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Assessment of the available potassium in the soil of Baharka District, Kurdistan-Iraq

Saima Jadoon, Hamsa K. Aljaff, Jalal K. Hamawandy, Shwan S. Pashdary and Ayman S. Zakhoy

Department of Natural Resources Engineering and Management, University of Kurdistan, Hewler, Erbil, Kurdistan

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ABSTRACT

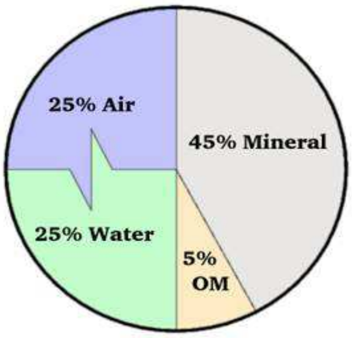
This study determined the potassium (K) concentrations in the soil of theBaharkadistrict in the south west of Erbil, Iraqusing flame-photometer, the soil sample analysis showed that theBaharka district has an optimal K concentration with a mean value of 65ppm. In addition, the soil samples in this area were obtained within a coordinate frame ranging between minimum and higher coordinates of 36.34 and 44.0 i. e. respectively. The concentration of potassium was found normal for the plant nutrition. Moreover, K fertilizer would notbe requiredfor future fertilization of fields. Repetitive, this study indicated a substantial availability of K in the agricultural fields, and the research would have tangible future prospects for K management in soils.

Key words: Soil nutrients**,** availability of the potassium**,** flame photometer, Baharkadistrict.

INTRODUCTION

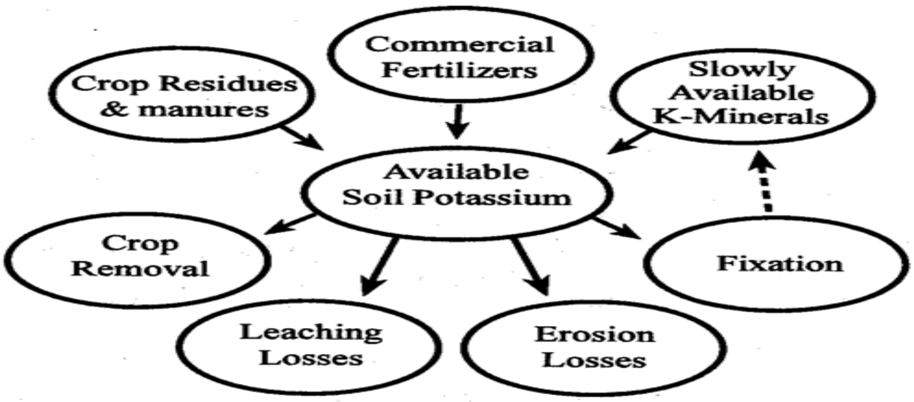
Soil is a mixture of mineral and organic matter that covers the earth's crust. Potassium plays a major rule in the growth of a plant. Also, the mineral portion of soil is divided into three particle-size classes, which are sand, silt, and clay. There are also other minerals which are important to plants and industry such as potassium (K), calcium (Ca), iron (Fe) and so on. As a result, any increase or decrease in the amount of potassium in soil will show a direct effect on the plants growth. Information on the availability of potassium in soil of certain area may provide valuable information for agriculture and industrial needs. Therefore, it is important to understand theKlevel in the soil ofthe Kurdistan region as an imperative factor. It is very difficult to assess K levels across the whole Kurdistan region. This research study focused on the determination of the availability of K in theBaharka district. The district is located in the south west of Erbil and was selectedas a sampling area due to the significance of this area and the absence of information data about the soil[1].

Figure 1: Components of soil [2]



Potassium is a major mineral that exists within soil and plays a major role in plant growth [3]. Potassium is essential for crop production and stimulates early plant growth,increases protein production, improves the efficiency of water use, which is vital for is the connected to, longevityan winter hardiness, and improves resistance to diseases and insects[4].

Figure 2:Potassium dynamics in soil [5]



Therefore, in order to determine the percentage of potassium, several pieces of equipment are used. One of the most important pieces equipment is aflame photometer. It is used due to its simplicity, lack of error, high quality of work andthe short time needed to complete the K analysis.

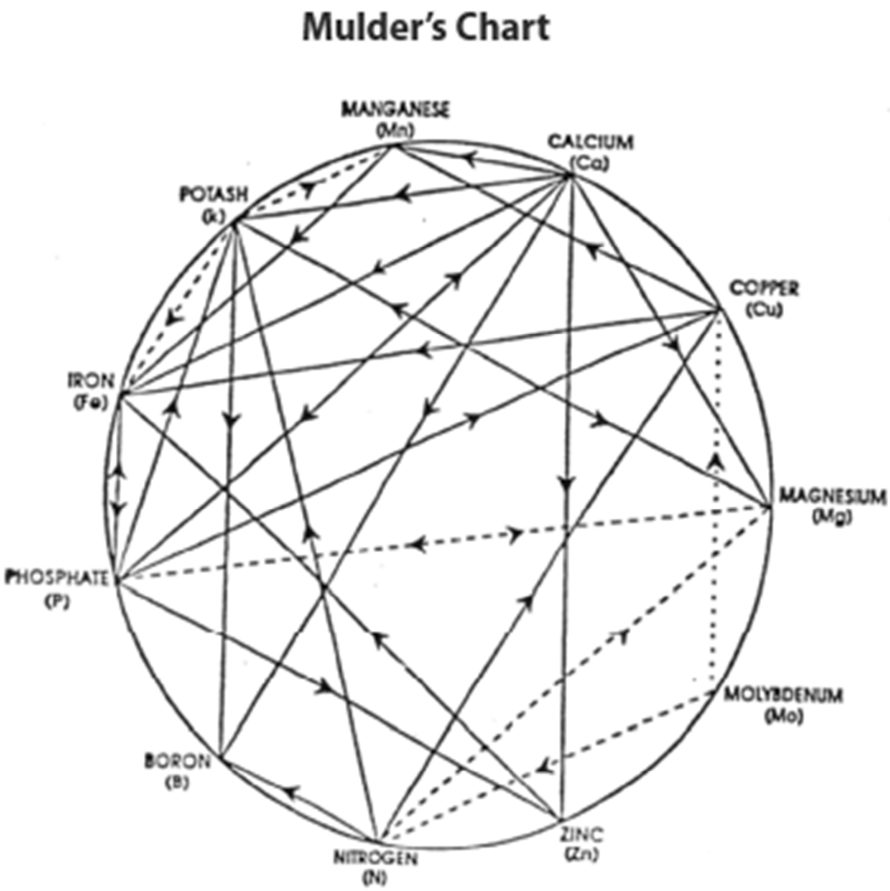
1.2. Relationship of K with other elements

For a plant to build up protein and have a good living cells function they need thirteen nutrients. These essential nutrients are given as follows:

1. Primary nutrients:nitrogen (N), phosphorus (P) and potassium (K)
2. Secondary nutrients: calcium (Ca), magnesium (Mg) and slur(S)
3. Micro-nutrients:boron (B), copper (Cu), iron (Fe), chloride (Cl), manganese (Mn), molybdenum (Mo) and zinc (Zn).

Even though plants need fewer micronutrients, they are still important for good growth [6].The combination of those primary and secondary nutrients in an exact amount will give a suitable quality of soil. Conducive quality of soil isessential for healthy crop growth.Figure 3 shows the occurrence of potassium as affected by the occurrence of other elements. The existence of K in soil has a direct effect on the plant growth and plant nutrition. This directly affects the agricultural productivity. Potassium increases crop yield and improves its quality in a way that it can be considered as one of the main mineral constituents in soil which is required for a large number of processes that relate to the growth of the plants [7].It is essential to determine the exact amount of K in soil for fertilization management of the soils of theBaharka district.

Figure 3: Occurrence of K as affected by other elements [6]



1.3. Flame-photometer

A flame-photometer (model PFP7 Jenway, UK)was used to determine theK content in soil. The instrumentis also used to investigate the concentrations of different types of minerals and heavy metals in soil. Overall, to examine the concentration of different elements contained in different samples, the solutions of the desired samples are aspirated to the nebulizer and passed to the flame which is fuelled by propane and air, or a different gaseous mixture. Later, the solution of the sample is evaporated and eventually atomized. After that, the atom will gain an additional energy from the flame, and as a result return to ground state in which it emits a radiation of a different wave length depending on the energy level of the atoms, Later, the flame photometer directly selects the wave length of the desired element by a filter,and finally the intensity of the emission is measured in accordance with the concentration of the original sample (Monzir-pal.net/Lab) [8]. This instrument was used for the determination of different type of minerals concentration in soil due to the high accuracy of the performance, low cost, minimum rate of error, and accurate data in a short period of time.

Figure 4: Flame photometer instrumentused to determine the K concentration

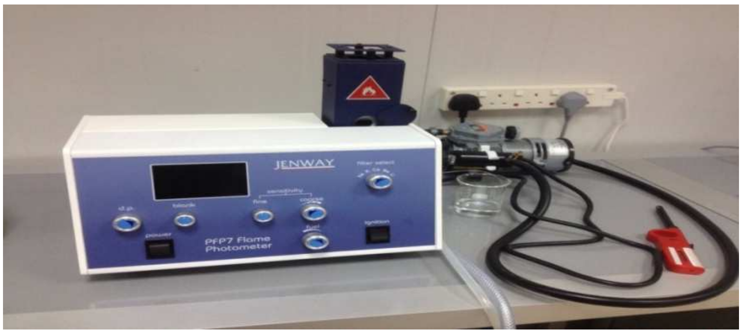
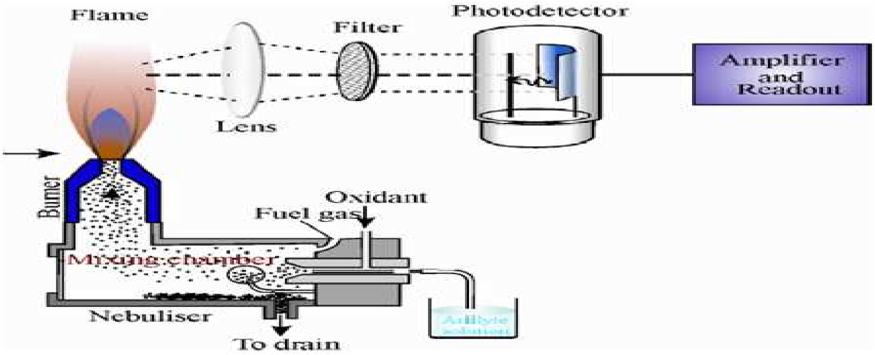


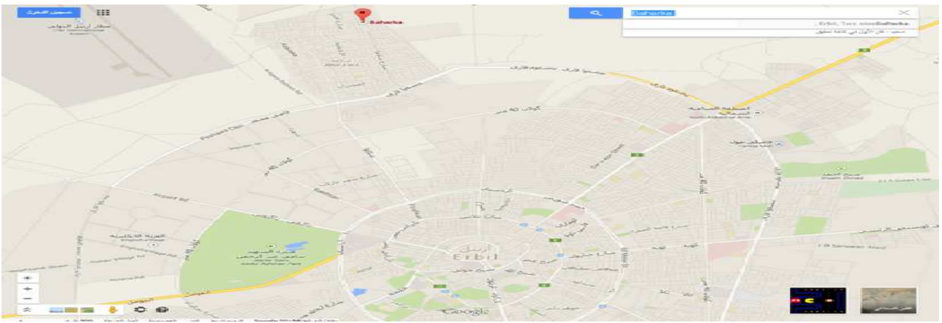
Figure 5: Mechanism of the instrument to determine K in the soil sample by flame photometer [9]



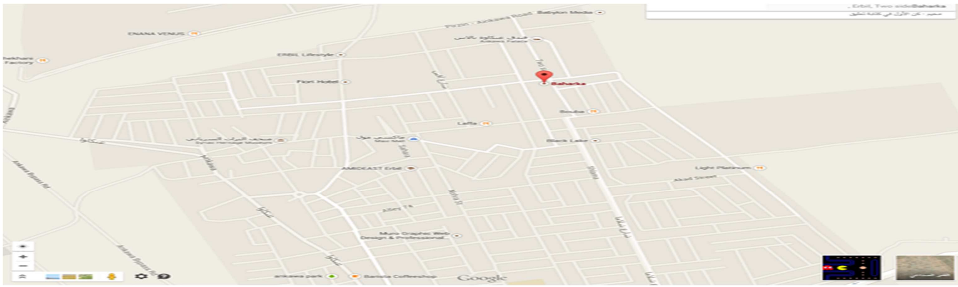
1.4. Agricultural importance of Baharkain Kurdistan

Baharka is a small town about 10km north of the Kurdish city of Erbil, Iraq. It is a nice residential area which rich soil. Soil is useful for agricultural activities.

Map1: Location of Baharka, Erbil on the map [10]



Map 2: Location of Baharka on the map [10]



MATERIALS AND METHODS

2.1. Data collection

Soil sampling was done from 30cm soil depth (root zone).The samples were collected in a random pattern in an average of 5 to 7 samples. In addition, to reach the target and obtain better and accurate soil samples, the roads, along with low, salty, wet areas were avoided [11].

Table 1: Latitude and altitude of sampling area

Number of samples	Latitude of place N	Longitude of place E	Altitude of place (m)
1	36.339166666	44.0018	466
2	36.339427	44.005050	459
3	36.339451	44.005112	496
4	36.319302	44.005199	480
5	36.339103	44.005094	472.0
6	36.335050	44.005316	467.0
7	36.339318	44.005416	473

Soil samples were collectedfrom an agricultural area ofBaharkato examine the concentration of K in soil using a flame photometer. Before the determination of K in soil samples, the instrument was calibrated with a standard solution of K.

2.2.3. Preparation of soil samples

Soil samples were collected and then dried.The samples were placed in the oven (Goshin Model: SM-73 com)for a given period. Thereafter, the samples were sieved by a 2mm sieve to obtain a fine grain soil. Each soil sample was weighed upto 5g using the sensitive balance (ae ADAM PGW 253m). 50mL ammonium acetate (CH_3COONH_4) solution was pouredin to agraduated cylinder. For the preparation of the ammonium acetate (Sigma company) mature 38.5g the Ammonia crystal by using a sensitive balance, then diluted in 29 mL of Glacial acetic acid ($C_2H_4O_4$).The soil samples wereshakenfor 30 munition and then left for a while.Then samples were passed through afilter paper.The filtered mixture was read on theflame photometer to determine the K content in soil [12].

2.2.2. Preparation of standard solutions of K

Standard solutions of K were prepared for the calibration of theflame photometer. For this purpose, 5 standard solutions were prepared i. e., 0, 20, 40, 60, 80 and 100ppm. Ammonium acetate solution was used as a blank. After calibration, the soil samples were fed to the flame to determine the K contents in soil.

Data Analysis

The data were analyzed for statistical parameters [13]. The statistical method used is given as follows:

$$Mean = \frac{\sum xi}{n}$$

$$Mean = 165$$

$Mean =$ Where X_i is the sum of the concentration of the samples;

N is the number of the collected samples;

$Range = Maximum\ value\ of\ K\ concentration - minimum\ value\ of\ K\ concentration\ of$

$Range = 211\ ppm - 146\ ppm = 65\ ppm$

Standard Deviation

SD = (xi-x¯) (xi-x¯)^2= $\frac{(xi-x-)2}{n-1} = \sqrt[2]{\frac{(xi-x-)2}{n}} = \frac{(xi-x-)2}{n-1} = \frac{30.33}{7-1} = 5.058$

$$= \sqrt[2]{\frac{(xi - x-)2}{n}} = 30.33$$

The confidence interval

$Z_{a/2}*\frac{SD}{\sqrt{n}}$=10.89047934

$X_{mean} \pm Z_{a/2}*\frac{SD}{\sqrt{(n)}}$

= 175.9, 154.1

RESULTS AND DISCUSSION

Table 2: Concentrations of standard solution byflame photometer

No	Concentration(ppm)
1	0
2	20
3	40
4	60
5	80
6	100

Figure 6: Calibration graph of the standard solution byflame photomer

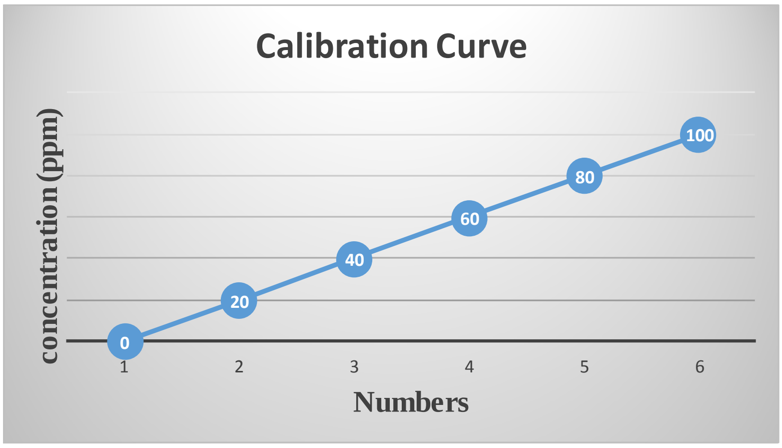
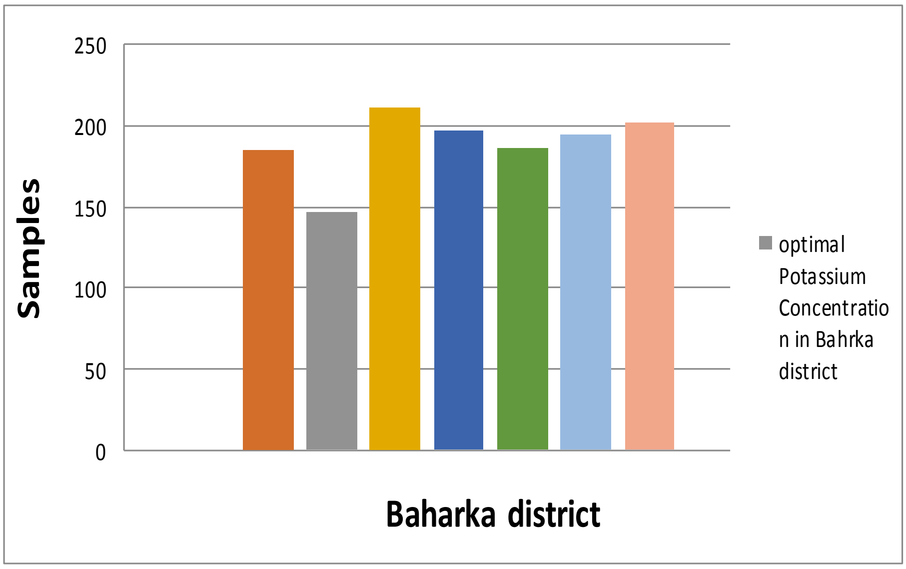


Table 3: Soil samples concentration of K

Samples	Concentration (ppm)
0	0
1	185
2	146
3	211
4	197
5	186
6	194
7	201
Sum	1320

The range of the results was 65ppm, with 30.33 standard deviation obtained within a range of the seven samples, and confidence interval was±10.89.

Figure 7: Graphical representation of the concentration of Kin different places of Baharka district



DISCUSSION

From the analysis of soil samples, it was concluded that there were three levels of potassium concentrations in soil (high, low and optimum), according to the modified Kelowna method for the determination of K concentration. In thecase of higher concentration (> 400 ppm), the ability of the soil to work in balance with the applied fertilizer was incompatible [14], [15]. While in the case of the lower concentration < 125 ppm K, the result of such concentration in soil will lead to a decrease in the productivity of the soil [16]. In the third case where the concentration of the potassium is optimum, this is the same type of concentration that was obtained in the conducted experiment of this research paper concluded by comparing between the standard international concentrations of potassium in agriculture [15], and the results information collected from the Baharka land. It concluded that the agriculture area of Baharka district had an optimal rate of potassium with a range of 65ppm and Standard Deviation of 30.33 and confidence interval was ± 10.8, so our results will range between 175.9ppm, and 154.1ppm. The results indicate that this area is considered as a good agricultural area, and the concentration is not harmful for the plants.

CONCLUSION

As long as the potassium percentage remain at the same rate, the growth of olive there which are concentrated in that area will not be affected. According to what has been discussed, more no more fertilize, is need especially for the olive plants.

It is concluded that the farmers do not need to add more fertilizer or decrease the amount of potassium in the area. The following recommendations are suggested:
1. The land must be examined in order to keep the normal range of potassium.
2. Record the change of potassium concentration in the soil, and note the changes every year.

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