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Irrigation Water Management and Soil Conditioners, A. Review

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Abstract
Irrigation water management is very necessary not only to promote the implementation of irrigation scheduling methods, but concurrently to improve system design and performance and to enhance farmers' skills.
Improved use of irrigation water for agricultural, which is crucial in periods of scarcity, has led to a method for determining its distribution, in terms of date and volume, according to the water needs of plants. Maximize the cultivated area during periods of the low environmental demand for evapotranspiration (ET), and / or the period when precipitation is more likely to occur, which may have beneficial effects on water productivity (WP). This can be obtained by the changing of the planting dates in the field, or considering the protected cultivation strategies that would agree to control climate variables and reduce the crop evapotranspiration (ETc).

Keywords: Irrigation Management, Soil Conditioners, ETc, Water productivity, Crop yield.

Introduction

The water used by crops in semiarid areas is only a relative to a small percentage from the available water. The competing uses for water (domestic, industrial, and environmental) and increasing demand for food, due to the rapidly growing world population require an urgent improvement of productivity per the unit of water used in the field of agriculture (FAO, 2002). This can be accomplished by both advancing the understanding of the physiology and molecular basis of plant WP and implementing current knowledge to improve WP in agricultural productions. Therefore, farmers often have to manage irrigation under moderate or severe water shortage.
The allocation of the limited water supply is fundamental to irrigation management decisions, the main issues for irrigation water management are: 1- the amount of water needed to meet the demand for crops, 2- when irrigation is needed, and 3- how to supply water to the crop (i.e. choosing the irrigation method). Also, the objective has been comprehensively studied in the classic experiments which aiming to the define yield response curves for increased water applied. A great deal of data is available on the water requirements of the major field vegetable crops, (Allen et al., 1998; Tognoni et al., 2002).
The Egyptian Government plays an important role to farmers to be achievements in water conservation. There are many steps might be taken to adjust to climate change, but more must be done to ensure a sustainable future for irrigated agriculture, especially in the new reclaimed lands where the water is more expensive due to well construction and pumping and soil is poor relative ti its water characteristics. Mostly cultivated lands in Egypt is irrigated one, where water is not used as efficiently as it could be.
In the semi-arid regions, for example, soil salinity must be controlled by the soil filtration, and the amount of water required to washing the soil salts down the root zone must be taken into consideration for sustainable irrigated agriculture (Jensen, 2007). Moreover, the efficient use of water in the agricultural field is a complex topic that includes a wide range of the disciplines, including the plant physiology; agronomy, and engineering. In this subject, efficiency is meaning of the transpiration efficiency for the physiologists; the irrigation efficiency for agronomists, and the water use efficiency for engineers, (Hsiao et al., 2007).

Water productivity:

As agriculture seeks to increase crop yields while relying on a gradually diminishing vital resource, the need for increased water productivity (WP) becomes the progressively more important. The little success to date has been achieved with genetic methods to modify complex traits such as transpiration efficiency. Targeted agricultural practices such as crop / variety selection suitable for a given environment as well as planting and harvest times, adequate plant nutrition, soil management and weed control can contribute significantly to improving WP (Robert et al., 1996). White phosphorous can be improved by enhancing soil properties by modifications that should be made.

Soil conditioners

There many types of the soil amendments natural (Farmyard manure, compost and factories residues) and/or synthetic (polymers, ratings, glue, manufactured papers residues) could help in increasing soil ability to retain more water and keep it from ways of losses, (Ebtisam Et al., 2015). Mostly any improvement of the soil hydro-physical properties was associated with improving in soil water retain ability through improvement of aggregates formation and increase fine particles in soil especially in active root zone (Abd El-Hady, 2005, Ebtisam and Abd El-Hady, 2015a;b, Mansour 2015, Mansour et al., 2015 a, b, c; Mansour et al. 2016a, b, c); Mansour 2006; 2012; Mansour and Goyal 2015, Goyal and Mansour 2015; El-Hagarey et al. 2015; Mansour et al 2019 a,b; Mansour et al 2015 a,d; Mansour et al 2016a,c, and Tayel et al, 2016, 2018).

Other criteria for improving the water productivity (WP) may include the control of physiological processes affecting plant transpiration and yield. In this regard, our understanding of ABA perception and signaling mechanism has been greatly advanced. This potentially opens up new avenues for developing commercial products that modify / control ABA's action to improve plant WP, (Weineret al., 2010). Over the years, crop WP has increased mostly because of higher harvest index and improved efficiency of irrigation methods rather than increased biomass production per unit of the water used (Passioura, 2006).

Another method used to improve WP is mulching where the benefit in the production of vegetable crops is well established.

The plastic mulches are used to increasing the soil temperature, the control weeds, and thus improve crop yields. The plastic sheeting reduces the nutrient leaching and stabilizes of the soil moisture (Zajicek and Heilman, 1991), which in turn may enhance fast and uniform of the soil coverage of crops and increase yields. The light reflected from the surface of the plastic wrap can improve the growth of tomatoes plants (Decoteau et al., 1989). Although plastic mulching may require labor and specialized equipment for fertilization and water management, drip irrigation and fertilization (fertigation) systems may increase the yield of covered vegetable crops. Partial fulfillment of topsoil requirements is called incomplete irrigation and is an important tool for increasing white phosphorous. Deficient irrigation implies a gradual increase in the water stress of crops, which is obtained through regular reduction of the amount of water used (Fereres and Soriano, 2007). This practice is based on the prior knowledge of the crop responses to water deficit and is increasingly used in fruit crops (Evansand Sadler, 2008). The pecific technologies have been developed that cause partial water shortages in recent years. This includes regulated hypo irrigation and controlled alternative partial irrigation or partial drying of the root zone, which have been suggested to improve white phosphorus and fruit crops, (Kang and Zhang, 2004) who reported that excessive irrigation (> 120 % from ET) resulted in lower WP due to deep percolation and leaching, whereas N distribution with fertigation proved to increase WP.

Regarding the vegetable crops, in general the yield decreases significantly in the absence of sufficient water to completely replenish the ETc. In addition, the negative impacts of limited irrigation water on the quality of vegetable crops further contribute to a significant decrease in marketable yields. For crops with high marginal productivity of water used, such as maize (Zea mays), 70% of the maximum yield is obtained through seasonal water supplies equivalent to 45% of full ETc requirements, while for crops with lower marginal productivity of water (tomatoes) And snap bean) the same yield value is obtained with irrigation volumes between 70 and 90% of complete ETc.

Water deficit:

The deficient irrigation strategies require careful assessment of the growth stage stress tolerance of vegetable crops, (Upchurch et al., 2005) and the optimal water management has been supported by the advanced irrigation systems; That is, is able to quickly cope with the water requirements of crops in the sensitive phenological stages (Evans and Sadler, 2008). However, in semi-arid environments, meeting leaching requirements greatly limits the applicability of deficient irrigation criteria and reduces white phosphorous in irrigated vegetable production. Adopting methods to control the level of water stress for plants (using soil tensiometers, other soil water sensors or water balance calculations) can reduce the amount of water applied to the crop by up to 53% (Tognoni et al., 2002). The use of subsurface drip irrigation has evolved from being a recent one used only in experimental fields to an acceptable method of irrigation for both tree and vegetable crops (Lamand Camp, 2007). Thompson and Doerge (1995) reported that subsurface drip irrigation on lettuce, tomatoes, and sweet corn (Z. mays) significantly increased yields and WP in all of these crops. Subsurface drip irrigation may increase white phosphorus in semi-arid environment under saline conditions by increasing yield (Ayarset al., 1999). Also, subsurface drip irrigation can provide more stable soil water and a nutritious environment for optimal crop growth, and is also effective for salinity management, soil water redistribution, and agrochemical use (Lamand Camp, 2007). Farmers who produce high-value crops in arid and semi-arid regions have a greater potential to benefit from adopting the drip and subsurface drip irrigation (Wichelns, 2007).

Drip irrigation:

Mansour et al. (2015a-f), (2019a,b) and (2016a-c) mentioned that in the drip irrigation areas, irrigation water is distributed through the pores located above the surface of the soil while in the subsurface drip, the wet area below the surface is small for the total area of the land and surface area. The rate of flow or the rate of the conduction of hydraulic points is a specific factor with physical soil properties, the evaporation rate from the surface of the soil and the size of the wet surface area of the horizontal soil through which the infiltration occurs. The surface area of saturated soil increases when the water application rate increases and when the soil's ability to deliver water (which depends on soil strength and physical properties, among other factors).

The nature of the land is developed in the area around the points according to the rate of water use, the water flow rate of the drips and the soil properties in that area, the most important of which is the hydraulic conductivity (HC) and is influenced by the water quality and quality according to the value and electrical conductivity(EC) (Tayel et al. (2012a,b), (2015a-e), (2016), (2018), (2019); Mansour (2015) and Mansour et al. (2014) Consequently, the water of application rate is one of key factor determining the soil water content around the emitter, Mansour et al., (2013) and Mansour et al., (2014). The water uptake pattern Mansour et al., 2015a. However, the use of water in an inaccurate and random and without dates or the appropriate quantities lead to a significant reduction in the value of efficiency of the system of drip irrigation and this reflected negatively on the final yield resulting, for example, if the use of water at high rates and timeout of time and the appropriate quantity this will reduce the apparent stress Water at plants but at the same time will reduce the efficiency of irrigation system drip and nutrient flight and fertilizer with the ground water deep leakage and go away from the area of root spread does not benefit the plant and thus there is no economic feasibility of the irrigation process, (Ibrahim et al. 2018 and Mansour and Aljughaiman 2012, 2015, Mansour and El-Melhem 2012, 2015; Attia et al 2019 and Pibars et al. 2015, 2019).

Conclusion

Enhancement of some physical water properties such as aggregate, soil resistance, water retention ability and other soil water stability which plays an important role in increasing the soil's ability to retain plant nutrients that aid in developing yield, yield components, and water productivity (WP). These adjustments are individually or socially considered when proposing best management practices with the goal of increasing productivity and reducing not only hydration but also loss of plant nutrients. Promoting the standardization of the irrigation system is another task that we will work on.

References:

1. Abd El-Hady M. and Ebtisam I. Eldardiry, 2012. Sustainable reclamation of newly reclaimed sandy soil through local marine deposits application: I-Improvement of hydrophysicalcharacteristics.Journal of Applied Sciences Research, 8(4): 2350-2355.
2. Abd-Elmabod, S.K.; Bakr, N.; Muñoz-Rojas, M.; Pereira, P.; Zhang, Z.; Cerdà, A.; Jordán, A.; Mansour, H.; De la Rosa, D.; Jones, L. 2019, Assessment of Soil Suitability for Improvement of Soil Factors and Agricultural Management. Sustainability 11, 1588. doi: 10.3390/su11061588
3. Allen, R.G., L.S. Pereira, D. Raes, and M. Smith. 1998. Crop evapotranspiration: Guidelines for computing crop water requirements. Irr. Drainage Paper No. 56. Food and Agriculture Organization of the United Nations, Rome.
4. Ayars, J.E., C.J. Phene, R.B. Hutmacher, K.R. Davis, R.A. Schoneman, S.S. Vail, and R.M. Mead. 1999. Subsurface drip irrigation of row crops: A review of 15 years of research at the Water Management Research Laboratory. Agr. Water Mgt. 42:1–27.
5. Baille, A. 2001. Trends in greenhouse technology for improved climate control in mild winter climates. Acta Hort. 599:161–168.
6. Decoteau, D.R., M.J. Kasperbauer, and P.G. Hunt. 1989. Mulch surface color affects yield of fresh-market tomatoes. J. Amer. Soc. Hort. Sci. 114:216–219.
7. Ebtisam I. Eldardiry and M.Abd El-Hady 2015a. Effect of different soil conditioners application on somesoil characteristics and plant growthI-Soil moisture distribution, barley yield and water useefficiency. Global Advanced Research Journal of Agricultural Science (ISSN: 2315-5094) Vol. 4(7) pp. 361-367, July, 2015.
8. Ebtisam I. Eldardiry and M.Abd El-Hady, 2015b. Effect of different soil conditioners application on some soil characteristics and plant growth. I-Soil moisture distribution, barley yield and Water productivity. Global Advanced Research Journal of Agricultural Science (ISSN: 2315-5094) Vol. 4(7) pp. 361-367, July, 2015.
9. Ebtisam I. Eldardiry, SabreenKh. Pibars and M. Abd El Hady (2012). Improving Soil Properties, Maize Yield Components Grown in Sandy Soil Under Irrigation Treatments and Humic Acid Application Australian Journal of Basic and Applied Sciences, 6(7): 587-593.
10. Ebtisam I. Eldardiry, Sabreen, Kh. Pibars, and M. Abd El-Hady, 2015. Influence of irrigation deficit and humic acid on soil and canola growth characters and Water productivity. International Journal of ChemTech Research, 8(6): 505-513, 2015
11. Eldardiry, E.E., Hellal, F., Mansour, H.A.A. 2015, Performance of sprinkler irrigated wheat – part II.Closed Circuit Trickle Irrigation Design: Theory and Applications, pp.41
12. El-Hagarey, M.E., Mehanna, H.M., Mansour, H.A. 2015, Soil moisture and salinity distributions under modified sprinkler irrigation. Closed Circuit Trickle Irrigation Design: Theory and Applications, pp.3-21.
13. Evans, R.G. and E.J. Sadler. 2008. Methods and technologies to improve efficiency of water use. Water Resources Res. 44:1–15.
14. FAO. 2002. Crops and drops: Making the best use of water for agriculture Natural Resources Environ. Dept., FAO, Rome.
15. Fereres, E. and M.A. Soriano. 2007. Deficit irrigation for reducing agricultural water use. J. Expt. Bot. 58:147–159.
16. Goyal, M.R. and Mansour H.A.A. 2015.Closed circuit trickle irrigation design: theory and applications, (book), Apple Academic Press, Publisher: Taylor and Frances.
17. Hsiao, T.C., P. Steduto, and E. Fereres. 2007. A systematic and quantitative approach to improve Water productivity in agriculture. Irr. Sci. 25:209–231.
18. Jensen, M.E. 2007. Beyond irrigation efficiency. Irr. Sci. 25:233–245.
19. Kang, S.Z. and J.H. Zhang. 2004. Controlled alternate partial root-zone irrigation: Its physiological

consequences and impact on Water productivity. J. Expt. Bot. 55:2437–2446.

20. Lamm, F.R. and C.R. Camp. 2007. Subsurface drip irrigation, p. 473–551. In: F.R. Lamm, J.E. Ayars, and F.S. Nakayama (eds.). Microirrigation for crop production: Design, operation, and management. Elsevier, Amsterdam, the Netherlands.
21. Mansour H. A., Hu Jiandong, Ren Hongjuan, Abdalla N. O. Kheiry and Sameh K. Abd-Elmabod. 2019b. Influence of using automatic irrigation system and organic fertilizer treatments on faba bean water productivity, International Journal of GEOMATE, Oct., 2019 Vol.17, Issue 62, pp. 256 – 265.
22. Mansour H. A., Sameh K. Abd-Elmabod and B. A. Engel. 2019a. Adaptation of modeling to the irrigation system and water management for corn growth and yield. Plant Archives Vol. 19, Supplement 1, pp. 644-651.
23. Mansour, H. A., 2015, Performance automatic sprinkler irrigation management for production and quality of different Egyptian wheat varieties. International Journal of ChemTech Research. Vol.8, No.12 pp 226-237.
24. Mansour, H. A., Abdel-Hady, M.,Eldardiry, E.I., Bralts, V.F., 2015a, Performance of automatic control different localized irrigation systems and lateral lengths for emitters clogging and maize (Zea mays L.) growth and yield. International Journal of GEOMATE, Vol. 9, No. 2 (Sl. No. 18), pp. 1545-1552.
25. Mansour, H. A., Pibars, S.K., Abd El-Hady, M., Ebtisam I. Eldardiry, 2014, Effect of water management by drip irrigation automation controller system on Faba bean production under water deficit. International Journal of GEOMATE, Vol. 7, No. 2 (Sl. No. 14), pp. 1047-1053.
26. Mansour, H. A., Sabreen Kh. Pibars, M.S. Gaballah, and Kassem A. S. Mohammed. 2016a. Effect of Different Nitrogen Fertilizer Levels, and Wheat Cultivars on Yield and its Components under Sprinkler Irrigation System Management in Sandy Soil., Vol.9, No.09 pp.1-9.
27. Mansour, H. A., M. Abd El-Hady, V. F. Bralts, and B. A. Engel, 2016b. Performance Automation Controller of Drip Irrigation System and Saline Water for Wheat Yield and Water Productivity in Egypt. Journal of Irrigation and Drainage Engineering, American Society of Civil Engineering (ASCE), J. Irrig. Drain Eng. 05016005, http://dx.doi.org/10.1061/ (ASCE) IR, 1943-4774.0001042.
28. Mansour, H.A., Aljughaiman, A.S. 2012, Water and fertilizers use efficiency of corn crop under closed circuits of drip irrigation system. Journal of Applied Sciences Research, 8 (11), pp.5485-5493.
29. Mansour, H.A., E.F.Abdallah, M.S.Gaballah and Cs.Gyuricza, 2015b, Impact of Bubbler Discharge and Irrigation Water Quantity on 1- Hydraulic Performance Evaluation and Maize Biomass Yield. Int. J. of GEOMATE, Dec. Vol. 9, No. 2 (Sl. No. 18), pp. 1538-1544.
30. Mansour, H.A., Pibars, S.K.; Bralts, V.F., 2015c, the hydraulic evaluation of MTI and DIS as a localized irrigation systems and treated agricultural wastewater for potato growth and water productivity. International Journal of ChemTech Research, Vol.8, No.12 pp 142-150.
31. Mansour, H.A., Saad, A., Ibrahim, A.A.A., El-Hagarey, M.E., 2016c. Management of irrigation system: Quality performance of Egyptian wheat (Book Chapter). Micro Irrigation Management: Technological Advances and Their Applications. pp. 279-293.
32. Mansour, H.A., M. Abd El-Hady (2014). Performance of Irrigation Systems under Water Salinity in Wheat Production. (IOSR-JAVS)-Journal of Agriculture and Veterinary Science 7 (7), 19-24
33. Mansour, H.A.A. 2015. Design considerations for closed circuit design of drip irrigation system (Book Chapter). pp.61-133.
34. Mansour, H.A.A. and Aljughaiman, A.S. 2015.Water and fertilizer use efficiencies for drip irrigated corn: Kingdom of Saudi Arabia (book chapter) closed circuit trickle irrigation design: theory and applications, Apple Academic Press, Publisher: Taylor and Frances. pp. 233-249
35. Mansour, H.A.A. and El-Melhem, Y. 2015. Performance of drip irrigated yellow corn: Kingdom of Saudi Arabia (Book Chapter), closed circuit trickle irrigation design: theory and applications, Apple Academic Press, Publisher: Taylor and Frances. pp. 219-232
36. Mansour, H.A.A., Mehanna, H.M., El-Hagarey, M.E.,Hassan, A.S. 2015d, Automation of mini-sprinkler and drip irrigation systems.Closed Circuit Trickle Irrigation Design: Theory and Applications, pp.179-204.
37. Mansour, H.A.A., Mehanna, H.M., El-Hagarey, M.E.,Hassan, A.S. 2015d, Automation of mini-sprinkler and drip irrigation systems.Closed Circuit Trickle Irrigation Design: Theory and Applications, pp.179-204.
38. Mansour, H.A.A., Tayel, M.Y.,Lightfoot, D.A.,El-Gindy, A.M. 2015e. Energy and water savings in drip irrigation systems. Closed Circuit Trickle Irrigation Design: Theory and Applications, pp.149-178.
39. Mansour, H.A.A., Tayel, M.Y.,Lightfoot, D.A.,El-Gindy, A.M. 2015e. Energy and water savings in drip irrigation systems. Closed Circuit Trickle Irrigation Design: Theory and Applications, pp.149-178.
40. Mansour, H.A.A., El-Hady, M.A., Gyurciza, C.S. 2015f. Water and fertilizer use efficiencies for drip irrigated maize (Book Chapter). Closed Circuit Trickle Irrigation Design: Theory and Applications. pp. 207-218.
41. Mansour, H.A.A., El-Hady, M.A., Gyurciza, C.S. 2015f. Water and fertilizer use efficiencies for drip irrigated maize (Book Chapter). Closed Circuit Trickle Irrigation Design: Theory and Applications. pp. 207-218.
42. Passioura, J. 2006. Increasing crop productivity when water is scarce: From breeding to field management. Agr. Water Mgt. 80:176–196.
43. Robert Evans, R. E. Sneed, and J. H. Hunt, 1996. Irrigation Management Strategies To Improve Water- & Energy-Use EfficienciesNorth Carolina Cooperative Extension Service Publication Number: AG 452-5- Last Electronic Revision: June 1996 (KNS)
44. Samir S. Attia, Abdel-Ghany M. El-Gindy, Hani A. Mansour, Soha E. Kalil and Yasser E. Arafa. 2019. Performance analysis of pressurized irrigation systems

using simulation model technique. Plant Archives Vol. 19, Supplement 1, pp. 721-731.

45. Tayel, M. Y., A.M. El-Gindy and H.A. 2012a. Mansour. Effect of drip irrigation circuit design and lateral line lengths iv- on uniformity coefficient and coefficient of variation. Journal of Applied Sciences Research. 8(5): 2741-2748.
46. Tayel, M.Y., El-Gindy, A.M., Mansour, H.A. 2012b. Effect of drip irrigation circuits design and lateral line length on III-dripper and lateral discharge. Journal of Applied Sciences Research, 8 (5), pp.2725
47. Tayel, M.Y., Pibars, S.K., Mansour, H.A.A. 2015c. Evaluation of emitter clogging. Closed Circuit Trickle Irrigation Design: Theory and Applications, pp.287-300.
48. Tayel, M.Y., Shaaban, S.M., Mansour, H. A. 2015d. Effect of plowing conditions on the tractor wheel slippage and fuel consumption in sandy soil. International Journal of ChemTech Research, Vol.8, No.12 pp 151-159.
49. Tayel, M.Y., Shaaban, S.M., Eldardiry, E.A., Mansour, H.A. 2018, Wheat yield versus seed bed conditions. Bioscience Research, 15(3), pp. 1943-1951.
50. Tayel, M.Y.; S. M. Shaaban; H. A. Mansour and E.F. Abdallah, 2016. Response of Fodder Beet Plants Grown in a Sandy Soil to Different Plowing Conditions. International Journal of ChemTech Research. Vol.9, No.09 pp.20-27.
51. Tayel, M.Y.; S.M. Shaaban and H.A. Mansour. 2019. Impact of seedbed preparation condition on aggregates stability, yield, water productivity and fertilizers use efficiency on maize (zea mays). Plant Archives Vol. 19, Supplement 1, pp. 706-710.
52. Thompson, T.L. and T.A. Doerge. 1995. Nitrogen and water rates for subsurface trickle-irrigated romaine lettuce. Hort- Science 30:1233–1237.
53. Tiwari, K.N., P.K. Mal, R.M. Singh, and Chattopadhyay. 1998. Response of okra (Abelmoschusesculentus L.) to drip irrigation under mulch and non-mulch conditions. Agr. Water Mgt. 38:91–102.
54. Tognoni, F., G. La Malfa, G. Barbieri, G. Serra, A. Maggio, and C. Leonardi. 2002. Some aspects of the vegetable industry in Italy. Acta Hort. 582:121–133.
55. Upchurch, D.R., J.R. Mahan,D.F. Wanjura, and J.J. Burke. 2005. Concepts in deficit irrigation: Defining a basis for effective management. Paper No. 9028. Proc. World Water Environ. Resources Congr., 15–19 May 2005.
56. Weiner, J.J., F.C. Peterson, B.F. Volkman, and S.R. Cutler. 2010. Structural and functional insights into core ABA signaling. Curr. Opin. Plant Biol. 13:495–502.
57. Wichelns, D. 2007. Economic implications of microirrigation, p. 221–259. In: LammF.R., Ayars J.E., and F.S. Nakayama (eds.). Microirrigation for crop production: Design, operation, and management. Elsevier, Amsterdam, the Netherlands.
58. Zajicek, J.M. and J.L. Heilman. 1991. Transpiration by crape myrtle cultivars surrounded by mulch, soil, and turfgrass surfaces. HortScience 26:1207–1210.