Study and Evaluation the Importance of Water Rationing for Crops in Combating Desertification in the State of Kuwait

Khaled Abdallah El Naka[1 *], Saad A E Abdelrazek[1]

ABSTRACT

Due to the scarcity of water in the State of Kuwait and to insurance food security, attention has been oriented to agricultural investment to reduce the gap between food consumption and the process of importing it. Therefore, the State of Kuwait has tended to use unconventional water resources such as the treatment of sewage water and reduce the cost of treating salt water and turning it into fresh water. The most important results were to identify the water rating of the most important crops in cubic meters, whose root length reaches 0.6, 1.6, 1.8 m, in addition to identifying the climate conditions in the State of Kuwait, as it is clear from them that they are harsh conditions.

Words key: Water rationing, Desertification, State of Kuwait.

INTRODUCTION

Water is one of the essentials for agriculture. The estimated amount of water in the weight of green plants is about 75-90%, and this indicates the importance of water for vegetable plants. In Kuwait, it depends on treated water and groundwater for irrigation (Nassar, 1992).

Plants differ from any other living organism in expressing their need for water in terms of its quantity and timing in the so-called irrigation periods. Where there are some plants show symptoms of wilting as a result of an intense need for water, for example beets, but there are many vegetables that do not show signs of wilting despite its need of water, such as carrots, cabbage, asparagus and others. Therefore, it is necessary to select the optimum and suitable irrigation scheduling for each crop (Abdelrazek, 2019).

The amount and periods of irrigation (irrigation scheduling) vary depending on several factors, including the type of soil, type of crop, plant growth periods, agronomy management and weather factors, especially air temperatures (Abdelrazek, 2014).

Vegetables classified, according to the level of moisture in the soil, into fifth groups. The first group of crops is that grow well near the wilting point and also grow in good condition when there is a high percentage of soil moisture such as cabbage - pepper - radish - Alexandrian pumpkin - turnip – watermelon (Abdelrazek and Fayed, 2019). The second group of crops that required at least 20% of the ground moisture above the wilting point, for example, beans, carrots, cucumbers, onions, spinach and tomatoes (Aisueni et al., 2009). Third group of crops is that consumed at least 33% of the soil moisture above the wilting point such as lima beans and peas (Abdelrazek, 2017). The fourth group is that require at least 50% of the soil moisture above the wilting point such as beetroot – lettuce (Attia and Arsanius, 2009). Fifth group of crops is that need moisture level higher than the field capacity such as celery and perhaps taro (Kassab, 2009).

Among the ways of losing irrigation water from the soil, there are three ways to lose irrigation water from the soil, the surface loss, which is the amount of excess water when irrigation, the loss by evaporation. In general, we are concerned with the amount of water lost through evaporation, especially if the amount of irrigation is low or the roots of plants superficial, as in the case of beets, loss through leaching, which related to the nature of the soil, the level of water table, and the presence of drains **(**Al-Barrak, 2018**).**

The total available water for plant is the difference between field capacity and wilting point. Soil type, weather condition and crop are control the amount and period of irrigation **(**Al-Ramadhani, 1979**).** For example, in irrigated sandy soil, it is necessary to repeat irrigation at short intervals, especially in summer, to ensure that moisture is constantly available around the roots of plants **(**Al-Nakshabandi and Kijne, 1974**).** It is also recommended to irrigate vegetable crops by about 2 inches (210 m^3) per week per feddan (4200m^2) in sandy soil in dry weather **(**Debaeke and Aboudrare, 2004**).**

In terms of yield, the nature of plant growth must be known before irrigation, Crops differ in relation to the quantity of irrigation water and the length of time during which they are in most need of water (Gong et al., 2004; Li et al., 2007 and El-Sayed, 2013).

DOI: 10.21608/asejaiqjsae.2022.249811
[1] Soil Salinity Department, Alexandria Soil, Water and Environment Research Institute, Agriculture Research Center (ARC), Giza, Egypt/ saadabdelsamad1@gmail.com - Gmail
*Kuwait National Guard

Received May 25, 2022, Accepted, June 30, 2022.

Hamada (2015) studied the impact of climate change on cropping pattern. The results show that the use of agricultural resources has deviated from the optimum utilization of resources in south and north Egypt, which maintains the economic efficiency after land effective by impacts of climate change.

The State of Kuwait is a community of research, where the rate of desertification reached 100%, the diversity of the composition of crops and the amount of water consumed and due to the prevalence of desertification with the lack of water. Therefore, the water rationing of crops is one of the solutions proposed by the study to combat desertification. Therefore, attention was oriented to find ways for reducing the amount of wasted water, including the use of water rations for each crop that is cultivated in the State of Kuwait.

MATERIALS AND METHODS

The research relied on the use of the descriptive and quantitative methods to show the relationship between the different variables. The research relied on the published and unpublished data from Public Authority for Agriculture Affairs and Fish Resources in the State of Kuwait and the Statistics Authority, in addition to the international references and research related to the subject of the research, in addition to the experimental method.

RESULTS AND DISCUSSION

Table (1) the date of irrigation may affect the yield, because delaying the date of the first irrigation of the pea reduced its yield significantly. In terms of the impact of weather factors, especially air temperatures, we find that the amount of irrigation water and the time of irrigation varies from one crop to another, according to the different weather factors that affect the amount of transpiration, the most important of which are heat, light, humidity, air and wind speed. For example, the amount of water lost by plants through transpiration is less in winter than in summer. In addition, transpiration increases with increasing temperature and increases during the day than during the night, in order to open the stomata during the day and this is due to the effect of light. The transpiration increases with a decrease in atmospheric humidity and increases with an increase in wind speed until the wind speed reaches about 15 miles, at which point the stomata are closed and transpiration decreases. Temperature, humidity and wind speed also affect the amount of water present in the soil surface.

Table (2), (3), (4) In terms of the effect of different growth periods on the quantity and timing of irrigation, we find that there are some crops that need water at some times during their growth more than they need water at other times of this growth. An example of this is potatoes, which are in most need of water when the plant is between 40-55 days old, which is the period of formation of tubers, when plants benefit from irrigation during this period. While tomato plants need the most water during flowering

It is observed in the case of surface irrigation.

1- Excessive irrigation in the early life of the plant results in abundant vegetative growth and a delay in the time of flowering and knotting. Sometimes the knots are absent, especially in cowpeas and turkey, or the knots may decrease, especially in zucchini, pumpkins, tomatoes and peppers.

2- The best time to water vegetables in summer is the early morning before the sun gets too hot, or in the afternoon when the sun's heat decreases. As for irrigation at noon (when the heat intensifies), it causes temporary anesthesia in the roots of plants, especially if the planting is in a state of extreme thirst or if the ground is sandy or light yellow.

3- It is not necessary to irrigate a basin from a basin or irrigate about one year, because this means increasing the irrigation water in the section that will be irrigated first, which may adversely affect the plants planted there.

4- The soil should not irrigated immediately after it has razed before it can benefit from its exposure to the atmosphere.

5- The land should not irrigated without the need for irrigation.

6– It should be avoid getting water in the lines above the seeds before they germinate.

7- It is notice that the water speed should reduce when irrigating the basins (planting in the basins) so that the seeds do not drift towards the end of the basin.

8- It is preferable when surface irrigation to extend the period between planting and irrigation (the first irrigation) as much as possible, especially in crops sown directly by seed, as is the case in watermelon, zucchini, pumpkin, cowpea, beans, types of beans and okra, until the roots deepen and this is due to the fact that when the land dries up And the lack of moisture around the small roots of these plants, as their roots spread in the surface layer and go deep into the ground in search of moisture. The lack of moisture during this period may lead to a lack of plant juices, which leads to the plants accelerating the formation of flowering and fruit buds to ensure the preservation of their offspring before their death due to the increased drying of the moisture around them. Always, especially in its early growth.

9- Irrigation at short intervals with a small amount of water is better than irrigation over long periods and with a large amount of water.

Table 1. Average of meteorological date in the State of Kuwait.

Month	Temp ^{0}C	The amount of rain (mm)	Wind speed (Km/day)	Rel Humidity	Sunshine (Hour)	Radiation	Evaporation transportation	
January	42	59	32	62	5.8	2.9	4.66	2. 36
February	42	59	30	60	6.3	5.4	3.08	2.64
March	43	51	33	63	8.2	6.7	5.89	4.95
April	44	51	34	64	10.2	10.5	6.25	5.99
Mayo	45	14	35	65	10.5	10.8	6.85	6.05
June	45	32	50	70	11	10.2	6.77	6.69
July	48	31	50	70	11	10.2	7.28	5.10
August	47	37	55	69	9.6	10.9	7.78	7.68
September	47	37	56	69	10	9.5	5.62	5.20
October	42	36	40	63	10.5	9.5	4.30	4.45
Nov	43	63	40	63	7.8	9.7	4.15	4.55
Dec	42	43	32	62	6.9	9.2	4.56	4.20
Annual Average	44	55	62	60	9.2	9.2	6.81	6.93

Source: The average of the State of Kuwait was obtained from the weather stations in the State of Kuwait: Abdali, Mutribah, Jal Al-Layya, Al-Sabriyah, Al-Salami, Mazraat Al-Abraq, Al-Rabiah, Kuwait City, Kuwait International Airport, Mina. Ahmadi, Ras Salmiya, Jahra, Sulaibiya, Wafra, Umm al-Qadir.

Table 2. The most important vegetable crops and their need for irrigation, the number of irrigations, the amount of one irrigation in cubic meters, and the total water needed for irrigation. Crops with roots up to 24 inches (0.6 m^3),

Crops produce	Life period of the crop in the field	Amount of water in inches (105 m^3)	The number of irrigations in the sandy ground	Irrigation rate in cubic metres	Total water needed for the crop, in cubic metres
Potatos	4	30	2 - 3	250	2000m^3
Brussels sprouts	3	12	10	300	3500
cabbage	5.5	12	10	300	3500
cauliflower	5.5	12	10	300	3600
Celery	-	30	15	650	3700
lettuce - winter	3	6	7	300	2000
lettuce - summer	3	18	5	300	2500
medium ripe onion	5	15	7	300	2500
late-ripening onions	5	24	8	350	2500
radish	3	15	4	300	2000
spinach	3	3	10	300	3500
broccoli	3	3	15	650	3700

Table 3. The most important vegetable crops and their need for irrigation, the number of irrigations, the amount of one irrigation per cubic meter, and the total water needed for irrigation, crops with roots up to 48 inches (1.2 m^3).

Crops produce	Life period of the crop in the field	Amount of water in inches (105 m^3)	The number of irrigations in the sandy ground	Irrigation rate in cubic meters	Total water needed for the crop, in cubic meters
long beans	3	15	13	300	3500
Winter green beans	3	12	4	250	3000
Green beans	3	20	6	350	4500
(Kidney beans) dry beans	3		3	350	2000
Carrots	4	18	5	300	1800
Swiss chard		20	6	350	5000
cucumber	4	15	6	350	5000
(summer)Eggplant	4	15	13	300	4000
(winter peas) long peas	6	7	7	300	3000
pepper	3	20	6	350	5000
Alexandrian percussion	5	20	6	350	5000
turnip	3	18	5	300	1800

Table 4. Crops with roots up to 72 inches (1.8 m^3).

Crops produce	Life period of the crop in the field	Amount of water in inches (105 m^3)	The number of irrigations in the sandy ground	Irrigation rate in cubic metres	Total water needed for the crop, in cubic metres
artichoke	7	25	4	350	4000
asparagus12	7	25	4	250	1500
Gaon	7	25	4	250	1500
lima beans	7	15	2	200	1000
parsnip	7	22	3	200	1000
Pumpkin	5	25	4	250	1500
Alexandrian gourd (Courgettes)	5	22	10	300	3000
Sweet Potato	6	20	8	300	3000
tomatoes	7	25	10	300	1500
watermelon	4	20	3	300	1500

ACKNOWLEDGEMENT

The authors would like to express great thanks to the Soil, Water and Environment Research Institute, Soil Salinity and Alkalinity Department, Alexandria and Kuwait Institute for Scientific Research in State of Kuwait.

RECOMMENDATIONS AND SUGGESTIONS

1. Water rationing for crops in combating desertification in the State of Kuwait.
2. Raising the costs of using water Irrigation in order to achieve a profit margin for this element.
3. Learn about economic efficiency to use the water resource to reduce the wasteful use of irrigation water.

REFERENCES

Abdelrazek, A.E. 2017. Heavy metals risk assessment for potato (*Solanum tuberosum* L.) Grown in soils at Borg El Arab region – Egypt. Alex. Sci. Exch. J. 38: 620-625.

Abdelrazek, S. 2019. Monitoring irrigation water pollution of Nile Delta of Egypt with heavy metals. Alex. Sci. Exch. J. 40: 441-450.

Abdelrazek, S.A.E. 2014. Effect of Wastewater Irrigation on Plant Enzymes and Soil Health Assessment in Borg Elarab Region. Ph.D .Thesis, University of Sadat City, 32-37.

Abdelrazek, S.A.E. and R.I.M. Fayed. 2019. The Soil Management Practices and Land Use Periods in Relation to Soil Health of some Sandy Calcareous Soils in Egypt. Alex. J. Soil Water Sci. 22: 652-672.

Aisueni, N.O.O., C.E. Ikuenobe, E.C. Okolo and F. Ekhator. 2009. Response of date palm (*Phoenix dactylifra*) seedling to organic manure, N and K fertilization in polybag nursery. Afr. J. Agric. Res. 4:162-165.

Al-Barrak, A.H. 2018. Evaporation and potential evapotrabs piration centralIraq. M.Sc. Thesis, Utah State University.

Al-Nakshabandi, G.A. and J.W. Kijne. 1974. Potential of Evaportanspiration in Central Iraq using penman method with modified wind function. J. Hydrol. 23: 319-328.

Al-Ramadhani, R.M.A. 1979. Scheduling irrigation using climate soil data. M.Sc. Thesis, College of eng. Univ. Mosul No. 1:26-31

Attia, S.R. and S.K. Arsanius. 2009. Using the concept of virtual water in the comparison Some crop structures in light of the limited water resource. Egypt. J. Econ. 1:16-11

Debaeke, P. and A. Aboudrare. 2004. Adaption of crop management to water limited environments. Eur. J. Agron. 21: 433.446.

El-Sayed, A.A.M. 2013. An economic study of water resources in agricultural policy. Ph.D. Thesis, Zagazig University, 45.

Gong, D.Z., S.Z. Kang, L. Tong and R.S. Ding. 2004|. Effect of root divided alternative irrigation on soil moisture distribution and root-trank sap flow dynamic of peach trees. J. Hydraul. Eng. 35: 112-118.

Hamada, Y.M. 2015. Impact of climate change on cropping pattern & possibility of enhance it. Egypt. J. Agric. Res. 93: 251-272.

Kassab, M.2009. "Crop Structure and Calculation of Water Needs" Nile Water and Challenges Symposium. Nineties, Cairo, March 25-24, 2: 75-81

Li, F., J. Liang, S. Kang and J. Zhang. 2007. Benefits of alternate partial root-zone irrigation on growth, water and nitrogen use efficiencies modified by fertilization and soil water status in maize. Plant Soil 295: 279-291.

Nassar, S.1992. Economic water rations for the most important field crops and their relationship to optimal technical water rations. Egypt. J. Appl. Sci. 3:21-26.

الملخص العربي

دراسة وتقييم أهمية تقنين المياه للمحاصيل في مكافحة التصحر في دولة الكويت

خالد عبد الله الناقة، سعد عبد الصمد عبد الرازق

نظرا لندرة المياه بدولة الكويت وكذلك العمل على توفير الامن الغذائى بسبب زيادة عدد السكان ولوجود وفرة مالية من عائد البترول فقد اتجهت الانظار الى الاستثمار الزراعى لتقليل الفجوة بين استهلاك الغذاء وعملية استيراده. ولحاجة الزراعة الشديدة الى المياه العذبة لرى محاصيل الانتاج النباتى فقد اتجهت دولة الكويت الى توفير هذا العنصر الحيوى من خلال معالجة مياه الصرف الصحى وتقليل تكلفة معالجة المياه المالحة وتحويلها الى مياه عذبة.

كذلك توفير المياه وعدم الاسراف فى مياه الرى واللجوء الى الرى الحديث بدلا من الرى السطحى ما يستلزم معرفة المقنن المائى لكل محصول خلال فترة نموه وهذا ما يهدف اليه البحث الحالى، وكانت اهم النتائج التعرف على المقنن المائى لأهم المحاصيل بالمتر المكعب والتى يصل طول الجذر منها الى ٠,٦، ١,٦، ١,٨م بجانب التعرف على ظروف المناخ بدولة الكويت وكما يتضح منها انها ظروف قاسية.

الكلمات المفتاحية: تقنين المياه، التصحر، دولة الكويت.