International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
www.chemijournal.com
IJCS 2021; 9(1): 2777-2780

Received: 29-10-2020
Accepted: 06-12-2020

A Sairam
Water Technology Centre, Professor Jayashankar Telangana State Agricultural University, Rajendranagar, Hyderabad, Telangana, India

K Avil Kumar
Water Technology Centre, Professor Jayashankar Telangana State Agricultural University, Rajendranagar, Hyderabad, Telangana, India

G Suresh
ICAR-Indian Institute of Oil seeds Research, Rajendranagar, Hyderabad, Telangana, India

K Chaitanya
Water Technology Centre, Professor Jayashankar Telangana State Agricultural University, Rajendranagar, Hyderabad, Telangana, India

Corresponding Author:
A Sairam
Water Technology Centre, Professor Jayashankar Telangana State Agricultural University, Rajendranagar, Hyderabad, Telangana, India

Effect of different levels of drip irrigation regimes and fertigation on dry matter and nutrient uptake by *Rabi* sunflower (*Helianthus annuus* L.)

A Sairam, K Avil Kumar, G Suresh and K Chaitanya

DOI: https://doi.org/10.22271/chemi.2021.v9.i1am.11645

Abstract
A field experiment was conducted at Water Technology Centre, College of Agriculture, PJTSAU, Rajendranagar, Hyderabad during *rabi* 2019-20 on "Response of *rabi* sunflower (*Helianthus annuus* L.) to different levels of drip irrigation regimes and fertigation". The experiment was laid out in a split-plot design with DRSH-1 and replicated thrice. The treatments comprices of three irrigation treatments *viz.*, surface drip irrigation at 0.8 Epan, 1.0 Epan and 1.2 Epan as main-plots and four fertigation treatments *viz.*, 60% RD N & K_2O, 80% RD N & K_2O, 100% RD N & K_2O and 120% RD N & K_2O as sub-plots with recommended dose (RD) of nutrients of 75:90:30 kg NPK ha^{-1}. Among drip irrigation regimes, drip irrigation was scheduled at 1.2 Epan recorded higher dry matter at harvest (6041 kg ha^{-1}). On the other hand higher NPK uptake at harvest was obtained with drip irrigation with 1.2 Epan (73.8, 29.7 & 92.3 kg ha^{-1}). Among sub-treatments fertigation with 120% RD N & K_2O recorded higher dry matter (5950 kg ha^{-1}) and NPK uptakes at harvest (72.8, 30.5 & 91.8 kg ha^{-1}) than other fertigation levels. The interaction effect between irrigation regimes and fertigation levels on dry matter and uptake by NPK of *rabi* sunflower was not significantly influenced.

Keywords: Drip, irrigation, fertigation, Rabi, *Helianthus annuus* L.

Introduction
Sunflower (*Helianthus annuus* L.) is an important oilseed crop in India. It contains sufficient amount of calcium, iron and vitamins A, D, E and B complex. Because of high linoleic acid content (64%) it has got anti cholesterol property as a result of which it has been used to the heart patients. It is being cultivated over an area of about 2.8 lakh hectares with a production of 2.2 lakh tones and productivity of 643 kg ha^{-1} (IIOR, 2018) [5]. Karnataka occupies first position in India with respect to area (1.7 lakh hectares) and production (1.06 lakh tones) followed by Andhra Pradesh, Maharashtra, Bihar, Orissa and Tamil Nadu. In Telangana, sunflower is being grown in an area of 4 thousand hectare, producing 8 thousand tonnes with the productivity of 1154 kg ha^{-1} (IIOR, 2018) [5]. The global challenge for the coming decades is to increase the food production with utilization of less water. It canbe partially achieved by increasing crop water use efficiency (WUE). Improving the water and nutrient use efficiency has become imperative in present day's Agriculture. Drip irrigation with proper irrigation schedule and application of fertilizers through drip with right quantity and right time will enhanced the crop growth which lead to increase dry matter.

Materials and Methods
The field experiment was conducted during *rabi* 2019-2020 at Water Technology Center, College farm, College of Agriculture, Professor Jayashankar Telangana State Agricultural University (PJTSAU), Rajendranagar, Hyderabad sandy clay loam soil which was alkaline in reaction and non-saline, low in available nitrogen, high in available phosphorous and available potassium, medium in organic carbon content, having total available soil moisture 60.91 mm in 45 cm depth of soil. Irrigation water was neutral (7.22 pH) and was classified as C3 class suggesting that it is suitable for irrigation by following good management practices. The experiment was laid out in a split plot design consisting of three main irrigation regimes *viz.*, drip irrigation scheduled at 0.8, 1.0 and 1.2 Epan and four fertigation levels of 60% RD N& K_2O, 80% RD N& K_2O,100% RD N& K_2O and 120% RD N& K_2O and replicated thrice.

The recommended dose of (RD) nutrients were 75:90:30 kg NPK $ha^{-1}$and entire dose of P_2O_5 was applied as basal, N and K_2O was applied as fertigation in 18 splits in the form of urea and sulphate of potash (SoP) based on crop requirement at each stage with 4 days interval from 10 days after sowing onwards. The data of Epan was collected from agro meteorological observatory away from 500 m at Agricultural Research Institute, Rajendranagar and accordingly application rate and drip system operation time was calculated. The crop was irrigated once in 2 days. Need based plant protection measures were taken up and kept weeds low to avoid crop weed competition by weeding at 30 days after sowing. When crop reach harvested maturity stage net plot yield was taken and computed to kg per hectare. The data collected was statistically analysed as suggested by Gomez and Gomez (1984) [3].

Results and Discussions

Dry matter production (kg ha^{-1})

Average dry matter production $plant^{-1}$ increased slowly up to 25 DAS, gradually between 25 and 50 DAS and thereafter it increased exponentially between 50 and 75 DAS, and after that although it continued to increase until harvest but at a diminishing rate (Table 1). At 25 DAS the dry matter production $plant^{-1}$ was not significantly influenced by varying drip irrigation regimes and fertigation levels and by their interactions effects.

Drip irrigation scheduled at 1.2 Epan (4675 kg ha^{-1} & 6041 kg ha^{-1}) produced significantly higher dry matter compared with 1.0 Epan (4298 kg ha^{-1} & 5683 kg ha^{-1}) and 0.8 Epan (3534 kg ha^{-1} & 4864 kg ha^{-1}) at 50 DAS and at harvest, respectively. On the other hand 1.2 Epan was on par with 1.0 Epan at 75 DAS. However, significantly lower dry matter was recorded with drip irrigation scheduled at 0.8 Epan over 1.0 Epan and 1.2 Epan at 50 DAS, 75 DAS and at harvest. Similar findings of increased dry matter with higher levels of irrigation was also reported by Kadasiddappa *et al.* (2015) [6] and Kassab *et al.* (2012) [7] in sunflower crop.

Fertigation with 120% RD N & K_2O (4842 kg ha^{-1}, 5580 kg ha^{-1} & 5950 kg ha^{-1}) recorded significantly superior dry matter $plant^{-1}$ than 80% RD N & K_2O (3763 kg ha^{-1}, 4824 kg ha^{-1} & 5422 kg ha^{-1}) and 60% RD N & K_2O (3438 kg ha^{-1}, 4344 kg ha^{-1} & 4918 kg ha^{-1}) and was not significant with 100% RD N & K_2O at 50 DAS, 75 DAS and at harvest, respectively. However, 100% RD N & K_2O (4634 kg ha^{-1}, 5388 kg ha^{-1} & 5829 kg ha^{-1}, respectively) also significantly higher than 80% RD N & K_2O and 60% RD N & K_2O (Table 4.6). Significantly lowest dry matter of *rabi* sunflower was found with 60% RD N & K_2O among the fertigation levels.

Table 1: Dry matter (kg ha^{-1}) of *rabi* sunflower as influenced by different levels of drip irrigation regimes and fertigation

Treatments	25 DAS	50 Das	75 Das	Harvesting
Main plot – (Irrigation regimes)				
I_1: Drip irrigation at 0.8 Epan	347	3534	4388	4864
I_2: Drip irrigation at 1.0 Epan	357	4298	5161	5683
I_3: Drip irrigation at 1.2 Epan	350	4675	5554	6041
S.Em ±	10	69	101	54
C.D (P=0.05)	NS	270	396	212
Sub plot – (Fertigation levels)				
F_1 – 60% RD N & K_2O	347	3438	4344	4918
F_2 – 80% RD N & K_2O	350	3763	4824	5422
F_3 – 100% RD N & K_2O	353	4634	5388	5829
F_4 – 120% RD N & K_2O	354	4842	5580	5950
S.Em ±	12	102	81	94
C.D (P=0.05)	NS	303	241	280
Interaction				
Fertigation levels at same level of irrigation regimes				
S.Em ±	21	177	140	164
C.D (P=0.05)	NS	NS	NS	NS
Irrigation regimes at same or different levels of fertigation				
S.Em ±	21	168	158	151
C.D (P=0.05)	NS	NS	NS	NS

Application of nutrients through drip system which enabled continuous availability of optimum soil moisture and nutrients in the root zone facilitating effective absorption of water and nutrients by plants at higher irrigation levels which lead to increases nutrient uptake results higher plant height, number of leaves,

LAI and SCMR readings increases the photo synthesis, ultimately it increased dry matter. Water deficit during any portion of reproductive phase *viz*., flowering, seed setting and seed filling reduced photosynthesis and the efficiency of translocation resulting in lower seed dry matter accumulation even though leaf and stem dry matter accumulation might have been at acceptable levels at vegetative period (Venkanna, 1992, Chamundeshwari and Rao, 1998; Turhan and Baser, 2004 and Geetha *et al*., 2012) [10, 1, 9, 2]. These findings are also in line with the observations of Preethika, (2018) [8] and Himaja, (2017) [4].

Nitrogen uptake (kg ha^{-1}): The data presented in Table 2, Table 3 & Table 4 indicated that nutrient uptake of NPK was not significantly influenced at 25 DAS by varied levels of irrigation and fertigation also interaction effect of irrigation and fertigation treatments did not influence uptake of NPK at all stages. Among irrigation regimes, at 50 DAS and at harvest significantly higher N uptake was observed with drip irrigation scheduled at 1.2 Epan (28.6 & 73.8 kg ha^{-1}, respectively) Compared with 1.0 (26.5 & 70.0 kg ha^{-1}, respectively) and 0.8 Epan (21.3 & 59.0 kg ha^{-1}, respectively). At 75 DAS drip irrigation at 1.2 Epan (55.1 kg ha^{-1}) recorded higher N uptake and was on par with 1.0 Epan (53.1 kg ha^{-1}).

Fertigation with 120% RD N & K_2O recorded higher N uptake (30.2, 57.7 & 73.8 kg ha^{-1}) compared to 80% RD N & K_2O (22.4, 47.2 & 65.6 kg ha^{-1}) and 60% RD N & K_2O (20.7, 41.1 & 59.0 kg ha^{-1}) and was on par with 100% RD N & K_2O (28.4, 57.5 & 72.0 kg ha^{-1}) at 50 & 75 DAS and total at harvest, respectively.

Table 2: Nitrogen uptake (kg ha^{-1}) by *rabi* sunflower as influenced by different levels of drip irrigation regimes and fertigation

Treatments	25 Das	50 Das	75 Das	Harvesting		
				Seed	Stalk	Total
Main plot – (Irrigation regimes)						
I_1: Drip irrigation at 0.8 Epan	0.6	21.3	44.5	26.3	32.7	59.0
I_2: Drip irrigation at 1.0 Epan	0.8	26.5	53.1	30.7	39.4	70.0
I_3: Drip irrigation at 1.2 Epan	0.8	28.6	55.1	31.7	42.1	73.8
S.Em ±	0.1	0.3	1.2	0.5	0.5	0.7
C.D (P=0.05)	NS	1.1	4.6	2.0	1.8	2.9
Sub plot – (Fertigation levels)						
F_1 – 60% RD N & K_2O	0.7	20.7	41.1	26.1	32.9	59.0
F_2 – 80% RD N & K_2O	0.7	22.4	47.2	28.8	36.8	65.6
F_3 – 100% RD N & K_2O	0.7	28.4	57.5	31.5	40.4	72.0
F_4 – 120% RD N & K_2O	0.8	30.2	57.7	31.8	42.0	73.8
S.Em ±	0.1	0.7	1.0	0.6	0.7	1.1
C.D (P=0.05)	NS	2.1	2.9	1.9	2.0	3.4
Interaction						
Fertigation levels at same level of irrigation regimes						
S.Em ±	0.1	1.2	1.7	1.1	1.2	2.0
C.D (P=0.05)	NS	NS	NS	NS	NS	NS
Irrigation regimes at same or different levels of fertigation						
S.Em ±	0.1	1.1	1.9	1.1	1.1	1.9
C.D (P=0.05)	NS	NS	NS	NS	NS	NS

Phosphorus uptake (kg ha^{-1})

Maximum phosphorus uptake at 50 & 75 DAS was observed with drip irrigation scheduled at 1.2 Epan (9.3 & 21.1, respectively) than 0.8 Epan (6.4 & 15.6 kg ha^{-1}, respectively) and was statistically on par with irrigation at 1.0 Epan (8.4 & 20.0 respectively). At harvest significantly higher P uptake was observed with drip irrigation scheduled at 1.2 Epan (29.7 kg ha^{-1}) than rest of the irrigation levels.

Among the different fertigation levels, significantly higher P uptake was recorded with fertigation with 120% RD of N & K_2O (10.4 kg ha^{-1}) at 50 DAS than other three fertigation levels. At 75 DAS and at harvest, higher uptake of P with fertigation of 120% RD of N & K_2O (21.9 & 30.5 kg ha^{-1}, respectively) was significantly higher than 80% RD of N & K_2O (16.8 & 25.3 kg ha^{-1}, respectively) and 60% RD of N & K_2O (15.7 & 21.9 kg ha^{-1}, respectively) and was statistically on par with 100% RD of N & K_2O (21.0 & 29.6 kg ha^{-1}, respectively).

Table 3: Phosphorus uptake (kg ha^{-1}) by *rabi* sunflower as influenced by different levels of drip irrigation regimes and fertigation

Treatments	25 DAS	50 DAS	75 DAS	Harvesting		
				Seed	Stalk	Total
Main plot – (Irrigation regimes)						
I_1: Drip irrigation at 0.8 Epan	0.4	6.4	15.6	9.0	14.1	23.1
I_2: Drip irrigation at 1.0 Epan	0.5	8.4	20.0	10.5	17.2	27.7
I_3: Drip irrigation at 1.2 Epan	0.5	9.3	21.1	11.1	18.6	29.7
S.Em ±	0.1	0.2	0.9	0.2	0.2	0.2
C.D (P=0.05)	NS	1.0	3.4	0.7	0.9	1.0
Sub plot – (Fertigation levels)						
F_1 – 60% RD N & K_2O	0.4	6.0	15.7	8.7	13.1	21.9
F_2 – 80% RD N & K_2O	0.5	6.9	16.8	9.6	15.7	25.3
F_3 – 100% RD N & K_2O	0.4	8.7	21.0	11.1	18.5	29.6
F_4 – 120% RD N & K_2O	0.5	10.4	21.9	11.3	19.2	30.5
S.Em ±	0.1	0.4	0.8	0.2	0.6	0.7
C.D (P=0.05)	NS	1.3	2.3	0.7	1.7	2.0
Interaction						
Fertigation levels at same level of irrigation regimes						
S.Em ±	0.1	0.7	1.4	0.4	0.1	1.2
C.D (P=0.05)	NS	NS	NS	NS	NS	NS
Irrigation regimes at same or different levels of fertigation						
S.Em ±	0.1	0.7	1.5	0.4	0.9	1.1
C.D (P=0.05)	NS	NS	NS	NS	NS	NS

Potassium uptake (kg ha^{-1})

At 50 DAS and at harvest significantly higher K uptake by *rabi* sunflower was realized with drip irrigation scheduled at 1.2 Epan (36.6 & 92.3 kg ha^{-1}) compared to 1.0 Epan (32.3 & 84.1 kg ha^{-1}) and 0.8 Epan (25.3 & 71.1 kg ha^{-1}). At 75 DAS drip irrigation scheduled at 1.2 Epan recorded higher K uptake (80.9 kg ha^{-1}) than 0.8 Epan (60.7 kg ha^{-1}) and was on par with 1.0 Epan (74.4 kg ha^{-1}).

In varies fertigation levels, drip fertigation with 120% RD of N & K_2O recorded significantly higher K uptake (37.3, 82.4 & 91.8 kg ha^{-1}) at 50 and 75 DAS and at harvest, respectively compared with 80% RD of N & K_2O (27.5, 68.2 & 80.4 kg ha^{-1}) and 60% RD of N & K_2O (25.3, 60.1 & 69.8 kg ha^{-1}) and was on par with 100% RD of N & K_2O (35.5, 77.4 & 88.0 kg ha^{-1}).

N, P and K uptake of sunflower was significantly increased with increase in water and N&K level due to availability of sufficient moisture and nutrients in the root zone depth favoring better crop growth, higher dry matter and LAI had resulted in higher uptake of nutrients. These results are in conformity with the findings of Preethika, (2018) [8] and Himaja, (2017) [4] with regard to higher nutrient uptake.

Table 4: Potassium uptake (kg ha^{-1}) by *rabi* sunflower as influenced by different levels of drip irrigation regimes and fertigation

Treatments	25 Das	50 Das	75 Das	Harvesting		
				Seed	Stalk	Total
Main plot – (Irrigation regimes)						
I_1: Drip irrigation at 0.8 Epan	2.1	25.3	60.7	17.9	53.2	71.1
I_2: Drip irrigation at 1.0 Epan	2.1	32.3	74.4	21.2	63.0	84.1
I_3: Drip irrigation at 1.2 Epan	1.9	36.6	80.9	21.8	70.5	92.3
S.Em ±	0.1	0.8	2.1	0.6	1.5	1.6
C.D (P=0.05)	NS	3.1	8.2	2.3	5.8	6.3
Sub plot – (Fertigation levels)						
F_1 – 60% RD N & K_2O	1.8	25.3	60.1	17.7	52.1	69.8
F_2 – 80% RD N & K_2O	2.0	27.5	68.2	19.8	60.7	80.4
F_3 – 100% RD N & K_2O	2.3	35.5	77.4	21.1	66.9	88.0
F_4 – 120% RD N & K_2O	1.9	37.3	82.4	22.6	69.2	91.8
S.Em ±	0.2	1.0	2.1	0.8	1.5	2.0
C.D (P=0.05)	NS	3.1	6.5	2.5	4.3	5.9
Interaction						
Fertigation levels at same level of irrigation regimes						
S.Em ±	0.2	1.8	3.8	1.5	2.5	3.5
C.D (P=0.05)	NS	NS	NS	NS	NS	NS
Irrigation regimes at same or different levels of fertigation						
S.Em ±	0.2	1.7	3.9	1.4	2.6	3.4
C.D (P=0.05)	NS	NS	NS	NS	NS	NS

Conclusion

Based on the above results obtained, it can be concluded that drip irrigation scheduled at 1.2 Epan in irrigation regimes and 120% RD N & K_2O in fertigation levels recorded higher dry matter and NPK uptakes.

References

1. Chamindeshwari C, Rao PV. Irrigation sunflower (*Helianthus annuus* L.) with deficit water supply. Journal of Oilseeds Research 1998;15(1):65-68.
2. Geetha A, Suresh J, Saidaiah P. Study on response of sunflower (*Helianthus annuus* L.) genotypes for root and yield characters under water stress. Current Biotica 2012;6(1):32-41.
3. Gomez KA, Gomez AA. Statistical Procedures for Agricultural Research. John Wiley & Sons, Singapore 1984.
4. Himaja I. Response of maize, sorghum and sunflower to different fertigation levels. M. Sc. (Ag.) Thesis. Professor Jayashankar Telangana State Agriculture University, Hyderabad, India 2017.
5. IIOR. Area, production and yield treands of sunflower in India, Ministry of Agriculture, Department of Agriculture and Cooperation, Government of India, New Delhi. www.nmoop.gov.in. Acessed in 2018-2019.
6. Kadasiddappa M, Rao VP, Yella Reddy K, Ramulu V, Uma Devi M, Reddy S. Effect of drip and surface furrow irrigation on growth, yield and water use efficiency of sun flower hybrid DRSH-1. Progressive Research 2015;3872-3875:10(7):5-7.
7. Kassab OM, Ellil AAA, El-Kheir MSAA. Water use efficiency and productivity of two sunflower cultivars as influenced by three rates of drip irrigation water. Journal of Applied Sciences Research 2012, 3524-3529.
8. Preethika R. Optimization of nitrogen and potassium fertigation schedules in *rabi* sunflower (*Helianthus annuus* L.). M. Sc. (Ag.) Thesis. Professor Jayashankar Telangana State Agricultural University, Hyderabad, India 2018.
9. Turhan H, Baser I. *in vitro* and *in vivo* water stress in sunflower (*Helianthus annuus* L.). Helia 2004;27:227-236.
10. Venkanna K. Response of sunflower (*Helianthus annuus* L.) to irrigation scheduling based on pan evaporation. M.Sc. (Ag.) Thesis, submitted to ANGRAU, Hyderabad 1992.