International Journal of Chemical Studies 2020; 8(3): 2708-2711

International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
www.chemijournal.com
IJCS 2020; 8(3): 2708-2711
© 2020 IJCS
Received: 23-03-2020
Accepted: 24-04-2020

S. Somasundaram
Associate Professor Agronomy, Department of Agronomy Anbil Dharmalingam Agricultural College and Research Institute, Tiruchirappalli, Tamil Nadu, India

S. Avudaithai
Professor Agronomy, Department of Agronomy Anbil Dharmalingam Agricultural College and Research Institute, Tiruchirappalli, Tamil Nadu, India

Corresponding Author:
S. Somasundaram
Associate Professor Agronomy, Department of Agronomy Anbil Dharmalingam Agricultural College and Research Institute, Tiruchirappalli, Tamil Nadu, India

Effect of irrigation methods on vegetable production in sodic Soil

S Somasundaram and S Avudaithai

DOI: https://doi.org/10.22271/chemi.2020.v8.i3am.9623

Abstract
Vegetable production in salt affected soil is a challenging task. One of the opportunities in improving vegetable yield in sodic soil is through identifying suitable irrigation methods. In this line field experiment was conducted at Anbil Dharmalingam Agricultural College and Research Institute, Trichy-9. Furrow irrigation and three micro-irrigation methods *viz*., drip, sprinkler and raingun were tested for three crops *viz*., cluster beans, bhendi and vegetable cowpea. Higher cluster beans equivalent yield was recorded under drip irrigation by 39, 34, and 41 per cent in cluster beans, bhendi and vegetable cowpea compared to furrow irrigation. Regarding crops bhendi recorded higher cluster beans equivalent yield (172.6 q/ha) followed by cowpea and cluster beans. Water saving in micro-irrigation compared to furrow irrigation was 23.1, 24.5 and 25.7 per cent in cluster beans, bhendi and vegetable cowpea. Water use efficiency was higher in drip irrigation (19.3 kg/ha mm) and lower in furrow irrigation (10.9 kg/ha mm) for all the crops. Drip irrigation recorded higher relative leaf water content and lower post harvest soil available nutrients. The result indicates that drip irrigation proves to be an efficient tool for improving vegetable yield under sodic soil conditions.

Keywords: Irrigation methods, drip irrigation, vegetables, sodic soil, bhendi

Introduction

In India, salt affected soil is emerging as major challenge to vegetable production. It is estimated that the area under salt affected soil (6.73 M ha) may increase to 16.20 M ha in 2050. In the study area, Manikandam Block of Tiruchirappalli district around 18000 ha is sodic soil. There are evidences of negative impacts on yield of vegetables in many parts of India due to increased salt content in the soil. Thus it is vital to design tools to increase vegetable production and productivity in sodic soil. One of the steps may be tailoring suitable irrigation methods for specific crops in problems soils as indicated by Sharma (2016) [15] in okra, Aboamera (2010) [1] in cowpea, Ahmed *et al*., (2017) [2] in tomato. Birbal *et al.* (2013) [5] conducted field experiments and concluded that higher yield was recorded under drip irrigation compared to furrow irrigation in okra. Rana*et al.* (2006) [13] tested sunflower under basin, furrow and raingun sprinkler irrigation and informed that the later was the most feasible method of irrigation. The objective of this study was to determine the appropriate irrigation method for vegetable crops in sodic soil.

Material and Methods

Field experiment was conducted at Anbil Dharmalingam Agricultural College and Research Institute, Trichy during 2010-11. The experimental site was with sodic soil of pH 9.8, EC 0.17 ds/m and ESP 18.1. The experiment was laid out in split plot design and replicated thrice. The treatment consist of four irrigation methods (I) viz., furrow, drip, sprinkler and raingun in main plot and three crops (C) *viz*., cluster beans (Pusa Naubahar), bhendi (N 10) and vegetable cowpea (Gomati) in sub plot. The surface irrigation plots were irrigated using IW/CPE ratio of 0.5 in cowpea and 0.8 in bhendi and cluster beans. In micro-irrigation plots (drip, sprinkler and raingun) irrigation was scheduled using Doorenbos and Pruitt (1977) [7] method as indicated below,

$$ETc = Eo \times Kp \times Kc$$

Where, ETc = crop evapotranspiration (mm/day); Eo = pan evaporation (mm/day); Kp= pan coefficient (0.8); Kc = crop coefficient. The same depth of water was applied in all the three micro-irrigation plots. The irrigation frequency is once in three days in drip irrigation and seven days for sprinkler and raingun irrigation. Effective rainfall was calculated using the method of Dastane (1974) [6]. Fertilizer was applied through irrigation water for drip method and though soil for all other methods. The fresh vegetable yield data of different crops were converted into cluster beans equivalent yield using the formula given below,

Cluster beans equivalent yield (q/ha) = $(Y_i \times P_i) / P_b$

Where, Y_i = yield of individual crop (q/ha); P_i = price of individual crop (Rs/q); P_b= price of cluster beans (Rs/q).
Relative leaf water content was determined during flowering stage and expressed in percentage as proposed by Barrs and Weatherly (1962) [4]. The post-harvest soil samples were analysed for available nitrogen (Subbiah and Asija, 1956) [17], phosphorus (Olsen *et al*., 1956) [11] and potassium (Stanford and English, 1949) [16]. The data were statistically analysed as per Panse and Sukhathme (1977) [12] and the results are presented.

Results and Discussion

Water used and water saving

The data on water applied, water used and water saving are given in Table 1. The rainfall during the cropping season was 135 mm for cluster beans and bhendi and 95 mm for cowpea. The effective rainfall was 74 mm for cluster beans and bhendi and 38 mm for cowpea. The irrigation depth or water applied for cluster beans, bhendi and cowpea was 636, 686 and 362 mm under furrow irrigation and 489, 518 and 269 mm under micro-irrigation viz., drip, sprinkler and raingun methods. The water used for cluster beans, bhendi and cowpea was 710, 760 and 400 mm under furrow irrigation and 563, 592 and 307 mm under micro-irrigation methods. The water used was higher in furrow irrigation for all the crops. The water saving in micro-irrigation compared to furrow irrigation was 23.1, 24.5 and 25.7 for cluster beans, bhendi and cowpea. Results were in same line as reported by Tagar *et al.* (2012) [18].

Table 1: Effect of irrigation methods and crops on water applied, water used and water saving (mm)

Crops	Pan evaporation (mm)	Effective rainfall (mm)	Water applied (mm)		Water used (mm)		Water saving (%)
			Furrow	Micro-Irrigation	Furrow	Micro-Irrigation	
Cluster beans	851	74	636	489	710	563	23.1
Bhendi	837	74	686	518	760	592	24.5
Cowpea	604	38	362	269	400	307	25.7

Relative leaf water content

The irrigation methods influenced the relative leaf water content recorded at flowering stage and given in Table 2. Drip irrigation (84 per cent) recorded higher relative leaf water content and was comparable with sprinkler irrigation (77.8 per cent). Furrow irrigation (69.4 per cent) recorded significantly low relative leaf water content. Enhanced soil moisture availability at the root zone with drip irrigation improved the water uptake of the plants and increased the relative leaf water as indicated by Sampathkumar*et al.* (2014) [14].

Cluster bean equivalent yield

The irrigation methods and different crops studied had significant influence on cluster beans equivalent yield and presented in Table 2. Regarding irrigation method higher cluster beans equivalent yield was recorded under drip irrigation (120.2 q/ha) followed by sprinkler irrigation (105.3 q/ha) and raingun irrigation. Significantly lower yield was recorded by furrow irrigation. The per cent yield increase in drip over furrow irrigation was 39, 34 and 41 per cent in cluster beans, bhendi and cowpea respectively. The optimum moisture supplied by drip compared to furrow method may enhanced yield attributes and yield as indicated by Aujla *et al.* (2007) [3]. Bhendi recorded higher cluster beans equivalent yield (172.6 q/ha) in sodic soil followed by cowpea (75.5 q/ha) and cluster beans (61.2 q/ha). Interaction effect revealed that bhendi under drip irrigation registered higher cluster beans equivalent yield (201.1 q/ha) and was followed by bhendi with sprinkler irrigation. Bhendi invested proportionally more of its photosynthetic resources in to yield and biomass production per unit of water transpired and thus bhendi under drip irrigation produced higher yields, compared to other crops. This high yielding character of bhendi under drip irrigation make it a very suitable candidate for sodic soil as informed by Haq *et al*. (2012) [8].

Table 2: Effect of irrigation methods and crops on relative leaf water content (%) and cluster bean equivalent yield (q/ha)

Treatments	Relative leaf water content (%)				Cluster bean equivalent yield (q/ha)			
	Crops (C)				Crops (C)			
Irrigation Methods (I)	Cluster beans	Bhendi	Cowpea	Mean	Cluster beans	Bhendi	Cowpea	Mean
Furrow	68.5	69.7	70.1	69.4	52.1	150.0	61.5	87.8
Drip	84.1	82.6	85.3	84.0	72.4	201.1	87.0	120.2
Sprinkler	78.2	76.2	79.1	77.8	63.1	176.6	76.4	105.3
Raingun	74.5	71.0	75.6	73.7	57.2	162.9	77.1	99.1
Mean	76.3	74.8	77.5		61.2	172.6	75.5	
	I	C	I at C	C at I	I	C	I at C	C at I
SEd	4.1	3.9	7.9	8.3	3.3	3.1	6.1	6.2
CD (p=0.05)	9.6	NS	NS	NS	8.2	6.5	13.5	13.1

Water use efficiency

The irrigation methods and crops significantly influenced the water use efficiency and are given in Fig 1. Drip irrigation recorded higher water use efficiency of followed by sprinkler and raingun methods of irrigation. Regarding crops bhendi recorded higher water use efficiency and was followed by cowpea. Interaction effects revealed that, bhendi under drip irrigation recorded higher water use efficiency (25.5 kg/ha mm) and was followed by bhendi under sprinkler irrigation (22.4 kg/ha mm) and raingun irrigation (20.6 kg/ha mm). Significantly lower water use efficiency was recorded by furrow irrigation combined with cluster beans (7.3 kg/ha mm). The reason of having high WUE under drip irrigation as indicated by Jha *et al*. (2017) [10], may be related to better distribution of the roots, increased water and fertilizer uptake by plants and the physiological response of the crop to the continuous supply of water.

Post-harvest soil available nutrient status

The irrigation methods influenced the post-harvest soil available nitrogen, phosphorus and potassium and given in Table 3. Significantly higher post-harvest soil available nitrogen (206.5 kg ha^{-1}), phosphorus (16.7 kg ha^{-1}), and potassium (441.3 kg ha^{-1}), was observed in plots with furrow irrigation and was followed by raingun sprinkler irrigated plots. Significantly lower post-harvest soil available nitrogen, phosphorus and potassium was recorded under drip irrigation. Regarding crops significant difference in post-harvest soil available nutrient was seen only for nitrogen. Cowpea (194.7 kg ha^{-1}), registered higher post-harvest soil available nitrogen and was comparable with cluster beans. Bhendi recorded lower soil available nitrogen, which may be due to higher growth and yield as indicated by Hima Bindu and Subramanian (2008) [9].

Table 3: Effect of irrigation methods and crops on post-harvest soil available nutrients (kg/ha)

Treatments Irrigation Methods	Nitrogen	Phosphorus	Potassium
Furrow	206.5	16.7	441.3
Drip	189.2	15.2	412.5
Sprinkler	193.6	15.8	424.6
Raingun	195.4	16.1	430.6
SEd	4.1	0.24	7.2
CD (p=0.05)	8.6	0.48	15.1
Crops			
Cluster beans	191.7	16.2	431.6
Bhendi	182.3	15.9	428.1
Cowpea	194.7	16.1	430.4
SEd	3.4	0.15	5.1
CD (p=0.05)	7.0	NS	NS

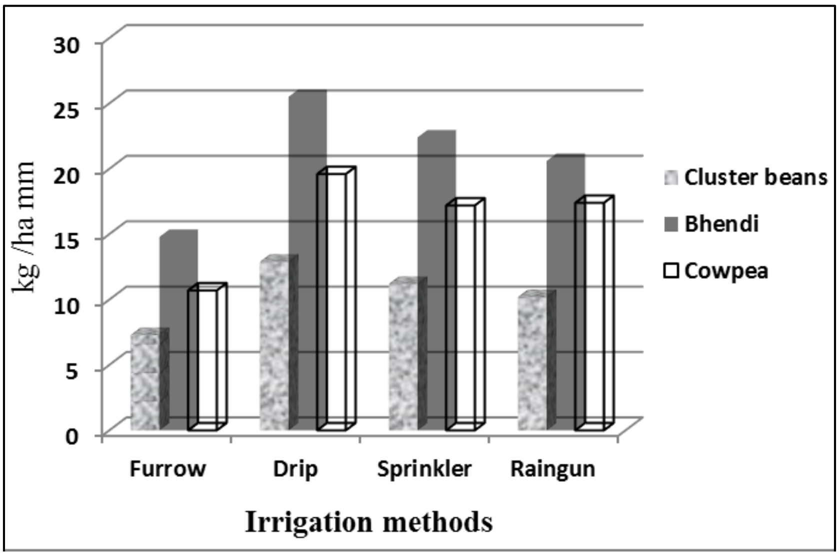

Fig 1: Effect of irrigation methods and crops on water use efficency (kg/ha mm)

Conclusion

From this study, it was concluded that drip irrigation may be recommended as an efficient tool for enhanced vegetable production under sodic soil condition. Bhendi with drip irrigation may be recommended in sodic soil for enhanced water saving, water use efficiency and yield for the farmers of the study region, Trichy district of Tamil Nadu.

References

1. Aboamera MA. Response of cowpea to water deficit under semi-portable sprinkler irrigation system.*Misr. J. Ag. Eng*., 2010; 27(1):170-190.
2. Ahmed TF, Hashmi HN, Ghumman AR, Seihkh AA, Afzal MA. Influence of surface and sub-surface drip irrigation methods on performance and yields of two tomato varieties. Acad. J. Agric. Res. 2017; 5(9):196-202.
3. Aujla MS, Thind HS, Buttar GS. Fruit yield and water use efficiency of eggplant as influenced by different quantities of nitrogen and water applied through drip and furrow irrigation. *Scientia* Horticulturae, 2007; 112:142-148.
4. Barr HD, Weatherley PE. A re-examination of the relative turgidity techniques for estimating water deficits in leaves. Australian J. of Biol. Sci. 1962; 15:413-428.
5. Birbal VS, Rathore NS, Nathawat, Bhardwaj V, Yadav ND. Effect of irrigation methods and mulching on yield of okra in ber based vegetable production system under arid region. Bhartiya Krishi Anusandh Patrika. 2013; 28(3):142-147.
6. Dastane NS. Effective rainfall. Irrigation Drainage Paper, 25 FAO, Rome, 1974, 69.
7. Doorenbos, Pruitt. Crop water requirements, FAO, Irrigation and Drainage Paper 24 (revised), Rome, Italy, 1977, 72.
8. Haq I, Ali AK, Ahmad IK, Abubakkar M. Comprehensive screening and selection of Okra (*Abelmoschusesculentus*) germplasm for salinity tolerance at the seedling stage and during plant ontogeny. Zhejiang Univ. Sci. B. J. 2012; 13(7):533-544.
9. HimaBin S, Subramanian S. Nutrient availability vis-a-vis uptake in CORH2 rice as influenced by split application of N. Madras Agric. J. 2008; 95(1-6):42-46.

10. Jha BK, Mali SS, Naik SK, Sengupta T. Yield, water productivity and economics of vegetable production under drip and furrow irrigation in Eastern plateau and hill region of India. Int. J of Agri. Sci. and Res. 2017; 7(3):43-50.
11. Olsen SR, Cole CV, Watanable PS, Bean L. Estimation of available phosphorus in soils extraction with sodium carbonate. U.S.Dept. Agric. Circ, 1956, 939.
12. Panse VG, Sukhathme PV. Statistical methods for agricultural workers. ICAR. Ne, 1977, 361.
13. Rana MA, Arshad M, Masud J. Effect of basin, furrow and raingun sprinkler irrigation systems on irrigation efficiencies, nitrate-nitrogen leaching and yield of sunflower. Pakistan J. of Water Res. 2006; 10(2):42-48.
14. Sampathkumar T, Pandian BJ, Jeyakumar P, Manickasundaram P. Effect of deficit irrigation on yield, relative leaf water content, leaf proline accumulation and chlorophyll stability index of cotton–maize cropping sequence. Experi. Agri. 2014; 50(3):407-425.
15. Sharma P, Arun KA, Singh A, Sunil G. Growth and yield attributes of Okra under Influence of drip irrigation. Int. J. of Eng. Res. and App. 2016; 6(2):85-91.
16. Stanford S, English L. Use of flame photometer in rapid soil tests for K and Ca. Agron. J. 1949; 41:446-447.
17. Subbiah BV, Asija GL. A rapid procedure for the estimation of available nitrogen in soils. Curr. Sci. 1956; 25:259-260.
18. Tagar A, Chandio M, Wagan B. Comparative study of drip and furrow irrigation methods at farmer’s field in Umarkot. Int. J of Bio., Biomol. Agri. Food and Biotech. Eng. 2012; 6(4):788-792.