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Effect of levels of drip irrigation and fertigation on yield, SPAD and nutrient uptake of sunflower in a *Vertisol*

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Abstract

A field investigation was performed at Irrigation Water Management Research Centre, Belavatagi, Navalgund, Dharwad during *rabi/summer* 2021-22 to study the “Effect of levels of drip irrigation and fertigation on seed yield, SPAD and nutrient uptake of sunflower in a *Vertisol*”. The experiment was laid out in a strip plot design with three main plots *viz.*, surface drip irrigation at 0.6 PE (I_1), 0.8 PE (I_2) and 1.0 PE (I_3) and three sub plots *viz.*, fertigation of 75% RDF (F_1) (67.5: 67.5: 45 kg N, P_2O_5 and K_2O ha^{-1}), 100% RDF (F_2) (90: 90: 60 kg N, P_2O_5 and K_2O ha^{-1}) and 125% RDF (F_3) (112.5: 112.5: 75 N, P_2O_5 and K_2O ha^{-1}) and a control *i.e.* surface furrow irrigation and manual fertilizer application of 100% RDF replicated thrice. At harvest, seed yield was significantly higher with drip irrigation at 1.0 PE (I_3) and fertigation of 125% RDF (F_3). Drip irrigation at 1.0 PE recorded significantly higher seed yield (34.4 q ha^{-1}). Application of fertilizers at 125% RDF (F_3) through fertigation recorded higher seed yield (33.8 q ha^{-1}). Interaction of drip irrigation at 1.0 PE along with 125% RDF (I_3F_3) recorded higher seed yield (36.9 q ha^{-1}). Drip irrigation at 1.0 PE (I_3) recorded significantly higher SPAD values (35.8) over I_1 *i.e.* drip irrigation at 0.6 PE (28.6) and I_3 was found on par with I_2 (33.7) at harvest. Significantly higher total nutrient uptake (121.5, 52.8, 135.3, 35.7 kg ha^{-1} N, P, K, S, respectively and 42.2 g ha^{-1} B) was recorded in drip irrigation at 1.0 PE (I_3) which was found on par with drip irrigation at 0.8 PE. However, manual application of 100% RDF along with surface furrow irrigation *i.e.* control recorded significantly lower yield, SPAD and nutrient uptake.

Keywords: Sunflower, fertigation, pan evaporation (PE), SPAD, nutrient uptake

Introduction

Irrigation and fertilization are the most important methods through which farmers can manage productivity. The combination of drip irrigation and fertilization (fertigation) expands the possibilities of controlling water and nutrient supplies to crops and maintaining the desired concentration and distribution of ions and water in the soil (Yosef, 1999) ^[1].

Around 70 per cent of freshwater withdrawals go into agriculture. Water management in agriculture would play a key role in enhancing agricultural productivity and doubling farmer's income. With a growing food demand, agriculture production will need to expand by 70 per cent by 2050. Given that, irrigated agriculture can be up to twice as productive as rainfed cultivation systems, it is certain that water consumption for agriculture will keep growing. This will allow using land more efficiently, allow for more secure crop diversification, and provide an important buffer against climate variability. Therefore, water scarcity should be coped with ways to reducing water losses, increase in water productivity by producing more crop per volume of water applied which is possible through drip irrigation.

The oilseeds contribute significantly to agricultural economy in India. Presently, in India the production of oilseeds is not up to the demand due to rapidly increasing population, high living standard with increased purchasing power of population. So, the country is forced to import edible oil from other countries which involves high expenditure in foreign exchange. Therefore, it is very essential to increase the productivity of oilseed crops to cope up with the present demand. The maximum inherent potential of a variety can only be achieved when nutrients are applied in balanced form with recommended dose of fertilizers (RDF) (Murali *et al.*, 2009) ^[4]. Drip fertigation improves yield, water and fertilizer use efficiency by sunflower by fulfilling the crop demand for water and nutrients throughout the crop period (Reddy, 2018) ^[7].

Materials and Methods

The experiment was conducted at Irrigation Water Management Research Centre (IWMRC), Belvatagi, Navalagund taluk of Dharwad district to study the effect of levels of drip irrigation and fertigation on yield, SPAD and nutrient uptake of sunflower in a *Vertisol*. The experimental site is situated in the Northern dry zone (Zone-3) of Karnataka. It is located at a latitude of 15°16' North latitude, 75°23' East longitude with an altitude of 579 m above mean sea level. The soil was clay in texture, alkaline in reaction (pH=8.25), normal in salt content (0.31 dS m⁻¹), low in available nitrogen (183.0 kg ha⁻¹), medium in available phosphorus (33.30 kg ha⁻¹) and high in available potassium content (742.0 kg ha⁻¹).

The research was laid out in strip plot design with three main plots viz., surface drip irrigation at 0.6 PE (I₁), 0.8 PE (I₂) and 1.0 PE (I₃) and three sub plots viz., fertigation of 75% RDF (F₁) (67.5: 67.5: 45 kg N, P₂O₅ and K₂O ha⁻¹), 100% RDF (F₂) (90: 90: 60 kg N, P₂O₅ and K₂O ha⁻¹) and 125% RDF (F₃) (112.5: 112.5: 75 N, P₂O₅ and K₂O ha⁻¹) and a control i.e. surface furrow irrigation and manual fertilizer application of 100% RDF replicated thrice in a net plot of 3.6m × 3.2 m.

Harvesting and threshing

The crop was harvested when the dorsal side of the head turned to lemon yellow colour. The heads were harvested treatment wise and kept separately in the threshing yard. The heads were sun dried for 3-4 days on the threshing floor. Threshing was done by gently beating at the back of the heads with a stick. The produce was cleaned and per plot seed yield was recorded after drying. Based on the yield from net plot, the grain yield per hectare was calculated and expressed in quintal per hectare (qha⁻¹). The stalk yield after removing the head from each net plot area were dried completely in sun for a week and weight was recorded. Based on the stalk yield from net plot area, stalk yield ha⁻¹ was worked out and expressed in qha⁻¹.

SPAD Chlorophyll Meter Readings values

The third fully expanded leaf from the apex was used for the SCMR determination. Several measurements were made on each leaf at top and middle and averaged to make an appropriate estimate of leaf chlorophyll at 30, 60 DAS and at harvest from labelled plants using hand held SPAD meter (Soil Plant Analysis Development).

Nutrient uptake

Young matured leaf blade of 3rd or 4th leaf from apical bud around 50 leaves were collected as an index leaf. The plant samples were collected for estimating the nutrient uptake from each plot at harvest were thoroughly washed with distilled water and dried in hot air oven at 65°C. Total nitrogen content of plant and seed samples was determined by Kjeldahl's digestion- distillation method as described by Piper (1966) [6].

Powdered plant and seed samples were separately treated with HNO₃ for 12 hours for pre-digestion. Then pre-digested samples were treated with di-acid (HNO₃: HClO₄) mixture (10:4) and kept on hot sand bath for digestion till white precipitate appeared. Precipitate was dissolved in 6N HCl and filtered repeatedly. The contents were made to a 50 ml by using distilled water. A known quantity of aliquot was used for nutrient analysis. Phosphorus in the digested samples was analysed by vanadomolybdo phosphoric yellow colour method at 420 nm (Jackson, 1973) [2]. Potassium content was determined by flame photometer (Tandon, 1998) [9]. Sulphur in the plant sample was precipitated by barium sulphate and the turbidity was measured in spectrophotometer at 420 nm

(Tandon, 1998) [9]. Boron concentration in di-acid digested plant sample was estimated using Azomethine-H reagent method (Jaiswal, 2013) [3].

Nutrient uptake

Nutrients uptake in seed and stalk at harvest was calculated by multiplying the respective nutrient concentrations with the corresponding seed yield and stalk yield as follows.

$$\text{Nutrient uptake (kg ha}^{-1}\text{)} = \frac{\text{N content (\%)} \times \text{seed/stalk yield (kg ha}^{-1}\text{)}}{100}$$

The sum of uptake by grain/seed and stalk was considered as the total uptake by the crop.

Results and discussion

Seed and stalk yield

Among levels of drip irrigation, drip irrigation at 1.0 PE (I₃) recorded higher seed yield (34.4 q ha⁻¹) which was found on par with drip irrigation at 0.8 PE (32.5 q ha⁻¹) but was significantly superior over drip irrigation at 0.6 PE (27.6 q ha⁻¹). Among levels of fertigation, fertigation of 125% RDF (F₃) through drip recorded significantly higher seed yield (33.8 q ha⁻¹) which was found on par with fertigation of 100% RDF (31.5 q ha⁻¹). However, F₃ was significantly superior over fertigation of 75% RDF (29.1 q ha⁻¹). Among the interactions, drip irrigation at 1.0 PE along with 125% RDF (I₃F₃) recorded significantly higher seed yield (36.9 q ha⁻¹) which was found on par with I₃F₂ i.e. drip irrigation at 1.0 PE along with 100% RDF (33.7 q ha⁻¹). With the application of frequent but less quantity of water and nutrients resulted in reduction of leaching losses of the nutrients which might have contributed to the higher nutrient availability to the plants leading to higher yield and yield attributes of the crop. Similar results were reported by Vasu (2011) [10], Sanju (2013) [8], Himaja (2017) [1] and Reddy (2018) [7].

SPAD chlorophyll meter readings (SCMR)

The variation in SCMR was significant among the treatments due to levels of drip irrigation and fertigation. All the drip irrigation and fertigation treatments recorded higher SCMR during all growth stages except at 30 DAS compared to the control treatment (Table 2). Significantly higher SCMR was recorded due to application of drip irrigation at 1.0 PE (I₃) at 60 DAS and harvest (36.6 and 35.8, respectively) over drip irrigation at 0.6 PE (I₁) (30.8 and 28.6, respectively). However, I₃ was on par with drip irrigation at 0.8 PE (I₂) at 60 DAS and harvest (35.8 and 33.7, respectively).

For fertigation levels, significantly higher leaf area per plant was noticed with application of fertilizers at 125% RDF through fertigation (F₃) at 60 DAS and harvest (36.2 and 35.0, respectively) over 75% RDF (F₁) through fertigation (32.0 and 30.0, respectively). However, F₃ was found on par with fertigation of 100% RDF (F₂) at 60 DAS and harvest (35.1 and 33.1, respectively).

Among the interactions, drip irrigation at 1.0 PE along with 125% RDF through fertigation (I₃F₃) recorded significantly higher SCMR at 60 DAS and harvest (37.6 and 37.8, respectively) and was found on par with I₃F₂ (37.5 and 36.7, respectively), I₂F₃ (37.1 and 35.1, respectively) and I₂F₂ (36.4 and 34.1, respectively). However, RPP recorded significantly lower SCMR at 60 DAS and harvest (25.6 and 22.6, respectively) and was found on par with lower irrigation and fertigation interactions.

Total nitrogen uptake: Among the irrigation levels, the total nitrogen uptake was significantly higher (121.5 kg ha⁻¹) due to

application of drip irrigation at 1.0 PE (I_3) over drip irrigation at 0.6 PE (I_1) (95.1 kg ha⁻¹). However, I_3 was on par with drip irrigation at 0.8 PE (I_2) (115.6 kg ha⁻¹).

For fertigation levels, significantly higher total nitrogen uptake (121.0 kg ha⁻¹) was noticed with application of fertilizers at 125% RDF through fertigation (F_3) over 75% RDF (F_1) through fertigation (98.6 kg ha⁻¹). However, F_3 was found on par with fertigation of 100% RDF (F_2) (112.6 kg ha⁻¹). Drip irrigation at 1.0 PE along with 125% RDF through fertigation (I_3F_3) recorded significantly higher total nitrogen uptake (129.6 kg ha⁻¹) and was found on par with I_3F_2 (122.6 kg ha⁻¹), I_2F_3 (122.1 kg ha⁻¹) and I_2F_2 (118.4 kg ha⁻¹). However, RPP recorded significantly lower total nitrogen uptake (71.4 kg ha⁻¹) and was found on par with I_1F_1 interaction (77.4 kg ha⁻¹).

Total phosphorous uptake

Among the irrigation levels, the total phosphorous uptake was significantly higher (52.8 kg ha⁻¹) due to application of drip irrigation at 1.0 PE (I_3) over drip irrigation at 0.6 PE (I_1) (39.8 kg ha⁻¹). However, I_3 was on par with drip irrigation at 0.8 PE (I_2) (49.9 kg ha⁻¹). Significantly higher total phosphorous uptake (52.8 kg ha⁻¹) was noticed with application of fertilizers at 125% RDF through fertigation (F_3) over 75% RDF (F_1) through fertigation (41.1 kg ha⁻¹). However, F_3 was found on par with fertigation of 100% RDF (F_2) (48.4 kg ha⁻¹).

Drip irrigation at 1.0 PE along with 125% RDF through fertigation (I_3F_3) recorded significantly higher total phosphorous uptake (57.3 kg ha⁻¹) and was found on par with I_3F_2 (53.8 kg ha⁻¹), I_2F_3 (53.3 kg ha⁻¹) and I_2F_2 (51.2 kg ha⁻¹). However, RPP recorded significantly lower total phosphorous uptake (28.9 kg ha⁻¹) and was found on par with I_1F_1 interaction (31.1 kg ha⁻¹).

Total potassium uptake

Among the irrigation levels, the total potassium uptake was significantly higher (135.3 kg ha⁻¹) due to application of drip irrigation at 1.0 PE (I_3) over drip irrigation at 0.6 PE (I_1) (103 kg ha⁻¹). However, I_3 was on par with drip irrigation at 0.8 PE (I_2) (127.4 kg ha⁻¹). Significantly higher total potassium uptake (134.5 kg ha⁻¹) was noticed with application of fertilizers at 125% RDF through fertigation (F_3) over 75% RDF (F_1) through fertigation (105.2 kg ha⁻¹). However, F_3 was found on par with fertigation of 100% RDF (F_2) (125.9 kg ha⁻¹).

Drip irrigation at 1.0 PE along with 125% RDF through fertigation (I_3F_3) recorded significantly higher total phosphorous uptake (145.2 kg ha⁻¹) and was found on par with I_3F_2 (139.9 kg ha⁻¹), I_2F_3 (137.0 kg ha⁻¹) and I_2F_2 (132.3 kg ha⁻¹). However, RPP recorded significantly lower total phosphorous uptake (76.0 kg ha⁻¹) and was found on par with I_1F_1 interaction (82.0 kg ha⁻¹).

Total sulphur uptake

Among the irrigation levels, the total sulphur uptake was significantly higher (35.7 kg ha⁻¹) due to application of drip irrigation at 1.0 PE (I_3) over drip irrigation at 0.6 PE (I_1) (28.4 kg ha⁻¹). However, I_3 was on par with drip irrigation at 0.8 PE (I_2) (33.9 kg ha⁻¹). For fertigation levels, significantly higher total sulphur uptake (35.6 kg ha⁻¹) was noticed with application of fertilizers at 125% RDF through fertigation (F_3) over 75% RDF (F_1) through fertigation (28.6 kg ha⁻¹). However, F_3 was found on par with fertigation of 100% RDF (F_2) (33.8 kg ha⁻¹).

Drip irrigation at 1.0 PE along with 125% RDF through fertigation (I_3F_3) recorded significantly higher total sulphur uptake (37.6 kg ha⁻¹) and was found on par with I_3F_2 (36.6 kg ha⁻¹), I_2F_3 (36.4 kg ha⁻¹), I_2F_2 (35.0 kg ha⁻¹) and I_3F_1 (32.8 kg ha⁻¹).

However, RPP recorded significantly lower total sulphur uptake (19.8 kg ha⁻¹) and was found on par with I_1F_1 interaction (22.7 kg ha⁻¹).

Total boron uptake

Among the irrigation levels, the total boron uptake was significantly higher (42.2 g ha⁻¹) due to application of drip irrigation at 1.0 PE (I_3) over drip irrigation at 0.6 PE (I_1) (32.5 g ha⁻¹). However, I_3 was on par with drip irrigation at 0.8 PE (I_2) (39.2 g ha⁻¹). For fertigation levels, significantly higher total boron uptake (41.4 g ha⁻¹) was noticed with application of fertilizers at 125% RDF through fertigation (F_3) over 75% RDF (F_1) through fertigation (34.0 g ha⁻¹). However, F_3 was found on par with fertigation of 100% RDF (F_2) (38.4 g ha⁻¹).

Drip irrigation at 1.0 PE along with 125% RDF through fertigation (I_3F_3) recorded significantly higher total boron uptake (45.2 g ha⁻¹) and was found on par with I_3F_2 (42.1 g ha⁻¹) and I_2F_3 (41.4 g ha⁻¹). However, RPP recorded significantly lower total sulphur uptake (25.2 g ha⁻¹) and was found on par with I_1F_1 interaction (26.8 g ha⁻¹).

Drip irrigation at 1.0 PE (I_3) recorded significantly higher total nutrient uptake (N, P, K, S and B) which was found on par with drip irrigation at 0.8 PE. However, it was significantly superior over drip irrigation at 0.6 PE. The higher nutrient uptake might be due to continuous and optimum availability of soil moisture content at higher level of drip irrigation (I_3) which helped in solubilization of plant nutrients near the root zone and preferential easy absorption of plant nutrients by the crop (Narendra, 2017) [5].

Table 1: Influence of drip irrigation and fertigation levels on seed yield and stalk yield of sunflower crop

Treatment	Seed yield (q ha ⁻¹)	Stalk yield (q ha ⁻¹)
Drip irrigation levels (I)		
I_1 : DI at 0.6 PE	27.6 ^b	59.6 ^b
I_2 : DI at 0.8 PE	32.5 ^a	70.3 ^a
I_3 : DI at 1.0 PE	34.4 ^a	74.7 ^a
S.Em. $\pm$	0.7	1.4
Fertigation levels (F)		
F_1 : 75% RDF	29.1 ^b	60.2 ^b
F_2 : 100% RDF	31.5 ^{ab}	70.0 ^a
F_3 : 125% RDF	33.8 ^a	74.5 ^a
S.Em. $\pm$	0.9	2.4
Interaction (I×F)		
I_1F_1 : DI at 0.6 PE and 75% RDF	23.6 ^d	47.7 ^d
I_1F_2 : DI at 0.6 PE and 100% RDF	27.9 ^c	61.4 ^c
I_1F_3 : DI at 0.6 PE and 125% RDF	31.2 ^{bc}	69.8 ^{a-c}
I_2F_1 : DI at 0.8 PE and 75% RDF	31.0 ^{bc}	63.6 ^{bc}
I_2F_2 : DI at 0.8 PE and 100% RDF	33.0 ^{ab}	72.3 ^{ab}
I_2F_3 : DI at 0.8 PE and 125% RDF	33.4 ^{ab}	75.1 ^a
I_3F_1 : DI at 1.0 PE and 75% RDF	32.5 ^b	69.3 ^{a-c}
I_3F_2 : DI at 1.0 PE and 100% RDF	33.7 ^{ab}	76.2 ^a
I_3F_3 : DI at 1.0 PE and 125% RDF	36.9 ^a	78.6 ^a
Control (C)	22.3 ^d	45.7 ^d
S.Em. $\pm$	1.2	3.2

Means followed by the same alphabet (s) within a column are not significantly differed by DMRT (P= 0.05)

Note

DI - Drip irrigation

RDF - Recommended dose of fertilizers

75% RDF - 67.5:67.5:45 kg N, P₂O₅ and K₂O ha⁻¹

100% RDF - 90:90:60 kg N, P₂O₅ and K₂O ha⁻¹

125% RDF - 112.5:112.5:75 N, P₂O₅ and K₂O ha⁻¹

Control - Recommended package of practice

Table 2: Influence of drip irrigation and fertigation levels on SPAD values of sunflower

Treatment	SPAD values		
	30 DAS	60 DAS	Harvest
Drip irrigation levels (I)			
I ₁ : DI at 0.6 PE	36.3 ^a	30.8 ^b	28.6 ^b
I ₂ : DI at 0.8 PE	37.3 ^a	35.8 ^a	33.7 ^a
I ₃ : DI at 1.0 PE	37.8 ^a	36.6 ^a	35.8 ^a
S.Em. ±	1.2	0.80	0.9
Fertigation levels (F)			
F ₁ : 75% RDF	36.5 ^a	32.0 ^b	30.0 ^b
F ₂ : 100% RDF	37.1 ^a	35.1 ^a	33.1 ^{ab}
F ₃ : 125% RDF	37.8 ^a	36.2 ^a	35.0 ^a
S.Em. ±	1.2	0.9	1.0
Interaction (I×F)			
I ₁ F ₁ : DI at 0.6 PE and 75% RDF	35.1 ^a	27.2 ^{cd}	25.1 ^{de}
I ₁ F ₂ : DI at 0.6 PE and 100% RDF	35.9 ^a	31.3 ^{bc}	28.6 ^{cd}
I ₁ F ₃ : DI at 0.6 PE and 125% RDF	37.9 ^a	34.0 ^{ab}	32.2 ^{bc}
I ₂ F ₁ : DI at 0.8 PE and 75% RDF	36.7 ^a	34.0 ^{ab}	32.0 ^{bc}
I ₂ F ₂ : DI at 0.8 PE and 100% RDF	37.4 ^a	36.4 ^a	34.1 ^{ab}
I ₂ F ₃ : DI at 0.8 PE and 125% RDF	37.7 ^a	37.1 ^a	35.1 ^{ab}
I ₃ F ₁ : DI at 1.0 PE and 75% RDF	37.6 ^a	34.7 ^{ab}	32.8 ^{bc}
I ₃ F ₂ : DI at 1.0 PE and 100% RDF	37.9 ^a	37.5 ^a	36.7 ^{ab}
I ₃ F ₃ : DI at 1.0 PE and 125% RDF	38.0 ^a	37.6 ^a	37.8 ^a
Control (C)	35.0 ^a	25.6 ^d	22.6 ^e
S.Em. ±	1.8	1.2	1.4

Table 3: Influence of drip irrigation and fertigation levels on nitrogen, phosphorus and potassium uptake by sunflower crop

Treatment	Total N (kg ha ⁻¹)	Total P (kg ha ⁻¹)	Total K (kg ha ⁻¹)
Drip irrigation levels (I)			
I ₁ : DI at 0.6 PE	95.1 ^b	39.8 ^b	103.0 ^b
I ₂ : DI at 0.8 PE	115.6 ^a	49.9 ^a	127.4 ^a
I ₃ : DI at 1.0 PE	121.5 ^a	52.8 ^a	135.3 ^a
S.Em. ±	2.3	0.7	2.5
Fertigation levels (F)			
F ₁ : 75% RDF	98.6 ^b	41.1 ^b	105.2 ^b
F ₂ : 100% RDF	112.6 ^a	48.4 ^a	125.9 ^a
F ₃ : 125% RDF	121.0 ^a	52.8 ^a	134.5 ^a
S.Em. ±	2.8	1.8	3.4
Interaction (I×F)			
I ₁ F ₁ : DI at 0.6 PE and 75% RDF	77.4 ^e	31.1 ^e	82.1 ^e
I ₁ F ₂ : DI at 0.6 PE and 100% RDF	96.7 ^d	40.3 ^d	105.5 ^d
I ₁ F ₃ : DI at 0.6 PE and 125% RDF	111.3 ^{bc}	47.9 ^{bc}	121.3 ^{bc}
I ₂ F ₁ : DI at 0.8 PE and 75% RDF	106.1 ^{cd}	45.1 ^{cd}	112.8 ^{cd}
I ₂ F ₂ : DI at 0.8 PE and 100% RDF	118.4 ^{a-c}	51.2 ^{a-c}	132.3 ^{ab}
I ₂ F ₃ : DI at 0.8 PE and 125% RDF	122.1 ^{ab}	53.3 ^{ab}	137.0 ^a
I ₃ F ₁ : DI at 1.0 PE and 75% RDF	112.3 ^{bc}	47.1 ^{b-d}	120.8 ^{bc}
I ₃ F ₂ : DI at 1.0 PE and 100% RDF	122.6 ^{ab}	53.8 ^{ab}	139.9 ^a
I ₃ F ₃ : DI at 1.0 PE and 125% RDF	129.6 ^a	57.3 ^a	145.2 ^a
Control (C)	71.4 ^e	28.9 ^e	76.0 ^e
S.Em. ±	6.4	2.4	4.7

Table 4: Influence of drip irrigation and fertigation levels on sulphur and boron uptake by sunflower crop

Treatment	Total S (kg ha ⁻¹)	Total B (g/ha)
Drip irrigation levels (I)		
I ₁ : DI at 0.6 PE	28.4 ^b	32.5 ^b
I ₂ : DI at 0.8 PE	33.9 ^a	39.2 ^a
I ₃ : DI at 1.0 PE	35.7 ^a	42.2 ^a
S.Em. ±	0.6	0.8
Fertigation levels (F)		
F ₁ : 75% RDF	28.6 ^b	34.0 ^b
F ₂ : 100% RDF	33.8 ^a	38.4 ^a
F ₃ : 125% RDF	35.6 ^a	41.4 ^a
S.Em. ±	1.1	0.9
Interaction (I×F)		
I ₁ F ₁ : DI at 0.6 PE and 75% RDF	22.7 ^c	26.8 ^f
I ₁ F ₂ : DI at 0.6 PE and 100% RDF	29.8 ^b	33.0 ^e
I ₁ F ₃ : DI at 0.6 PE and 125% RDF	32.7 ^{ab}	37.6 ^{cd}
I ₂ F ₁ : DI at 0.8 PE and 75% RDF	30.9 ^b	36.0 ^{de}
I ₂ F ₂ : DI at 0.8 PE and 100% RDF	35.0 ^{ab}	40.1 ^{b-d}
I ₂ F ₃ : DI at 0.8 PE and 125% RDF	36.4 ^a	41.4 ^{a-c}
I ₃ F ₁ : DI at 1.0 PE and 75% RDF	32.8 ^{ab}	39.2 ^{b-d}
I ₃ F ₂ : DI at 1.0 PE and 100% RDF	36.6 ^a	42.1 ^{ab}
I ₃ F ₃ : DI at 1.0 PE and 125% RDF	37.6 ^a	45.2 ^a
Control (C):	19.8 ^c	25.2 ^f
S.Em. ±	1.6	1.4

Conclusion

It is concluded that, drip irrigation at 1.0 PE (I₃) recorded significantly higher seed and stalk yield which was found on par with drip irrigation at 0.8 PE and I₃ was significantly superior over drip irrigation at 0.6 PE. Fertigation of 125% RDF (F₃) through drip recorded significantly higher seed yield which was found on par with fertigation of 100% RDF. However, it was significantly superior over fertigation of 75% RDF.

Drip irrigation at 1.0 PE along with 125% RDF (I₃F₃) recorded significantly higher seed yield (36.9 q ha⁻¹) which was found on par with I₃F₂. Drip irrigation at 1.0 PE along with 100% RDF (33.7 q ha⁻¹). Performance of control treatment was significantly lower (22.3 q ha⁻¹). Therefore drip irrigation at 1.0 PE and 125% RDF in drip will be followed in order to exploit its maximum

yield potential and nutrient uptake of sunflower crop.

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