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Effect of cultivars and irrigation-fertigation regimes on growth and yield of subsurface drip irrigated sweet corn in sodic soil

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Abstract
A field experiment was conducted to study the effect of cultivars and irrigation-fertigation regimes on subsurface drip irrigated sweet corn in sodic soil at Anbil Dharmalingam Agricultural College and Research Institute, Tiruchirapalli during *kharif*, 2018. The experiment was laid out in factorial randomized block design with three replications. The treatments consisted of combination of two factors *viz*., three cultivars (CSCH-14003, CSCH-15005 and Misthi) and four different irrigation-fertigation regimes (100% PE + 100% RDF, 100% PE + 125% RDF, 75% PE + 100% RDF and 75% PE + 125% RDF). The results revealed that plant height, dry matter production, cob length, cob girth, number of rows per cob, number of kernels row, test weight and eventually green cob yield were recorded significantly higher with misthi cultivar subsurface drip irrigation-fertigation regimes of 100% PE + 125% RDF. The study shows that sweet corn may be recommended has a new crop for the sodic soils of Trichy district. For higher productivity of sweet corn in this region, misthi combined with 100% PE + 125% RDF may be recommend under subsurface drip irrigation.

Keywords: Sweet corn, subsurface drip irrigation, irrigation-fertigation regimes, cultivar, PE, sodic soil

Introduction
Maize is the third most important cereal crop next to rice and wheat in the world. In India, maize is cultivated in 8.9 million hectare, with production and productivity of 23.0 million tonnes and 2584 kg/ha respectively (Directorate of Economics and Statistics, 2018) [9]. Sweet corn is a special type of corn used for table purpose and has been known since 18th century. Recently, sweet corn is becoming popular in India and is being cultivated in maize growing areas. Due to its extra sweetness and short duration, sweet corn is gaining momentum and already awareness has been created among the Tamil Nadu farming community (Meena, 2012) [21].

Soil salinity is a serious threat to its production worldwide. Germination and early growth are more sensitive to salinity than during later developmental stages, because of reduced water uptake and embryo toxicity by sodium. Reduced grain weight and number are responsible for low grain yield in maize under salt stress (Farooq *et al.*, 2015) [10]. But specific cultivars may overcome the stress. So, identification of suitable sweet corn cultivars to perform well in sodic soil is paramount important.

A technology which ensures, judicious use of irrigation water coupled with efficient nutrient management is more important to enhance sweet corn yield. One such technology proven in many parts of the world is subsurface drip irrigation-fertigation technology. In this technology, water nutrients are directly applied to the plant roots. Many scientists (Wei *et al*., 2018 ; Martinez-Gimeno *et al*., 2018 and Sidhu *et al*., 2019) [20, 23] have reported that sub surface drip irrigation have the potential to save irrigation water by reducing soil surface wetting, thus reducing evaporation. But optimum irrigation-fertigation regime should be identified for subsurface drip irrigation under sodic soils with study area.

So combination of hybrids and subsurface drip irrigation and fertigation may sustain sweet corn productivity with water and fertilizer saving in sodic soil. Hence this study was initiated.

Materials and Methods
The field experiment was conducted during *kharif* 2018 at Anbil Dharmalingam Agricultural College and Research Institute, Tiruchirapalli. The soil of the experimental field was sandy

clay loam texture with low in available nitrogen (238 kg ha^{-1}), medium in available phosphorus (18.4 kg ha^{-1}) and high in available potassium (263.1 kg ha^{-1}). The experiment was laid out in factorial randomized block design and replicated thrice. The treatments consisted of combination of two factors *viz*., three cultivars (CSCH-14003, CSCH-15005 and Misthi) and four different irrigation-fertigation regimes (100% PE + 100% RDF, 100% PE + 125% RDF, 75% PE + 100% RDF and 75% PE + 125% RDF). The sweet corn cultivars were sown at a spacing of 60 x 20 cm on 18 July, 2018. All the agronomic practices were carried out as per TNAU crop production guide. Observations on sweet corn were taken at 25 and 50 days after sowing (DAS) and at harvest. The data recorded on various parameters of crop was subjected to statistical scrutiny by the method of analysis of variance as outlined by (Gomez, 1984) [11].

Results and Discussion

Growth attributes

Plant height

Sweet corn hybrids and subsurface drip irrigation-fertigation regimes caused variations in the plant height as depicted in table 1. Sweet corn hybrid misthi recorded significantly taller plants of 85.5 cm at 50 DAS and 152.5 cm at harvest compared to CSCH 14003 and CSCH 15005. This may be due to the genetic makeup of plants (Sivamurugan *et al.*, 2017) [24].

Among the subsurface drip irrigation-fertigation regimes, subsurface drip irrigation-fertigation regime of 100% PE + 125% RDF recorded higher plant height of 155.8 cm and was comparable with 100% PE + 100% RDF at harvest. This may be due to continuous availability of required moisture and nutrients near the crop root zone which might have resulted in higher nutrient uptake resulting in greater cell division and elongation. Similar results were also reported by Govindan and Grace (2012) [12], Karthika and Ramanathan (2019) [15] and Venkatesan *et al*. (2014).

Dry matter production

The dry matter production was significantly influenced by sweet corn hybrids and subsurface drip irrigation-fertigation regimes as depicted in table 1 and 2.

Accumulation of significantly higher dry matter at all the stages was noticed with misthi hybrid with a weight of 1.09 t ha^{-1} at 25 DAS, 5.75 t ha^{-1} at 50 DAS and 13.66 t ha^{-1} at harvest compared to CSCH 14003 and CSCH 15005. This may be due to higher plant height and more leaf area as indicated by Keerthi *et al*. (2017) [17].

Subsurface drip irrigation-fertigation regime of 100% PE + 125% RDF (5.60 and 13.50 t ha^{-1}) accumulated higher DMP and was comparable with 100% PE + 100% RDF (5.43and 12.89 t ha^{-1}) at 50 DAS and at harvest. This was in turn comparable with subsurface drip irrigation-fertigation of 75% PE + 125% RDF regime at 50 DAS and at harvest. This may be due to better availability of moisture (Leta Tulu, 1998 and Bibe *et al*., 2017) [19, 7] and nutrients under higher fertilizer dose (Bibe *et al*., 2018) [8].

The interaction between different cultivars and irrigation-fertigation regimes showed significant variation with respect to dry matter production (table 2). Misthi combined with subsurface drip irrigation-fertigation of 100% PE + 125% RDF regime recorded significantly higher DMP (15.78 t ha^{-1}). This was followed by misthi combined with subsurface drip irrigation-fertigation of 100% PE + 100% RDF regime and was comparable with the same hybrid with 75% PE + 125% RDF regime. This may be due to the genetic makeup of misthi (Keerthi *et al*., 2012) [16] and enhanced water and nutrients under 100% PE + 125% RDF (Reddy and Murthy, 2017) [22]. Lower DMP was observed with the combination of CSCH 15005 and subsurface drip irrigation-fertigation of 75% PE + 100% RDF regime.

Yield attributes

Yield attributes were significantly influenced by sweet corn hybrids and subsurface drip irrigation-fertigation regimes as depicted in table 3, 4 and 5.

Sweet corn yield attributes *viz*., cob length (16.9 cm), cob girth (13.1 cm), number of rows per cob (13.5), number of kernels row (35.9) and test weight (33.9 g) were significantly higher in misthi cultivar compared to CSCH 14003 and CSCH 15005. The significance of Misthi over other cultivars are also reported by Gozubenli *et al.* (2001) [13] and Banotra *et al.* (2017) [4].

Among the subsurface drip irrigation-fertigation regimes, subsurface drip irrigation 100% PE+ 125% RDF recorded higher yield attributes *viz*., cob length (17.0 cm), cob girth (13.3 cm), number of rows per cob (13.6), number of kernels row (36.0) and test weight (33.9 g) and was comparable with 100% PE+ 100% RDF of cob length, cob girth, number of rows per cob, number of kernels row and test weight. The later was in turn comparable with 75% PE+ 125% RDF regime. Trend had been differed in number of rows per cob, 100% PE+ 125% RDF regime was followed by 100% PE+ 100% RDF and 75% PE+ 125% RDF. This may be due to enhanced moisture and nutrients resulted in better transfer of photosynthates from source to the sink under enhanced moisture as reported by Khanna and Richa (2013) [18].

Lower yield attributes *viz*., cob length, cob girth, number of rows per cob, number of kernels row and test weight were recorded by 75% PE+ 100% RDF regime. This may be due to the water stress under low PE which resulted in poor plant growth due to restriction imposed on nutrient translocation, photosynthesis and metabolic activities of plant system. All these above referred yield attributes were decreased with subsequent decrease in the level of irrigation. These findings are in close conformity with those of Tyagi *et al.* (1998) [26] and Bharti *et al.* (2007) [6].

The interaction between different cultivars and irrigation fertigation regimes showed significant variation with respect to enhanced attributes *viz.*, cob length and number of kernels row (table 4 and 5). Misthi combined with subsurface drip irrigation-fertigation of 100% PE + 125% RDF regime recorded significantly higher yield attributes *viz.*, cob length (20.3 cm) and number of kernels row (42.7). This was followed by misthi combined with subsurface drip irrigation-fertigation of 100% PE + 100% RDF regime and was comparable with misthi combined with subsurface drip irrigation-fertigation of 75% PE + 125% RDF regime. Lower cob lengths and number of kernels row were observed the combination of CSCH 15005 and subsurface drip irrigation-fertigation of 75% PE + 100% RDF regime. The results as same line was also reported by Abd El-Rahman (2009) [1].

Green cob yield

Green cob yield was significantly influenced by sweet corn hybrids and subsurface drip irrigation-fertigation regimes as depicted in table 3.

Sweet corn misthi recorded significantly higher cob yield of 15.9 t ha^{-1} compared to CSCH 14003 and CSCH 15005. This may be due to potential of cultivar in utilization of all the resources which are essential for better growth performance of crop. This is line with findings of Begum and Basvarajappa (2018) [5].

Subsurface drip irrigation-fertigation of 100% PE + 125% RDF regime recorded higher cob yield of 16.0 t ha^{-1} and was on par with subsurface drip irrigation-fertigation of 100% PE with 100% RDF regime. This was in turn comparable with subsurface drip irrigation-fertigation of 75% PE with 125% RDF regime with 15.2 t ha^{-1}. This may be due to application of water in accordance with plant need (100% CPE) to the root zone with required quantity and irrigation intervals through subsurface drip in combination with enhanced fertilizer level. This favored higher uptake of nutrients which contributed better for higher yield attributes and yield of sweet corn. This line of work was confirmed by Reddy and Murthy (2017) [22].

Significantly lower cob yield was observed with subsurface drip irrigation-fertigation of 75% PE + 100% RDF regime. This may be attributed to decrease in synthesis of metabolites and reduction in absorption and translocation of nutrients from soil to plant. The physiological response of plants by decreased cell division and cell elongation under moderate moisture stress may have also contributed to reduced grain yield. The results are in conformity with the findings of Balaji Naik *et al.* (2015) [2].

The interaction between different cultivars and irrigation-fertigation regimes showed significant variation with respect to green cob yield (table 6). Cob yield was enhanced with the combination of misthi and subsurface drip irrigation-fertigation of 100% PE + 125% RDF regime (18.7 t ha^{-1}) and was comparable with combination of misthi and subsurface drip irrigation-fertigation of 100% PE + 100% RDF regime. The later combination was in turn comparable with the combination of misthi with subsurface drip irrigation-fertigation of 75% PE + 125% RDF regime. This may be due to cumulative effect of superior attributing characters in cultivar misthi (Banotra *et al.*, 2015) [3] and efficient water and nutrient absorption and accumulation of nutrients by crop and maintenance of excellent soil-water-air relationship with oxygen concentration in the root zone under 100% PE + 125% RDF regime of subsurface drip irrigation (Gururaj *et al.*, 2015). The lowest green cob yield was registered by CSCH 15005 combined with subsurface drip irrigation-fertigation of 75% PE + 100% RDF regime. Decreasing yield under decreased quantity of water was also reported by Sundrapandiyan (2012) [25] under subsurface drip irrigation.

Table 1: Effect of cultivars and irrigation-fertigation regimes on growth attributes of sweet corn

Treatments	Plant height (cm)			Dry matter production (t ha^{-1})		
	25 DAS	50 DAS	Harvest	25 DAS	50 DAS	Harvest
Hybrids						
V_1 - CSCH-14003	20.6	78.9	143.1	0.97	5.12	12.05
V_2 -CSCH-15005	18.6	75.0	141.4	0.90	5.00	11.50
V_3 –Misthi	22.0	85.5	152.5	1.09	5.75	13.66
SEd	1.3	2.9	4.4	0.05	0.09	0.30
CD (p=0.05)	NS	6.0	9.2	0.10	0.19	0.63
Irrigation - fertigation regimes						
I_1 - 100% PE + 100% RDF	20.3	80.8	146.6	0.97	5.43	12.89
I_2 - 100% PE + 125% RDF	21.1	81.0	155.8	1.06	5.60	13.50
I_3 - 75% PE + 100% RDF	19.9	79.9	136.3	0.95	4.89	11.06
I_4 - 75% PE + 125% RDF	20.3	80.1	144.1	0.96	5.24	12.18
SEd	1.5	3.8	5.1	0.05	0.10	0.35
CD (p=0.05)	NS	NS	10.6	NS	0.22	0.73
Interaction	NS	NS	NS	NS	NS	S

PE- Pan Evaporation, RDF- Recommended Dose of Fertilizer, S- Significant and NS- Non Significant

Table 2: Interaction of sweet corn hybrids and irrigation-fertigation regimes on dry matter production (t ha^{-1}) at harvest

Treatments	Hybrids			
Irrigation-fertigation regimes	V_1 -CSCH 14003	V_2 -CSCH 15005	V_3 -Misthi	Mean
I_1 - 100% PE + 100% RDF	12.36	11.97	14.33	12.89
I_2 - 100% PE + 125% RDF	12.69	12.04	15.78	13.50
I_3 - 75% PE + 100% RDF	11.29	10.43	11.45	11.06
I_4 - 75% PE + 125% RDF	11.85	11.59	13.09	12.18
Mean	12.05	11.50	13.66	
	SEd		CD (p=0.05)	
V X S	0.61		1.27	

Table 3: Effect of cultivars and irrigation-fertigation regimes on yield attributes and yield of sweet corn

Treatments	No of rows cob^{-1}	No of kernels row^{-1}	Cob length (cm)	Cob girth (cm)	Test weight (g)	Cob yield(t ha^{-1})
Hybrids						
V_1 - CSCH-14003	12.1	31.0	14.5	11.5	31.8	14.0
V_2 -CSCH-15005	11.5	29.6	13.8	10.8	30.3	13.4
V_3 –Misthi	13.5	35.9	16.9	13.1	33.9	15.9
SEd	0.3	0.9	0.4	0.6	0.8	0.3
CD (p=0.05)	0.6	1.9	0.9	1.3	1.8	0.7
Irrigation - fertigation regimes						
I_1 - 100% PE + 100% RDF	12.3	34.3	16.1	12.7	32.0 `	15.3
I_2 - 100% PE + 125% RDF	13.6	36.0	17.0	13.3	33.9	16.0
I_3 - 75% PE + 100% RDF	11.4	26.1	12.0	11.0	31.0	12.0

I_4 - 75% PE + 125% RDF	12.1	32.2	15.1	12.1	31.1	14.4
SEd	0.3	1.0	0.5	0.7	1.0	0.4
CD (p=0.05)	0.8	2.2	1.1	1.5	2.0	0.9
Interaction	NS	S	S	NS	NS	S

PE- Pan Evaporation, RDF- Recommended Dose of Fertilizer, S- Significant and NS- Non Significant

Table 4: Interaction of sweet corn hybrids and irrigation-fertigation regimes on number of kernels row^{-1}

Treatments	**Hybrids**			
Irrigation-fertigation regimes	**V_1 - CSCH 14003**	**V_2 - CSCH 15005**	**V_3 - Misthi**	**Mean**
I_1 - 100% PE + 100% RDF	32.6	31.6	38.8	34.3
I_2 - 100% PE + 125% RDF	33.4	31.8	42.7	36.0
I_3 - 75% PE + 100% RDF	26.7	24.5	27.1	26.1
I_4 - 75% PE + 125% RDF	31.1	30.4	35.0	32.2
Mean	31.0	29.6	35.9	
	SEd		CD (p=0.05)	
V X S	1.8		3.8	

Table 5: Interaction sweet corn of hybrids and irrigation-fertigation regimes on cob length (cm)

Treatments	**Hybrids**			
Irrigation-fertigation regimes	**V_1 - CSCH 14003**	**V_2 - CSCH 15005**	**V_3 - Misthi**	**Mean**
I_1 - 100% PE + 100% RDF	15.3	14.8	18.4	16.1
I_2 - 100% PE + 125% RDF	15.7	14.9	20.3	17.0
I_3 - 75% PE + 100% RDF	12.3	11.2	12.5	12.0
I_4 - 75% PE + 125% RDF	14.5	14.2	16.5	15.1
Mean	14.5	13.8	16.9	
	SEd		CD (p=0.05)	
V X S	0.9		1.9	

Table 6: Interaction of sweet corn hybrids and irrigation-fertigation regimes on green cob yield (t ha^{-1})

Treatments	**Hybrids**			
Irrigation-fertigation regimes	**V_1 - CSCH 14003**	**V_2 - CSCH 15005**	**V_3 - Misthi**	**Mean**
I_1 - 100% PE + 100% RDF	14.6	14.2	17.1	15.3
I_2 - 100% PE + 125% RDF	14.9	14.3	18.7	16.0
I_3 - 75% PE + 100% RDF	12.2	11.4	12.4	12.0
I_4 - 75% PE + 125% RDF	14.0	13.7	15.6	14.4
Mean	14.0	13.4	15.9	
	SEd		CD (p=0.05)	
V X S	0.7		1.5	

Conclusion

From this investigation, it was concluded that sweet corn hybrids may be recommended has a new crop/variety for the sodic soils of Trichy District. For higher productivity of sweet corn hybrid misthi combined with 100% PE + 125% RDF may be recommend under subsurface drip irrigation in this region. Also, in water scarcity condition 75% PE + 125% RDF may be recommended under subsurface drip irrigation.

Reference

1. Abd El-Rahman G. Water use efficiency of wheat under drip irrigation systems at Al- Maghara area, North Sinai, Egypt. American-Eurasian J Agric. Environ. Sci. 2009; 5(5):664-670.
2. Balaji Naik D, Krishna Murthy R, Pushpa K. Yield and yield components of aerobic rice as influenced drip fertigation. International J Sci. and Nature. 2015; 6(3):362-365.
3. Banotra M, Sharma BC, Nandan B, Kumar R. Productivity potential of sweet corn cultivars under different planting time in subtropical foothills of NW Himalayas. International Journal of Basic and Applied Agricultural Research, 2015, 331.
4. Banotra M, Sharma BC, Brij Nandan, Akhil Verma, Shah IA, Rakesh Kumar *et al*. Growth, phenology, yield and nutrient uptake of sweet corn as influenced by cultivars and planting times under irrigated subtropics of shiwalik foot hills. International Journal of Current Microbiology and Applied Sciences. 2017; 6(10):2971-2985.
5. Begum F, Basvarajappa R. Response of sweet corn (*Zea mays* L. saccharata) cultivars to fertility levels in medium black soils of northern transitional zone of Karnataka. Recent Trends in Arts, Science, Engineering and Technology, 2018, 94.
6. Bharti V, Ravi Nandan, Vinod Kumar, Panday IB. Effect of irrigation levels on yields, water use efficiency and economics of winter maize (*Zea mays*) – based intercropping systems. Indian J. Agron. 2007; 52(1):27-30.
7. Bibe SM, Jadhav KT, Chavan AS. Response of irrigation and fertigation management on growth and yield of maize. International Journal of Current Microbiology and Applied Sciences. 2017; 6(11):4054-4060.
8. Bibe SM, Jadhav KT, Kalasare RS. Studies on fertigation management in post *kharif* maize. International Journal of Current Microbiology and Applied Sciences. 2018; Special Issue-6:1343-1347.
9. Directorate of Economics and Statistics. Agricultural Statistics at a Glance 2010. Department of Agriculture and Cooperation. All India Area, Production and Yield of Maize, 2018.
10. Farooq M, Hussain M, Wakeel A, Siddique KH. Salt stress in maize: effects, resistance mechanisms, and

management. A review. Agronomy for Sustainable Development. 2015; 35(2):461-481.
11. Gomez KA, Gomez. Statistical procedures for agricultural research (2nd ed). Intl. Rice. Res. Int., P.O.Box. Manila Philippines and John Wiley and Sons, New York, USA, 1984.
12. Govindan R, Grace TM. Influence of drip fertigation on growth and yield of rice varieties (*Oryza sativa* L.). Madras Agric. J. 2012; 99(4, 6):244-247.
13. Gozubenli H, Ulger AC, Sensor O. The effect of different nitrogen doses on grain field and yield related characters of some genotypes grown as second crop. Agric. Fac. 2001; 16:39-48.
14. Gururaj K, Sheshadri T, Thimmegowda MN, Basavaraja PK, Mallikarjuna GB. Performance of sugarcane under varied levels of irrigation and nutrients through subsurface drip fertigation. Mysore Journal of Agricultural Sciences. 2016; 50(2):290-293.
15. Karthika N, Ramanathan SP. Effect of drip fertigation on growth, physiological parameters and grain yield of rice grown in Cauvery new delta zone of Tamil Nadu. IJCS. 2019; 7(3):2758-2761.
16. Keerthi P. Performance of sweet corn cultivars under varied times of sowing during *rabi*. Doctoral dissertation, Doctoral dissertation, Acharya NG Ranga Agricultural University, Hyderabad, India, 2012.
17. Keerthi P, Reddy GP. Effect of cultivars, time of sowing on growth, yield and economics of sweet corn. Environment and Ecology. 2017; 35(3A):1829-1831.
18. Khanna and Richa. Effect of precision nutrient and water management with different sources and levels of fertilizers on maize production. M.Sc. (Ag.) Thesis, University of Agricultural Sciences, Bengaluru, Karnataka (India), 2013.
19. Leta Tulu. Response of maize (*Zea mays* L.) to moisture stress at different growth stages: A modeling approach. M.Sc. (Agri.) thesis, Univ. of Agril. Sciences, Bangalore, 1998.
20. Martinez-Gimeno MA, Bonet L, Provenzano G, Badal E, Intrigliolo DS, Ballester C. Assessment of yield and water productivity of clementine trees under surface and subsurface drip irrigation. Agricultural Water Management. 2018; 206:209-216.
21. Meena H, Sharma GL, Golada SL, Bairwa RK. Effect of Integrated Nitrogen Management on Yield and Nitrogen Uptake by Sweet Corn. Madras Agricultural Journal. 2012; 99(7-9):503-506.
22. Reddy JSVS, Murthy RK. Yield, nutrient and water use efficiency and economics of maize as influenced by levels of irrigation and fertigation. Asian Journal of Soil Science. 2017; 12(1):181-186.
23. Sidhu HS, Jat ML, Singh Y, Sidhu RK, Gupta N, Singh P, *et al*. Sub-surface drip fertigation with conservation agriculture in a rice-wheat system: A breakthrough for addressing water and nitrogen use efficiency. Agricultural Water Management. 2019; 216:273-283.
24. Sivamurugan AP, Ravikesavan, Yuvaraja A. Effect of Planting Density and Nutrient Management Practices on the Performance of Maize Hybrids in Kharif Season. Chem Sci Rev Lett. 2017; 6(22):1044-1048.
25. Sundrapandiyan R. Study on the effect of drip biogation on the productivity of aerobic rice, M.Sc. (Agri.) Thesis, Tamil Nadu Agricultural University, Coimbatore, 2012, 410-423.
26. Tyagi RC, Devender Singh, Hooda IS. Effect of plant population, irrigation and nitrogen on yield and its attributes of spring maize. Indian J. Agron. 1998; 43(4):672.
27. Venkatesan K, Saraswathi T, Pugalendhi L, Jhansi Rani P. Impact of irrigation and fertigation levels on the growth and yield of elephant foot yam (*Amorphophallus paeoniifolius* (Dennst.) Nicolson). Journal of Root Crops. 2015; 40(1):52-55.
28. Wei Q, Xu J, Li Y, Liao L, Liu B, Jin G, *et al*. Reducing Surface Wetting Proportion of Soils Irrigated by Subsurface Drip Irrigation Can Mitigate Soil N2O Emission. International Journal of Environmental Research and Public Health. 2018; 15(12):2747.