Indian Journal of Ecology (2023) 50(1): 99-107
DOI: https://doi.org/10.55362/IJE/2023/3860

Manuscript Number: 3860
NAAS Rating: 5.79

Response of Summer Sweetcorn to Drip Irrigation and Crop Growth Based Fertigation Levels under High Density Planting

N. Lavanya, P. Laxminarayana[1], K.B. Suneetha Devi[2], G. Jayasree [3] and Lakshmi Prayaga[4]

Subject Matter Specialist, Agromet- DAMU, KVK, Palem, PJTSAU, Nagarkurnool-509 209, India
[1]Department of Agronomy, Agricultural Research Institute,
[2]Director of Research, Admin office,
[3]Department. of Soil science and Agricultural Chemistry, PJTSAU, Hyderabad-500 030 India
[4]Department of Crop Physiology, IIOR, Hyderaba-500 030, India
E-mail: lavanyanookala94@gmail.com

Abstract: Enhancing nutrient use efficiency (NUE) and water use efficiency (WUE) are most critical and turn daunting research issues. A number of approaches are to be used in order to enhance water and nutrient use efficiency by reducing losses and to minimize the detrimental effect of water and nutrient stress in crop plants. This can be achieved through adoption of efficient methods of irrigation and fertilizer application. Field experiments were carried in, College of Agriculture, PJTSAU, Hyderabad, to determine the impact of drip irrigation and fertigation levels on the growth, yield and output of sweetcorn under high density planting during consecutive summer seasons of 2020 and 2021 respectively. Twelve treatment combinations (three levels of irrigation and four levels of fertigation through drip) with factorial concept. The results revealed that based on mean of two years, among irrigation levels, 1.0 Epan registered considerably higher growth parameters (plant height, leaf area and dry matter production), yield attributes (no. of cobs plant^{-1}, cob length, no. of kernels, cob weight, cob girth) and yield over 0.8 and 0.6 E pan. Among the fertigation levels, 125% RDNK in differential dosage (225-75-62.5 kg N, P_2O_5, K_2O ha^{-1}) in accordance with the crop coefficient curve resulted in significantly greater growth parameters, yield characteristics and yield.

Keywords: Fertigation, Irrigation, Sweetcorn, Yield

Zea mays L. cv. Saccharata, also known as sweet corn, is a variety of maize whose immature grains contain 13 to 15% sugar. A medium-sized plant called sweet corn produces green ears 65 to 85 days after planting. In the recent past the demand for sweet corn is increasing in cities as a snack. In the summer, sweet corn is a great additional source of green feed to keep the cow herd afloat. Being a shorter duration crop, it can be grown as a summer crop, when irrigation is scarce, after long-lasting *kharif* crops like cotton, red gram and rice. Among the agronomic practices, optimum plant stand is most crucial one, which helps to harness optimum growth and yield. With the increasing demographic pressure and dwindling natural resources. Best management practices are the need of the hour, to meet the increasing food demand apart from enhancing resource use efficiency. Traditional methods of nutrient and water application result in application losses apart poor use efficiency and high cost of cultivation. Drip fertigation is an effective method wherein, water soluble fertilisers are applied to the active plant root zone. Plant nutritional requirements vary depending on stage of development and drip fertigation, facilitates to apply them in accordance to plant requirement and limit fertiliser loss through leaching and. Fertigation delivered in varied doses produced higher cob yield over equal splits/ doses throughout the crop growth cycle, (Jha et al 2015). Hence, there is a need to revalidated fertiliser schedule of sweetcorn as the planting density has grown by 50% (from 83,333 to 1,60,000). Further, impact of drip irrigation and N fertigation levels on grain maize and sweetcorn, exact water and nutrient scheduling based on scientific evidence such as Kc values is not available in sweetcorn. In light of this, the present experiment was conducted to determine the impact of various irrigation and fertigation levels, as well as their interaction, on the growth and yield of summer sweet corn under high-density planting.

MATERIAL AND METHODS

Present field experiment was conducted at College Farm, PJTSAU, Hyderabad, Telangana State. The farm is classified as semi-arid tropics (SAT) by Troll's categorization and is situated at an elevation of 542.3 meters above mean sea level in the Southern Telangana agro-climatic zone of Telangana, at 17°19' N latitude and 78°23' E longitude. In 2019-20, the mean weekly maximum temperature ranged from 31.00 to 39.00 °C with an average of 35.0 °C, while, in 2020-21, ranged from 37.14 to 35.50 °C with an average of

36.32 °C. In 2019-20, the weekly mean minimum temperature ranged from 10.64 to 24.29 °C with an average of 17.46 °C, while in 2020-21, it ranged from 11.21 to 16.21 °C with an average of 13.71 °C. Rainfall totaled 21.00 mm in five rainy days in 2019-20 and 4.6 mm in one rainy day in 2020-21 during the crop growth period. In 2019-20, mean weekly pan evaporation (PE) ranged from 3.74 to 7.90 mm, while in 2020-21, ranged from 2.49 to 5.96 mm. During the crop research, total evaporation was 440.7 mm in 2019-20 and 340.7 mm in 2020-21. Due to the lack of rainfall during both years of the study, the crop was mostly grown under irrigation.

The experimental soil was sandy clay loam in texture (75.24 % sand, 10.4 % silt, and 14.06 % clay) with an average bulk density of 1.59 Mg m^3 for 0-60 cm depth and was slightly alkaline (pH) 7.5 and Ec (0.27 ds m^{-1}). The available N, P and K in the experimental soil were 187.5, 64.3, and 334.2 kg ha^{-1}. The experiment consisted of twelve treatments that were replicated thrice and laid out in randomized block design with factorial concept (FRBD). Treatments consisted of the three irrigation levels *viz*; (0.6 [I_1], 0.8 [I_2], and 1.0 Epan [I_3]) and four fertigation levels were 100 per cent recommended nitrogen and potassium as per recommendation [F_1], 100 percent RDNK in differential dosage as per crop coefficient curve [F_2], 125 percent RDNK in differential dosage as per recommendation [F_3], and 125 per cent RDNK in differential dosage as per crop coefficient curve [F_4]). Sweet corn (variety Madhuri) was seeded at 30cm x 20 cm spacing on February 5th, 2020 during first season and December 11th, 2020 during second season. The recommended fertilizer doses of 180, 60, and 50 kg N, P_2O_5, K_2O ha^{-1} were supplied through urea, single super phosphate (SSP) and sulphate of potash (SOP) respectively. As a baseline, the treatments received a standard amount of phosphorus. As per the treatments, nitrogen and potassium were applied in splits through fertigation.

Irrigation was scheduled every three days. The irrigation water was applied based on data collected from a USWB open pan evaporimeter located at the Meteorological observatory at Agro-climatic Research Centre, ARI, Rajendranagar, Hyderabad. On rainy days, the amount of water applied to each treatment was modified to account for the amount of rain fall received. The laterals (16 mm diameter) were spaced 0.6 m apart, with a 0.2 m interval between two inline emitters. The discharge rate of the emitter was 2.0 liters per hour. Application rate in drip irrigation treatments was arrived.

$$\text{Application rate (mmhr}^{-1}\text{)} \frac{Q}{DL \times DE}$$

Q = Dripper discharge (liters h^{-1}), D_L = space between laterals (m), D_E = spacing between emitters (m)

Irrigation duration for each treatment was calculated:

$$\text{Irrigation time (minutes)} = \frac{E_{pan}\text{ (mm)} \times 60}{\text{Application rate (mmhr}^{-1}\text{)}}$$

Fertigation in 10 splits once in 6 days interval in differential dosage as per crop growth was done from 10 days after sowing (DAS) to 70 DAS. For the treatments F_1 and F_3, fertigation was done in differential dosages as per recommendation as 100% and 125% RDF (Table 1). F_2 and F_4 fertigation was given in differential dosages as per crop coefficient curve as 100 and 125 % RDF respectively (Table 2). The crop was harvested on 24th April, 2020 and 12th March, 2021 during 1st and 2nd seasons respectively.

RESULTS AND DISCUSSION

Growth parameters: The drip irrigation scheduled at 1.0 Epan (I_3) registered statistically higher plant height, dry matter accumulation at 30, 60 DAS and at harvest and leaf area over 0.8 Epan (I_2) and 0.6 Epan (I_1). The minimum plant height, dry matter production and leaf area were recorded in drip irrigation at 0.6 Epan (I_1). Improved growth parameters in (I3) may be attributed to the presence of ideal moisture in the root zone, which encouraged higher nutrient uptake and, in turn, more photosynthesis, which encouraged better photosynthate accumulation. These findings are in agreement with the conclusions of earlier scientist (Sharanabasava 2012, Kadasiddappa 2015, Bibe et al 2017).

Among four fertigation levels, statistically higher plant height, dry matter production and leaf area were with (F_4) and on par with (F_3) during 2020 and 2021. F_3 was also on par with F_2. Significantly lowest plant height, dry matter production and leaf area were with (F_1) and it was on par with (F_2) during 2020 and 2021. Higher growth parameters under F_3 and F_4 might be due to better crop growth and higher leaf area as a

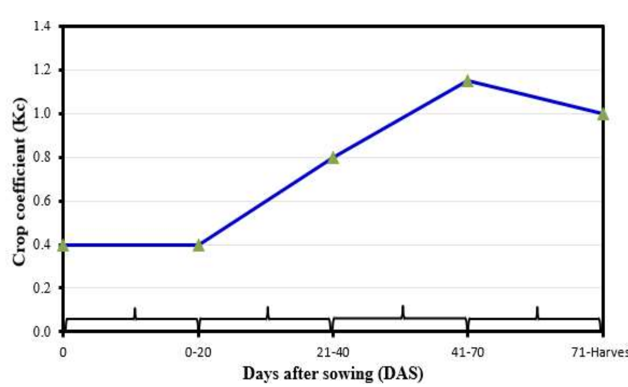

Fig. 1. Crop coefficient (Kc) values at different stages of sweetcorn crop according to FAO

Table 1. Differential dosage of fertilizer application based on growth stage of sweet corn crop as per recommendation

Crop stage	Nutrient dose ($kg\ ha^{-1}\ day^{-1}$)	
	N	K_2O
After sowing 20 days (10-30 DAS)	1.31	0.56
Grand growth period 20 days (30-50 DAS)	4.39	1.18
Reproductive stage 20 days (50-70 DAS)	3.30	0.75

Table 2. Differential dosage of fertilizer application based on growth stage of sweet corn as per crop coefficient curve

Crop stage (DAS)	Kc values	Nutrient dose ($kg\ ha^{-1}\ day^{-1}$)	
		N	K_2O
10-20	0.4	1.54	0.42
21-26	0.51	2	0.53
27-31	0.62	2.4	0.65
32-37	0.74	2.8	0.77
38-43	0.84	3.2	0.88
44-49	0.90	3.5	0.95
50-55	0.98	3.8	1.03
56-61	1.05	4.03	1.10
62-67	1.13	4.3	1.18
68-70	1.15	4.4	1.20
Average = 0.83			

result of nutrient supply (N and K) in higher doses than the recommended level under high density planting. Lack of nitrogen, necessary component of chlorophyll and a building block of protein, may have contributed to the slower dynamics of dry matter accumulation and resultant lower growth parameter at lower nitrogen dosages. Similar results were also reported by Fanish et al (2011). The supplying nutrients through fertigation in more scientific way under F_4 and F_2 treatments, lower fertiliser dose were applied during early, late growth stage and the crop's nutrient requirement was met by applying more fertiliser during growth period and reproductive stages, which led to greater uptake and accumulation of biomass over F_3 and F_1 treatments. These results are in line with the findings of Shekar et al (2016) and Jha et al (2015).

Time taken to attain 6th leaf stage, 50 % tasselling and silking were significantly less under drip irrigation scheduled at 1.0 Epan (I_3) over 0.6 Epan (I_1) and was at par with irrigation scheduled at 0.8 Epan (I_2) during 2020 and 2021. The reduction in days to attain 6th leaf stage, 50 per cent tasselling and silking under 1.0 Epan during both the years might be due to favourable soil moisture status throughout the crop growth. As sweetcorn crop is particularly sensitive to water deficits, onset of 6th leaf stage, emergence of tassels and silking were delayed under 0.6 Epan. Similar results were reported by Sharanabasava (2012) and Brar *et al* (2016). Number of days to attain 6th leaf stage was not significant among fertigation levels during both the years. While, the days 50 % tasselling and silking stages were lesser with (F_4) and it was comparable with (F_3). The days to attain 50%

Table 3. Plant height (cm) of sweet corn as influenced by drip irrigation and fertigation levels

Treatments	Days after sowing								
	30			60			Harvest		
	2020	2021	Mean	2020	2021	Mean	2020	2021	Mean
Irrigation levels (I)									
I_1	35.1	31.8	33.5	145.1	136.4	140.8	152.6	143.7	148.1
I_2	37.9	34.6	36.3	171.8	163.3	167.5	179.2	173.0	176.1
I_3	39.1	37.1	38.1	189.3	181.5	185.4	196.3	189.5	192.9
CD (P=0.05%)	2.4	2.5	2.5	14.2	10.0	12.1	12.8	10.6	11.7
Fertigation levels (F)									
F_1: F_1	36.4	34.0	35.2	163.0	156.3	159.6	164.4	158.6	161.5
F_2: F_2	36.8	34.3	35.6	156.6	151.9	154.3	168.3	162.7	165.5
F_3	38.0	34.7	36.4	181.2	168.2	174.7	184.3	173.3	178.8
F_4	38.4	34.9	36.7	174.2	165.4	169.8	187.1	180.4	183.7
CD (p=0.05)	NS	NS	NS	16.4	11.5	14.0	14.8	12.3	13.5
Interaction (IXF)									
CD (p=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS

tasselling and silking was higher with (F_1) which was statistically similar with the (F_2) . Application of nitrogen and potassium fertilisers at higher doses under F_3 and F_4 treatments has increased nutrient uptake and sparked quicker development, which has led to higher LAI. This has also improved dry matter production and accelerated the flowering and maturity time compared to lesser levels. (F_1 and F_2). Similar results were reported by Sharanabasava (2012) and Brar and Vashist (2020).

Yield attributes: Data on yield attributes revealed that, cobs number per plant, cob length, cob girth, cob weight plant^{-1}, number of kernels per cob were significantly higher under irrigation given at 1.0 Epan (I_3) over 0.8 and 0.6 Epan (I_2 and I_1). Improved yield attributes with increasing irrigation levels might be due to the higher photosynthetic area at higher irrigation regimes, which might have helped in the increased production and translocation of photosynthates from source to the sink. Eralier also similar findings were reported Karato

Table 4. Leaf area (cm^2) of sweet corn as influenced by drip irrigation and fertigation levels

Treatments	Days after sowing								
	30			60			Harvest		
	2020	2021	Mean	2020	2021	Mean	2020	2021	Mean
Irrigation levels (I)									
I_1	674.9	623.1	649.0	4605.4	4274.9	4440.1	4486.2	4174.0	4330.1
I_2	774.0	713.8	743.9	5073.7	4717.4	4895.5	4954.3	4573.2	4763.7
I_3	844.3	799.3	821.8	5445.3	5143.5	5294.4	5232.9	4946.8	5089.8
CD (P=0.05%)	47.1	45.4	-	342.1	281.9	-	278.4	312.0	-
Fertigation levels (F)									
F_1: F_1	722.8	672.8	697.8	4881.9	4545.9	4713.9	4662.2	4347.4	4504.8
F_2: F_2	746.1	697.8	721.9	4779.5	4514.6	4647.1	4721.9	4411.0	4566.5
F_3	783.9	726.7	755.3	5326.1	4945.7	5135.9	5076.6	4720.7	4898.7
F_4	804.7	751.0	777.9	5178.3	4841.5	5009.9	5103.6	4779.4	4941.5
CD (p=0.05)	54.4	52.4	-	395.1	325.5	-	321.5	360.3	-
Interaction (IXF)									
CD (p=0.05)	NS	NS	-	NS	NS	-	NS	NS	-

Table 5. Dry matter production (g m^{-2}) of sweet corn as influenced by drip irrigation and fertigation levels

Treatments	Days after sowing								
	30			60			Harvest		
	2020	2021	Mean	2020	2021	Mean	2020	2021	Mean
Irrigation levels (I)									
I_1	66.3	59.1	62.7	1761.4	1708.1	1734.8	3601.4	3404.3	3502.9
I_2	75.1	66.1	70.6	1881.1	1830.3	1856.0	4184.5	4073.2	4128.9
I_3	80.7	72.2	76.5	2025.4	1937.6	1981.5	4694.6	4521.2	4607.9
CD (p=0.05)	5.3	4.8	5.1	111.2	104.1	107.7	292.8	288.9	290.9
Fertigation levels (F)									
F_1: F_1	69.6	61.7	65.7	1835.6	1781.2	1808.4	3845.7	3706.1	3775.9
F_2: $1F_2$	72.2	63.9	68.1	1806.8	1747.1	1777.0	4007.6	3864.0	3935.8
F_3	75.8	67.9	71.6	1978.3	1904.0	1941.2	4306.9	4157.2	4232.1
F_4	78.5	69.7	74.1	1936.4	1869.0	1902.7	4480.5	4270.9	4375.7
CD (p=0.05)	6.1	5.5	5.8	128.4	120.2	124.3	338.1	333.5	335.8
Interaction (IXF)									
CD (p=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS

(2013), Kadasiddappa (2015) and Bibe *et al* (2017). Among, fertigation levels, higher yield attributes were recorded under (F_4) which were on par with (F_3). The application of 100 % RDNK differential dosage as per recommendation (F_1) recorded lower yield attributes and was on par with application of 100 % RDNK as crop coefficient curve (F_2) during 2020 and 2021. The increased physiological processes in crop plants resulted in higher growth and more photosynthates translocation the cobs with increased nitrogen and potassium fertiliser application. Further, the yield attributes produced under the treatment F_2 were comparable with F_3 as the nutrients were given more precisely based on growth needs under F_2 and F_4 fertigation pattern as compared to F_3 and F_1 fertigation treatments. These outcomes were consistent with Richa Khanna (2013). Yash pal (2016) and Bibe et al (2017).

Fresh cob yield and fodder yield (kg ha^{-1}): The drip irrigation at 1.0 Epan (I_3) has resulted significantly higher cob yield and fodder yield over other two irrigation levels (I_2 and I_1) and the lowest cob yield and green fodder yield was under drip irrigation at 0.6 Epan (I_1).

The favourable soil moisture conditions maintained

Table 6. Onset of different phenophases (number of days) of sweet corn as influenced by drip irrigation and fertigation levels

Treatments	Days after sowing								
	30			60			Harvest		
	2020	2021	Mean	2020	2021	Mean	2020	2021	Mean
Irrigation levels (I)									
I_1	26.4	27.6	27.0	53.6	59.3	56.4	59.7	65.5	62.6
I_2	25.3	26.6	26.0	50.3	56.4	53.3	56.1	62.6	59.3
I_3	24.7	25.8	25.2	49.8	54.5	52.2	54.3	60.1	57.2
CD (p=0.05)	1.3	1.2	-	2.2	2.5	-	2.4	2.7	-
Fertigation levels (F)									
F_1: F_1	26.1	27.1	26.6	52.6	58.2	55.4	58.4	64.3	61.4
F_2: $1F_2$	25.9	27.3	26.6	52.6	58.3	55.5	58.1	64.4	61.3
F_3	25.1	26.1	25.6	50.0	55.2	52.6	55.2	61.2	58.2
F_4	24.8	26.0	25.4	49.8	55.1	52.5	55.0	61.1	58.1
CD (p=0.05)	NS	NS	-	2.5	2.8	-	2.8	3.1	-
Interaction (IXF)									
CD (p=0.05)	NS	NS	-	NS	NS	-	NS	NS	-

Table. 7a. Yield attributes of sweet corn as influenced by drip irrigation and fertigation levels

Treatments	No. of cobs plant^{-1}			Cob weight plant^{-1} (g)			Cob length (cm)		
	2020	2021	Mean	2020	2021	Mean	2020	2021	Mean
Irrigation levels (I)									
I_1	1.2	1.1	1.2	128.7	120.1	124.4	17.2	16.6	16.9
I_2	1.3	1.2	1.3	156.6	150.7	153.7	18.8	18.6	18.7
I_3	1.5	1.3	1.4	181.8	171.1	176.5	20.2	20.0	20.1
CD (p=0.05)	0.08	0.09	-	11.6	15.5	-	1.1	1.0	-
Fertigation levels (F)									
F_1: F_1	1.2	1.1	1.2	141.8	133.3	137.5	17.8	17.6	17.7
F_2: $1F_2$	1.3	1.2	1.3	152.5	139.1	145.8	18.1	17.8	18.0
F_3	1.4	1.3	1.3	160.4	155.2	157.8	19.2	18.9	19.1
F_4	1.4	1.3	1.4	168.1	161.6	164.9	19.6	19.2	19.4
CD (p=0.05)	0.10	0.10	-	13.3	17.9	-	1.2	1.2	-
Interaction (IXF)									
CD (p=0.05)	NS	NS	-	NS	NS	-	NS	NS	-

during the crop growth period, might have improved the photosynthetic rate, biomass accumulation and partitioning to economic components, that have reflected in greater cob and fodder output in I3 (1.0 Epan). The crop's inability to absorb nutrients due to lack of moisture that resulted in lowest yield under I1 (0.6 Epan), as water is a medium for nutrient absorption (Islam et al 2012, Kadasiddappa et al 2013, Brar et al 2018).

Among fertigation levels, (F_4) registered significantly higher cob yield and green fodder yield over (F_1) and (F_2) during both the years. However, was statistically at par with (F_3) during 2020 and 2021. The lower fresh cob yield and fodder yield was recorded with (F_1) during both the years. Cob yield and fodder yield obtained in F_1 and F_2 were at par with each other and cob yield obtained with F_3 was also comparable with F_2 but, was statistically higher over F_1. Thus 25 % of the nutrients can be saved with recommendation based sustainable approach like crop coefficient curve. The higher yield recorded with (F_4) might be due to lower rates of fertiliser application during initial stages and higher rate at grand growth period and reproductive stages that coincided with the crop growth needs which helped towards higher

Table 7b. Yield attributes of sweet corn as influenced by drip irrigation and fertigation levels

Treatments	Cob girth (cm)			No. of kernels cob^{-1}		
	2020	2021	Mean	2020	2021	Mean
Irrigation levels (I)						
I_1	12.0	11.8	11.9	467	450	459
I_2	13.5	13.3	13.4	505	491	498
I_3	14.4	14.4	14.4	537	524	531
CD (p=0.05)	0.9	0.9	-	27	28	-
Fertigation levels (F)						
F_1: F_1	12.6	12.5	12.6	484	468	476
F_2: F_2	12.9	12.7	12.8	488	474	481
F_3	13.7	13.7	13.7	518	502	510
F_4	13.9	13.8	13.9	523	509	516
CD (p=0.05)	1.0	1.0	-	31	32	-
Interaction (IXF)						
CD (p=0.05)	NS	NS	-	NS	NS	-

Table 8. Nutrient uptake (kg ha^{-1}) by sweet corn at harvest as influenced by drip irrigation and fertigation levels

Treatments	Nutrient uptake (kg ha^{-1})								
	Nitrogen			Phosphorus			Potassium		
	2020	2021	Mean	2020	2021	Mean	2020	2021	Mean
Irrigation levels (I)									
I_1	321.4	300.9	311.2	123.9	115.4	119.7	449.7	401.2	425.5
I_2	414.6	409.8	412.2	160.2	156.3	158.3	585.7	537.3	561.5
I_3	525.6	477.4	501.5	189.8	182.6	186.2	691.9	662.5	677.2
CD (p=0.05)	56.7	52.1	-	16.7	16.6	-	66.5	73.5	-
Fertigation levels (F)									
F_1: F_1	364.5	335.0	349.8	137.6	132.1	134.9	494.9	464.8	479.9
F_2: F_2	385.7	368.3	377.0	146.9	142.4	144.6	536.1	494.3	515.2
F_3	450.5	429.4	440.0	168.1	162.2	165.2	614.4	574.6	594.5
F_4	481.3	451.5	466.4	179.3	169.0	174.2	657.8	600.9	629.4
CD (p=0.05)	65.4	60.2	-	19.3	19.2	-	76.8	84.9	-
Interaction (IXF)									
CD (p=0.05)	NS	NS	-	NS	NS	-	NS	NS	-

nutrient uptake. Nutrients were supplied more precisely and scientifically under F_4 and F_2 treatments when compared to F_1 and F_3 treatments. Improved growth and yield attributes under F_3 and F_4 fertigation levels over F_1 and F_2 was also due to increased nutrient levels (N and K) that attributed to sufficient intake of nutrients under higher density planting, which in turn improved cob yield. Similar findings on higher yields with the increase in the fertiliser rate were also reported by Sharanabasava (2012) and Richa Khanna (2013).

Water applied and water productivity: Total water applied including effective rainfall was 499.1 and 405.6 mm in case of the treatment drip at 1.0 Epan (I_3) followed by drip at 0.8 Epan (423.5 and 346.0 mm) (I_2), and drip at 0.6 Epan (348.5 and 286.5 mm) (I_1) (Table 10). Significantly higher water productivity were recorded with drip irrigation scheduled at 0.6 Epan. The, drip irrigation scheduled at 1.0 Epan produced lowest water productivity during 2020 and 2021 (Table 9). Although irrigation scheduled at 1.0 Epan produced the highest cob yield, it could not translate this yield into higher water productivity. Increase in the water productivity with the decrease in the amount of water applied were also

Table 9. Green cob yield, green fodder yield (kg ha^{-1}) and water productivity of sweet corn as influenced by drip irrigation and fertigation levels

Treatments	Green cob yield (kg ha^{-1})			Green fodder yield (kg ha^{-1})			Water productivity (kg m^{3})		
	2020	2021	Mean	2020	2021	Mean	2020	2021	Mean
Irrigation levels (I)									
I_1	9967	9332	9650	27878	26551	27215	2.9	3.3	3.1
I_2	11734	11195	11465	33149	31559	32354	2.8	3.2	3.0
I_3	12870	12337	12604	36409	35044	35727	2.6	3.0	2.8
CD (p=0.05)	941	899	920	2461	2485	2473	0.2	0.2	-
Fertigation levels (F)									
F_1: F_1	10724	10156	10440	30117	28879	29498	2.5	2.9	2.7
F_2: F_2	11131	10593	10862	31423	29937	30680	2.6	3.1	2.9
F_3	11891	11300	11596	33600	32294	32947	2.8	3.3	3.1
F_4	12349	11769	12059	34776	33096	33936	2.9	3.4	3.2
CD (p=0.05)	1087	1039	1063	2842	2870	2856	0.3	0.2	-
Interaction (IXF)									
CD (p=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	-

Table 10. Irrigation water, total water applied, effective and ineffective rainfall of *Summer* sweetcorn as influenced by drip irrigation and fertigation levels

Treatments	Irrigation water applied (mm)		Effective rainfall (mm)		Ineffective rainfall (mm)		Total water applied (mm)	
	2020	2021	2020	2021	2020	2021	2020	2021
I_1F_1	327.5	281.9	21.0	4.6	0.0	0.0	348.5	286.5
I_1F_2	327.5	281.9	21.0	4.6	0.0	0.0	348.5	286.5
I_1F_3	327.5	281.9	21.0	4.6	0.0	0.0	348.5	286.5
I_1F_4	327.5	281.9	21.0	4.6	0.0	0.0	348.5	286.5
I_2F_1	402.5	341.4	21.0	4.6	0.0	0.0	423.5	346.0
I_2F_2	402.5	341.4	21.0	4.6	0.0	0.0	423.5	346.0
I_2F_3	402.5	341.4	21.0	4.6	0.0	0.0	423.5	346.0
I_2F_4	402.5	341.4	21.0	4.6	0.0	0.0	423.5	346.0
I_3F_1	478.1	401.0	21.0	4.6	0.0	0.0	499.1	405.6
I_3F_2	478.1	401.0	21.0	4.6	0.0	0.0	499.1	405.6
I_3F_3	478.1	401.0	21.0	4.6	0.0	0.0	499.1	405.6
I_3F_4	478.1	401.0	21.0	4.6	0.0	0.0	499.1	405.6

Table 11. Economics of sweet corn as influenced by different drip irrigation and fertigation levels

Treatments	Net returns (Rs ha^{-1})			Benefit cost ratio		
	2020	2021	Mean	2020	2021	Mean
Irrigation levels (I)						
I_1	82803	71745	77274	2.9	2.5	2.7
I_2	104721	94733	99727	3.3	2.9	3.1
I_3	118327	108829	113578	3.5	3.2	3.4
CD (p=0.05)	9736	9725	-	0.12	0.10	-
Fertigation levels (F)						
F_1: F_1	93262	83505	88383	3.1	2.8	3.0
F_2: F_2	98638	88925	93782	3.2	2.9	3.1
F_3	105072	94580	99826	3.2	2.9	3.1
F_4	110830	100066	105448	3.3	3.0	3.2
CD (p=0.05)	11242	11230	-	0.14	0.12	-
Interaction (IXF)						
CD (p=0.05)	NS	NS	-	NS	NS	-

reported by Kadasiddappa *et al.* (2013) and Satish (2015). Among four fertigation levels, application of 125 % RDNK in differential dosage as per crop coefficient curve (F_4) recorded significantly higher water productivity over application of 100 % RDNK in differential dosage as per crop coefficient curve (F_2) and application of 100 % RDNK in differential dosage as per recommendation (F_1) and was on par with application of 125 % RDNK in differential dosage as per recommendation (F_3). This increase in WP with under F_4 and F_3 over F_1 and F_2 might be due to increased yield with the application of 125 % RDNK over 100% RDNK. Satish (2015) also observed improvement in water productivity with elevated levels of nitrogen. However, on growth metrics, yield attributes, sweet corn yield and water productivity there was no discernible interaction effect of drip irrigation and fertigation levels.

Economics: The irrigation scheduled at 1.0 Epan recorded significantly higher net returns and benefit cost ratio over 0.8 and 0.6 Epan. Lowest gross returns, net returns and B:C ratio were under 0.6 Epan (Table 11). Increased net returns and B:C ratio with (I_3) was mainly due to high cob and fodder yield obtained when compared to other treatments (I_2 and I_1). These results were in similarity with the Yash Pal (2016) and Brar et al (2018) with regard to higher gross and net returns with higher drip irrigation levels. Among the four fertigation levels, application of 125 % RDNK in differential dosage as per crop coefficient curve (F_4) recorded significantly higher net returns and B:C ratio on par with application of 125 % RDNK in differential dosage as per recommendation (F_3). The lower gross returns, net returns and B:C ratio were obtained with the application of 100 % RDNK in differential dosage per recommendation (F_1) which were on par with 100 % RDNK in differential dosage as per crop coefficient curve (F_2) (Table 11). The higher gross returns, net returns and B:C ratio under F_3, F_4 was due to higher fresh cob and green fodder yield obtained over other fertigation levels. Richa Khanna (2013) and Shruthi et al (2018) and also recorded higher gross returns, net returns and B:C ratio under higher fertigation levels.

CONCLUSION

Drip irrigation scheduled to summer sweet corn at 1.0 Epan throughout the crop growth period recorded higher growth, yield attributes, yield and returns over 0.6 and 0.8 Epan. Among fertigation levels, application of 125 % RDNK in differential dosage as per crop coefficient curve and application of 125 % RDNK in differential dosage as per recommendation curve recorded higher growth, yield and returns.

REFERENCES

Bibe SM, Jadhav KT and Chavan A 2017. Response of irrigation and fertigation management on growth and yield of maize. *International Journal of Current Microbiology and Applied Sciences* **6**(11): 4054-4060.

Brar HS, Krishan Kumar Vashist and Singh KG 2018. Water saving in spring maize under different drip irrigation regimes and nitrogen levels. *Agricultural Research Journal* **55**(1): 162-165.

Brar H and Vashist K 2020. Drip irrigation and nitrogen fertilization alter phenological development and yield of spring maize (*Zea mays* L.) under semi-arid conditions. *Journal of plant Nutrition* **43**(12): 1-11.

Erteka A and Karato B 2013. Yield and quality of sweet corn under deficit irrigation. *Agricultural Water Management* **129**: 138-144.

Fanish SA, Muthukrishnan P and Jeyaraman S 2011. Effect of drip fertigation and intercrops on yield and water use efficiency of maize (*Zea mays*) under maize based intercropping system.

Journal of Crop and Weed **7**(2): 41-45.

Gomez KA and Gomez A 1984. *Statistical Procedures for Agricultural Research* (1st Edition), Jhon Wiley and Sons, Wiley and Sons, Wiley Inter Science Publication, New York, USA., 680

Islam MR, Garcia SC and Horadagoda A 2012. Effects of irrigation and rates and timing of nitrogen fertilizer on dry matter yield, proportions of plant fractions of maize and nutritive value and in vitro gas production characteristics of whole crop maize silage. *Animal Feed Science and Technology* **172**(3-4): 125-135.

Jha BK, Santosh SM, Sushanta KN, Ajay Kumar and Arun KS 2015. *Optimal planting geometry and growth stage based fertigation in vegetable crops.* Technical Bulletin No R-56/Ranchi-25.

Kadasiddappa M 2015. *Drip irrigated maize and sunflower: growth, yield, evapotranspiration and water production functions.* Ph.D Dissertation, PJTSAU, Hyderabad.

Richa Khanna 2013. *Effect of precision nutrient and water management with different sources and levels of fertilizers on maize production.* M.Sc. Dissertation, Univeristy of Agricultural Sciences, Bengaluru.

Satish C 2015. *Optimization of drip irrigation and deficit irrigation for sorghum (Sorghum bicolor* L.*) Moench) water requirement using FAO Aqua crop model*. M.sc. Dissertation, PJTSAU, Hyderabad.

Sharana Basava. 2012. *Performance of sweet corn hybrid under different levels of irrigation and nitrogen applied through drip system.* M.Sc. Dissertation, ANGRAU, Hyderabad.

Shekar JC, Avil kumar K and Chary GR 2016. Yield and yield attributes of *Bt* cotton as influenced by different drip fertigation schedules. *The Journal of Research PJTSAU* **44**(4): 58-61.

Yash Pal 2016. *Drip fertigation studies in maize* (*Zea mays* L.). M.Sc. Dissertation, *G.B. Pant* University of Agriculture and Technology, Pantnagar.

Received 14 November, 2022; Accepted 24 January, 2023