25.2 (29.1)
Mixed flour	54.9 (74.9)	34.8 (61.4)	29.3 (52.8)	$P = 0.05$[c]	39.3 (64.7)
Sum flours	148.4 (69.7)	130.6 (75.7)	105.2 (62.0)	$P = 0.001$	131.9 (73.5)
Rice	27.0 (13.6)	28.9 (15.7)	33.8 (19.3)	$P = 0.02$	29.1 (15.8)
Olives	2.6 (2.8)	2.7 (2.3)	3.3 (3.0)	$P = 0.2$	2.8 (2.5)
Sugar	37.3 (21.2)	38.1 (25.0)	37.4 (20.4)	$P = 0.9$	37.8 (23.5)
Salt	9.5 (6.5)	8.8 (4.8)	10.0 (10.2)	$P = 0.9$	9.1 (6.2)

[a] Figures represent consumption (kg) per year per household member, with number of household members standardized as reference consumption units (expected energy expenditure for men aged 18–30 y).
[b]For variables where model assumption were violated, a Kruskal–Wallis non-parametric test was performed.
[c]*P*-value for Kruskal–Wallis test.
[d]Partially dehydrated yoghurt.

Objective: To describe the food consumption patterns in relation to wealth status and age groups in a Palestinian West Bank village population.
Design: Community-based cross-sectional survey of both households and individuals. A list recall method was used at the household level. At the individual level, a short food-frequency questionnaire was used in addition to a 24-h recall without estimates of portion sizes.
Setting: A Palestinian semi-rural village in the central West Bank.
Subjects: All households and all men and women aged 30–65 y in the study village were invited. All 368 households and 85% ($n = 500$) of eligible individuals participated.
Results: The mean energy consumption from 25 selected food items on household level was about 13.8 MJ (3300 kcal)/consumption unit/d (a consumption unit corresponds to the expected energy requirement for an adult male). The proportion of dietary energy from fat and the consumption of most animal products was highest among the wealthiest households, and the opposite trend was seen for the consumption of wheat flour and lentils. There seems to be an ongoing trend of increasing consumption of processed products rich in sugar among the younger age groups.
Conclusion: Shortage of dietary energy on the household level did not seem to be a problem in this population, even among the poorest. Differences in food consumption patterns between the poor and the wealthy, including a higher percentage of energy from fat among the wealthy, may be to the disadvantage of the wealthy with respect to some diet-related chronic diseases.
Sponsorship: The Norwegian Universities' Committee for Development Research (NUFU).
Descriptors: dietary survey; developing country; cross-sectional study; rural population; socio-economic factors

European Journal of Clinical Nutrition (1999) 53, 953–958

http://www.stockton-press.co.uk/ejcn

4.9 NOMADS

Geographically, the Arabic countries region is characterized by desert, arable land and coastal areas which influence the dietary patterns of the residents. The desert area is inhabited by nomadic animal breeding tribes, who live mainly on cereal, dates, milk and milk products. The settled nomads consume cereal, pulses, some vegetables, and relatively less milk and fewer milk products. Meat is rarely consumed in the desert, being reserved particularly for occasions when guests have been invited or for feasts (Moore, 1970). However, the food consumption patterns may differ slightly from area to area based on the available food resources. In Iraq, nomads consume wheat bread, dates, ghee, milk and yoghurt. Rice is sometimes substituted for bread, and the only vegetable consumed is the onion (Al-ani, 1980). In arable areas, the inhabitants consume more vegetables and fruits, but the seasonal production has an impact on the type of food consumed. For example, in Egypt, the consumption of green vegetables, fruit and meat is higher in the Delta area than in oasis areas (Patwardhan and Darby, 1972). In coastal areas, fish plays an important role in the diet. The consumption of fish in Bahrain, Oman, Qatar, the United Arab Emirates and Southern part of Yemen is higher than in other countries in the region (Feidi, 1986). In contrast, fish consumption is almost negligible in countries which have limited coastal areas such as Syria (Alderman and vonBraun,1986) and Jordan (Patwardhan and Darby, 1972) as well as in all desert areas.

Dietary habits of Nomads in Iraq are presented in publication of Majeed R. Al-Ani (Ecol. Of food and nutrition, 1980, v.9, 55-58).

Food	**Amount consumed (g/day/capita)**
Bread (markouk	200
Wheat, whole	100
Dates, dried (Zahdi)	150
Date syrup (dibs)	50
Milk, camel	200
Yoghurt (Laban)	200
Ghee (Sann)	50

References

AL-ANI M (1980). Diet and dietary habits of nomads in Iraq. Ecol Food Nutr 9, 55-58

ALDERMAN H and VONBRAUN J (1986). Egypt's food subsidy policy, lessons and options. Food Policy 11, 223-236

FEIDI I (1986). Consumer preferences of fishery products in the Arab countries. Infofish Marketing Digest 2, 10-12

MOORE F W (1970). Food habits in non-industrial societies. In: Dupont J, (ed). Dimension of nutrition. Colorado: Colorado Associated University Press 181-222

PATWARDHAN V N and DARBY W J (1972). The state of nutrition on the Arab Middle East. Nashville: Vanderbilt University

Differences in food intake between adult Jews and Bedouins in Southern Israel

(Drora Fraser et al. Ethnicity & disease v.18, February 2008, 13-18)

The Negev region in southern Israel is the home of two subpopulations, Jews and Bedouins, each with its own culture, and socioeconomic and educational systems. The Jewish population in Negev is mostly urban and of lower socioeconomic status than Jews in Israel as a whole; a high percentage of the Jewish population are new immigrants from the former Soviet Union. The Bedouins are a Muslim population in transition from a nomadic to a settled lifestyle and are at the lowest socioeconomic level of all population groups in Israel. These residents, who account for <25% of the Negev population, are on average younger than Jewish residents in the region and in the country as a whole. The Negev Jewish population has a higher educational level than does the Bedouin population, and Bedouins also have higher rates of unemployment and lower monthly incomes than do the Jewish population.

Age-adjusted intake of food groups per day per person in grams

Food group	Males			Females		
	Jews *n*=348	Bedouins *n*=56	*P*	Jews *n*=445	Bedouins *n*=113	*P*
Oils, butter, margarines	7.1 (.7)	6.1 (2.0)	.66	6.3 (.5)	3.9 (1.1)	.05
Alcohol	34.5 (7.3)	.0 (.0)	.10	9.6 (3.0)	.0 (.0)	.08
Legumes	38.3 (5.8)	59.3 (15.3)	.21	21.5 (3.2)	36.7 (6.4)	.04
Complex carbohydrates	289.3 (1.5)	481.5 (27.7)	<.001	209.9 (8.0)	330.2 (16.4)	<.001
Fruits	337.0 (23.4)	282.7 (62.0)	.42	301.8 (17.9)	340.3 (36.5)	.35
Vegetables	279.7 (13.7)	208.1 (36.2)	.07	247.6 (1.5)	208.6 (21.5)	.02
Meat	136.7 (8.1)	128.6 (21.4)	.73	93.4 (5.0)	106.1 (1.3)	.28
Milk & dairy products	206.7 (11.5)	112.3 (3.4)	.005	196.4 (8.6)	121.6 (17.5)	<.001
Fish	21.3 (3.5)	11.5 (9.2)	.33	17.8 (2.3)	8.3 (4.6)	.07
Eggs	22.8 (2.6)	34.0 (6.9)	.14	13.6 (1.6)	23.7 (3.4)	.008
Nuts	12.2 (1.7)	.5 (4.5)	.02	9.0 (1.2)	3.5 (2.5)	.05
Potatoes	58.3 (5.3)	23.5 (14.0)	.02	32.5 (3.2)	34.7 (6.6)	.77
Sweets	26.0 (1.5)	3.8 (3.9)	<.001	19.1 (1.2)	6.0 (2.4)	<.001
Soft drinks	153.8 (2.3)	41.1 (53.8)	.05	85.0 (13.8)	30.3 (28.2)	.09

Values are given as mean (standard error).

4.10 SUMMARY

Concerning agricultural practices and food consumption habits it is rather difficult if not impossible to recommend general food consumption baskets. As outlined above different cultural and environmental factors influence living conditions in arid regions and consequently require also rapid adaptation. Therefore for any estimation of contamination via food chains the optimal approach is to use consumption data and agricultural practise data from questionnaires reflecting the actual situation. This will also enable to identify the critical population groups and unusual pathways, which have to be considered in dose calculation models.

RadCon

We are experts in the fields of radiation protection, Monte Carlo modelling, radio ecology, retrospective dosimetry, computational dosimetry and data analysis and collection. We perform calculations and measurements for applications in nuclear sciences. We develop software for computations and the assessment and presentation of data. Operating worldwide, we link businesses with research.

Our expertise is in the field of Radioecology:

- Experimental radioecology;
- Environmental modelling;
- Decision support systems;
- Remediation and restoration;
- Statistical methods and data analysis;
- Scientific consultancy;
- Education and training;
- Public communication and information

Contact us

Address: Am Mittleren Moos 46 A, 86167 Augsburg, Germany

E-Mail: info@radcon.de

https://www.radcon-nuclear.com

Phone: +49 821 74839–20