Original Research Article

EFFECT OF NITROGEN AND POTASSIUM FERTIGATION SCHEDULES ON PLANT GROWTH PARAMETERS AND FERTILIZER USE EFFICIENCY OF SUNFLOWER

ABSTRACT

A field experiment was conducted at Water Technology Centre, College farm, Rajendranagar, Hyderabad with sunflower (variety DRSH-1) during *rabi* 2017-18 in a randomized block design with three replications and the treatments were nine with combinations of N (75 kg ha^{-1}) and K (30 kg ha^{-1}) fertilizers applied by fertigation through ventury at different intervals *viz*., 3 days and 4 days. Drip irrigation was scheduled once in 2 days at 0.8 E pan. Fertigation was imposed at 16 DAS to 88 DAS and completed in 19 and 10 splits in 4 and 8 days interval respectively. The source of N and K fertilizers was urea and potassium sulphate respectively. The soil was sandy clay loam in texture, alkaline in reaction, non saline, low in available nitrogen, medium in available phosphorus and potassium. The amount of total irrigation water applied was 3188 m^3 and 4666 m^3 in drip irrigation and furrow irrigation treatments, respectively. The N and K fertigation (75-30 kg N-K_2O ha^{-1}) at 4 days interval has recorded relatively higher plant growth parameters like number of leaves $plant^{-1}$ (25.5), plant height (208 cm), SPAD Chlorophyll Meter Reading (55.7), leaf area index (3.5) and dry matter (158.1 g m^{-2}) which were on par with N and K at 8 days interval. Higher N-FUE (12.8 kg seed yield / nutrient applied) and K-FUE (25.6 kg seed yield / kg nutrient applied) was recorded in application of N+K at 4 days interval.

Key words: Sunflower, nitrogen and potassium, fertigation schedule, growth parameters, SPAD, LAI, economics

INTRODUCTION

The projected population of India is expected to be around 1.48 billion by 2030 and the required oil seeds production will be around 102.3 million tonnes by 2030 (DRMR, Vision 2030). With the burgeoning population, improved living standard and purchasing power of the people, the demand for vegetable oil in the country is increasing at the rate of about 4-6 per cent. Thus, the country is constrained to import edible oil in large quantities involving huge expenditure in foreign exchange. It is imperative to enhance the domestic production to meet the increasing demand for edible oils. Therefore there is an urgent need to improve the productivity of oilseed crops to bridge up the current demand-supply gap. Till now there is no major breakthrough to increase the production of vegetable oil through traditional crops. On the other hand fresh water available for agriculture is decreasing due to increasing demand from industrial and home consumption sectors of water usage. Hence, a sustainable method to improve the water use efficiency and water productivity has to be evolved in arid and semiarid regions where water scarcity is already experienced. Drip irrigation is the one option available to optimize agricultural production with limiting water. It can save water up to 40 to 70% as well as increase the crop production to the extent of 20 to 100% (Reddy and Reddy, 2003). Water productivity is three times more by drip irrigation than the furrow irrigation (Kadasiddappa, 2015). Fertigation which is a sophisticated and efficient method of applying fertilizer through the irrigation system as a carrier and distributor of crop nutrients holds the key (Bachchhav, 2005). Application of fertilizers along with irrigation water through drip fertigation can improve sunflower yield and fertilizer use efficiency and meets crop demand throughout the crop growing season. Earlier studies (Himaja, 2017) indicated the optimum NPK level as 75-90-30 kg N-P_2O_5-K_2O ha^{-1} by fertigation for sunflower in Southern Telangana Zone. The present study was planned to identify the optimum schedule of N and K fertilizers for sunflower by fertigation.

MATERIAL AND METHODS

The experiment was conducted during *rabi* 2017-18 with variety DRSH-1 at Water Technology Centre, College farm, College of Agriculture, Rajendranagar, Professor Jayashankar Telangana State Agriculture University, Hyderabad on a sandy clay loam soil, alkaline in reaction, non saline, low in available nitrogen, medium in available phosphorus and potassium. The bulk density of soil at 0-15 cm depth was 1.46 mg m^{-3} with available soil moisture 32.6 mm. The irrigation water was alkaline (pH=8.1) and categorized under the Class II (C_3S_1) suggesting that it is suitable for irrigating the crop by following good management practices. There was no carbonates hazard. The drip specifications include laterals of 16 mm diameter laid at 1.2 m apart with spacing of 0.5 m distance between two inline emitters. The emitter discharge was 4.0 lph.

The experiment was laid out in a randomized block design with three replications and nine treatments at 100% RDF viz., no application of N and K_2O fertilizers + drip irrigation (T_1), manual application of N and K fertilizers + drip irrigation (T_2), application of only N (75 kg ha^{-1}) through fertigation at 4 days interval (T_3), application of only N (75kg ha^{-1}) through fertigation at 8 days interval (T_4), application of only K (30 kg ha^{-1}) through fertigation at 4 days interval (T_5), application of only K (30 kg ha^{-1}) through fertigation at 8 days interval (T_6), application of N and K (75 kg N - 30 kg K_2O ha^{-1}) through fertigation at 4 days interval (T_7), application of N and K (75 kg N - 30 kg K_2O ha^{-1}) through fertigation at 8 days interval (T_8) and manual application of N and K fertilizers + furrow irrigation (T_9) . The recommended dose of fertilizer (RDF) 75, 90 and 30 kg N, P_2O_5 and K_2O ha^{-1}, respectively was applied. A common dose of phosphorus was applied to all the treatments including control (T_1). Nitrogen and potassium were applied through drip fertigation at different growth stages as per treatments through urea and potassium sulphate respectively. For manual application treatments (T_2 and T_9) N was applied in three equal splits at basal, 30 and 50 DAS through urea and potassium was applied through muriate of potash (MOP) in a single basal dose. Irrigation scheduling was done as per the treatments. Scheduling of irrigation for treatments T_1 to T_8 (except T_9) were fixed for once in two days based on daily evaporation data recorded from USWB class 'A' pan evaporimeter in agro-meteorological station, ARI Farm, Rajendranagar, Hyderabad at 0.8 Epan and furrow irrigation (T_9) was at 1.0 IW/CPE ratio with 50 mm irrigation depth in furrows in between paired rows (80 cm/40 cm). There was no rainfall during the crop growth period. The amount of water applied under drip irrigation was 318.8 mm and under surface irrigation was 466.6 mm. Fertigation was given at 4 and 8 days intervals starting from 16 DAS to 88 DAS. The fertigation schedule is detailed in Table 1. Sunflower hybrid DRSH-1 was sown by a paired row system on 16th November 2017 by adopting a spacing of 80/40 cm between the rows and 25 cm between the plants to maintain a desired plant population of 66,666 plants ha^{-1}.

Table 1. Fertigation schedule of N and K (kg ha^{-1}) as applied for *rabi* sunflower crop

Cropgrowth stage	DAS	No of schedules	Fertilizer dose 4 days interval		Fertilizer dose 8 days interval	
			N kg ha^{-1}	K_2O kg ha^{-1}	N kg ha^{-1}	K_2O kg ha^{-1}
At sowing 10% N applied as basal	-	-	7.5	-	7.5	-
Vegetation development	16-45 DAS	1-8	54.75	12.6	36.95	13.5
Flowering and pollination	46-65 DAS	9-13	12.15	11.4	20.25	12
Seed development	66-88 DAS	14-19	8.1	6	10.3	4.5
Total	88 days	19	75	30	75	30

RESULTS AND DISCUSSION

Data on plant height is presented in Table 2. It ranged from 35.3 to 41.2 cm, 135.9 to 181.7 cm, 158.8 to 206.7 cm and 161.7 to 208.1 cm respectively at 30, 60, 90 DAS and at harvest respectively. Results revealed that plant height increased from 30 to 90 DAS rapidly and afterwards increase was at a slower pace up to harvest. It was significantly influenced by treatments at all the growth stages except at 30 DAS. At 60, 90 DAS and at harvest the highest plant height was observed under treatment T_7 (181.7 cm, 206.7 cm and 208.1 cm) which was on par with treatments T_8 (177.2 cm, 201.8 cm and 203.6 cm), T_3 (174.1 cm, 195.0 cm and 196.8 cm) and T_4 (172.6 cm, 194.9 cm and 196.7 cm). The lowest plant height was recorded under treatment T_1 (Control) (135.9 cm, 158.8 cm and 161.7 cm). The N + K at 4 days interval (T_7) has recorded higher plant height compared to manual application of N and K fertilizers + drip irrigation (T_2) and manual application of N and K fertilizers + drip irrigation (T_2) has recorded an increase in plant height compared to manual application of N and K fertilizers + furrow irrigation (T_9). Application of fertilizer especially nitrogen enhances chlorophyll synthesis resulting in increased carbohydrate assimilation, which in turn responsible for higher vegetative growth. Due to frequent application of water and fertilizers by drip fertigation, nutrients were effectively utilized due to direct contact with the root system and least loss of nutrients through leaching. Similar results for higher plant height at 100 % RDF through fertigation over manual application of 100 % RDF through surface irrigation were reported by Sanju *et al*. (2013) and Soni *et al*. (2017).

The no. of functional leaves plant^{-1} at 30, 60, 90 DAS and at harvest are presented in Table 3 and it ranged from 9.9 to 11.4, 18 to 25.5 and 14.0 to 19.7 respectively. The number of functional leaves plant^{-1} increased with crop ontogeny up to 60 DAS and thereafter started declining until harvesting due to re-mobilization of nutrients from source to sink and rapid senescence of leaves. The number of leaves plant^{-1} due to different treatments was not significantly influenced at all the growth stages of study except at 60 DAS. At 60 DAS maximum number of leaves plant^{-1} were recorded with T_7 (N + K at 4 days interval) (25.5) which has 10.9 % more number of leaves compared to manual application of N and K fertilizers + drip irrigation (T_2) and the least was recorded under treatment T_1 (Control) (18.0). At 90 DAS, the maximum number of leaves plant^{-1} recorded with T_7 (N + K at 4 days interval) (19.7) and the lowest was in T_9 (manual application of N and K fertilizers + furrow irrigation) (14.0).

Table 2. Plant height (cm) of *rabi* sunflower as influenced by N and K fertigation schedules

Treatments	Plant height (cm)			
	30 DAS	60 DAS	90 DAS	At harvest
T_1 - Control (N_0K_0)	35.3	135.9	158.8	161.7
T_2 - Manual application of N and K + drip	40.2	162.4	187.5	188.2
T_3 - Fertigation of N at 4 days interval	37.8	174.1	195.0	196.8
T_4 - Fertigation of N at 8 days interval	37.7	172.6	194.9	196.7
T_5 - Fertigation of K at 4 days interval	37.6	147.6	180.4	182.5
T_6 - Fertigation of K at 8 days interval	37.0	145.6	171.9	173.7
T_7 - Fertigation of N and K at 4 days interval	40.0	181.7	206.7	208.1
T_8 - Fertigation of N and K at 8 days interval	39.8	177.2	201.8	203.6
T_9 - Manual application of N and K + furrow	41.2	148.1	169.1	170.7
SEm ±	1.91	4.72	5.93	5.65
CD (p=0.05)	NS	14.29	17.94	17.07

Table 3. Number of leaves plant^{-1} of *rabi* sunflower as influenced by N and K fertigation schedules

Treatments	Number of leaves plant^{-1}		
	30 DAS	60 DAS	90 DAS
T_1 - Control (N_0K_0)	9.9	18.0	17.0
T_2 - Manual application of N and K + drip	11.4	23.0	17.3
T_3 - Fertigation of N at 4 days interval	11.0	24.3	19.0
T_4 - Fertigation of N at 8 days interval	10.9	24.1	18.1
T_5 - Fertigation of K at 4 days interval	10.5	20.8	17.0
T_6 - Fertigation of K at 8 days interval	10.3	20.1	16.9
T_7 - Fertigation of N and K at 4 days interval	11.1	25.5	19.7
T_8 - Fertigation of N and K at 8 days interval	11.1	24.4	19.1
T_9 - Manual application of N and K + furrow	11.3	20.5	14.0
SEm ±	0.86	0.78	1.35
CD (p=0.05)	NS	2.38	NS

The data on spad chlorophyll meter readings (SCMR) at 30, 60, 90 DAS and at harvest are presented in Table 4 and it ranged from 30.8 to 37.1, 33.2 to 55.7, 24.7 to 44.9 and 23.2 to 39.2 respectively. The readings were not significantly influenced by different fertigation schedules at 30 DAS and significantly influenced during the other stages. The SCMR readings at 60 DAS were observed to be higher when compared to other stages of crop growth. During all the growth stages, the lowest SCMR was noticed in T_1 (Control) and the highest was noticed with T_7 (N + K at 4 days interval) which was significantly higher over application of only K at 4 and 8 days interval treatments (T_6 and T_7) and manual application of N and K treatments (T_2 and T_9) respectively. Whereas, the SCMR recorded with T_8 (N + K at 8 days interval), T_3 (N at 4 days interval), T_4 (N at 8 days interval) treatments was found to be at par with $T_{7.}$ At 60, 90 DAS and at harvest, N + K at 4 days interval (T_7) has recorded 15.8, 11.9, 13.9 % higher SCMR compared to T_2 (manual application of N and K fertilizers + drip irrigation) treatment respectively. Manual application of N and K fertilizers + drip irrigation (T_2) has recorded 18.3, 21.1, 12.0 % higher SCMR compared to manual application of N and K fertilizers + furrow irrigation (T_9). The phenomenon of increased chlorophyll content with increased N nutrition under fertigation could be due to uniform distribution and adequate availability of nutrients and water under drip fertigation in the root zone of the crop (Gupta *et al*., 2010 and Aminifard *et al*., 2012).

Table 4. Spad Chlorophyll Meter Reading (SCMR) of *rabi* sunflower as influenced by N and K fertigation schedules.

Treatments	SCMR			
	30 DAS	60 DAS	90 DAS	At harvest
T_1 - Control (N_0K_0)	30.8	33.2	24.7	23.2
T_2 - Manual application of N and K + drip	36.9	48.1	40.1	34.4
T_3 - Fertigation of N at 4 days interval	36.5	54.1	43.5	37.9
T_4 - Fertigation of N at 8 days interval	36.4	53.8	42.8	37.8
T_5 - Fertigation of K at 4 days interval	36.1	40.3	32.4	30.1
T_6 - Fertigation of K at 8 days interval	36.0	39.9	32.1	29.7
T_7 - Fertigation of N and K at 4 days interval	37.1	55.7	44.9	39.2
T_8 - Fertigation of N and K at 8 days interval	36.6	54.6	43.6	38.2
T_9 - Manual application of N and K + furrow	36.4	40.6	33.1	30.7
SEm ±	1.51	1.57	1.78	1.49
CD (p=0.05)	NS	5.84	5.38	3.16

Leaf area index is defined as the ratio of green leaf area to a unit ground area, which is one of the important indicators of growth and productivity of the crops. The data is presented in Table 5 indicated that LAI ranged from 0.5 to 0.6, 1.5 to 3.7, 1.2 to 2.5 and 0.4 to 0.8 at 30, 60 and 90 DAS and at harvest, respectively. The LAI significantly influenced by treatments at all the growth stages studied except at 30 DAS. Relatively higher LAI values were noticed at 60 DAS. At 60, 90 DAS and at harvest the lowest LAI values were noticed with T_1 (Control) and the highest was noticed in T_7 (N + K at 4 days interval). At 60, 90 DAS and at harvest N + K at 4 days interval (T_7) has recorded 42.3, 38.8, and 60 % increase in LAI compared to T_2 (manual application of N and K fertilizers + drip irrigation) treatment, respectively. At 60 and 90 DAS manual application of N and K fertilizers + drip irrigation (T_2) has recorded 23.8 and 20.0 % increase in LAI compared to manual application of N and K fertilizers + furrow irrigation (T_9) respectively.

Table 5. Leaf area index of *rabi* sunflower as influenced by N and K fertigation schedules.

Treatments	Leaf Area Index			
	30 DAS	60 DAS	90 DAS	At harvest
T_1 - Control (N_0K_0)	0.5	1.5	1.2	0.4
T_2 - Manual application of N and K + drip	0.6	2.6	1.8	0.5
T_3 - Fertigation of N at 4 days interval	0.6	3.3	2.2	0.6
T_4 - Fertigation of N at 8 days interval	0.6	3.2	2.2	0.6
T_5 - Fertigation of K at 4 days interval	0.6	2.2	1.7	0.5
T_6 - Fertigation of K at 8 days interval	0.6	1.7	1.6	0.5
T_7 - Fertigation of N and K at 4 days interval	0.6	3.7	2.5	0.8
T_8 - Fertigation of N and K at 8 days interval	0.6	3.5	2.2	0.8
T_9 - Manual application of N and K + furrow	0.7	2.1	1.5	0.5
SEm ±	0.04	0.15	0.11	0.03
CD (p=0.05)	NS	0.46	0.35	0.10

The data of dry matter production (DMP) at 30, 60, 90 DAS and at harvest is presented in Table 6 and it ranged from 18.5 to 21.3 g, 30.7 to 108.8 g, 63.3 to 131.6 g plant^{-1} and 81.8 to 158.1 g plant^{-1}, respectively. Dry matter plant^{-1} was increased gradually up to harvest. The dry matter production was significantly influenced by different treatments at all the growth stages except 30 DAS. At 60, 90 DAS and at harvest the highest dry matter plant^{-1} was observed in T_7 (N + K at 4 days interval) (108.8 g, 131.57 g and 158.1 g) and the lowest was recorded in control (T_1).

Table 6. Dry matter production (g plant^{-1}) of *rabi* sunflower as influenced by N and K fertigation schedules.

Treatments	Dry matter production (g $plant^{-1}$)			
	30 DAS	60 DAS	90 DAS	At harvest
T_1 - Control (N_0K_0)	18.5	30.7	63.3	81.8
T_2 - Manual application of N and K + drip	19.9	76.0	108.3	134.1
T_3 - Fertigation of N at 4 days interval	19.2	99.0	93.2	122.4
T_4 - Fertigation of N at 8 days interval	19.1	92.8	88.1	118.5
T_5 - Fertigation of K at 4 days interval	19.1	54.3	79.8	109.3
T_6 - Fertigation of K at 8 days interval	18.6	52.9	71.8	102.2
T_7 - Fertigation of N and K at 4 days interval	19.7	108.8	131.6	158.1
T_8 - Fertigation of N and K at 8 days interval	19.5	99.9	126.2	146.9
T_9 - Manual application of N and K + furrow	21.3	59.1	89.3	110.1
SEm ±	0.93	5.30	6.04	6.41
CD (p=0.05)	NS	16.01	18.49	23.80

Table 7. Correlation and regression between seed yield Vs growth parameters of *rabi* sunflower as influenced by N and K fertigation schedules.

S.No.	Parameter	DAS	r^2 value	Regression Equation	R^2
1.	Plant height (cm)	30	0.401^{*}	y = 52.32x – 78.85	0.17
		60	0.717^{**}	y = 17.93x – 946.3	0.51
		90	0.734^{**}	y = 18.69x – 1516	0.54
		Harvest	0.694^{**}	y = 17.6x – 1355	0.48
2.	Number of leaves $plant^{-1}$	60	0.682^{**}	y = 147.9x – 1537	0.46
3	SCMR	30	0.484^{*}	y = 92.52x – 1422	0.23
		60	0.664^{**}	y = 47.91x – 279	0.44
		90	0.683^{**}	y = 50.86x – 18.20	0.47
		Harvest	0.758^{**}	y = 68.71x – 381.6	0.57
4.	LAI	60	0.677^{**}	y = 563.2x + 580.4	0.46
		90	0.594^{**}	y = 943.4x + 280.7	0.35
		Harvest	0.656^{**}	y = 2217x + 625.5	0.43
5.	Dry matter (g $plant^{-1}$)	60	0.828^{**}	y = 14.26x + 868.3	0.68
		90	0.780^{**}	y = 15.37x + 489.4	0.61
		Harvest	0.765^{**}	y = 13.60x + 257.8	0.59

Significant positive correlations were noticed between the seed yield of sunflower and different growth parameters presented in Table 7. The dependence of seed yield on plant height, number of leaves $plant^{-1}$, SCMR, LAI and dry matter $plant^{-1}$ was evident from significant (p=0.01) and positive correlation between yield and plant height, number of leaves plant^{-1}, SCMR, LAI and dry matter plant^{-1} data. The determination coefficient (R^2) was observed to be 0.54 for plant height at 90 DAS, 0.46 for number of leaves plant^{-1} at 60 DAS, 0.57 for SCMR at harvest, 0.46 for LAI at 60 DAS and 0.68 for dry matter plant^{-1} at 60 DAS which showed a linear increase in the growth parameters with the corresponding increase in yield.

Agronomic fertilizer use efficiency (kg increase in seed yield or / kg nutrient applied)

Agronomic fertilizer use efficiency is a function of yield of the crop and the quantity of fertilizer used. If crop could yield more for a given amount of fertilizer then it results in higher fertilizer use efficiency. Results pertaining to the fertilizer use efficiency were expressed as yield produced per unit quantity of fertilizer applied and presented in Table 8. FUE of K was observed to be higher than N.

Based on seed yield N fertilizer use efficiency for fertigation at 4 days interval recorded as 12.81 and for 8 days interval as 11.14 kg seed yield / kg N applied. K fertilizer use efficiency for fertigation at 4 days interval recorded as 25.59 and for 8 days interval as 20.74 kg seed yield / kg K applied. N-K fertilizer use efficiency for fertigation at 4 days interval recorded as 13.61 and for 8 days interval as 11.75 kg seed yield / kg N+K applied, N+K fertilizer use efficiency by manual application with drip recorded as 8.96 kg seed yield / kg N+K applied, N+K fertilizer use efficiency by manual application with furrow recorded as 5.33 kg seed yield / kg N+K applied. Higher N, K and N-K fertilizer use efficiency based on seed yield was recorded for fertigation at 4 days interval than fertigation at 8 days interval. Manual application with drip has recorded 3.63% higher N+K fertilizer use efficiency over manual application with furrow irrigation.

Based on total biomass N fertilizer use efficiency for fertigation at 4 days interval recorded as 53.58 and for 8 days interval as 44.85 kg biomass / kg N applied. K fertilizer use efficiency for fertigation at 4 days interval recorded as 94.90 and for 8 days interval as 79.56 kg biomass / kg K applied. N-K fertilizer use efficiency for fertigation at 4 days interval recorded as 56.10 and for 8 days interval as 48.76 kg biomass/ kg N+K applied, N+K fertilizer use efficiency by manual application with drip recorded as 36.94 kg biomass / kg N+K applied, N+K fertilizer use efficiency by manual application with furrow recorded as 19.83 kg biomass / kg N+K applied. Higher N, K and N-K fertilizer use efficiency based on total biomass was recorded for fertigation at 4 days interval than fertigation at 8 days interval.

Manual application with drip has recorded 17.1% higher N+K fertilizer use efficiency over manual application with furrow irrigation

Table 8. Agronomic fertilizer use efficiency of N, K and N+K as influenced by different treatments during *rabi* 2017-18

Sl. No.	Method of fertilizer application	Method of irrigation	Parameter	Formula*	FUE based on seed yield (kg seed yield/ kg nutrient applied	FUE based on total biomass (kg biomass / kg nutrient applied)
1	Fertigation	Drip	N-FUE at 4 days interval	$\frac{T_7-T_5}{75}$	12.81	53.28
2	Fertigation	Drip	N-FUE at 8 days interval	$\frac{T_8-T_6}{75}$	11.14	44.85
3	Fertigation	Drip	K-FUE at 4 days interval	$\frac{T_7-T_3}{25}$	25.59	94.80
4	Fertigation	Drip	K-FUE at 8 days interval	$\frac{T_8-T_4}{25}$	20.74	79.56
5	Fertigation	Drip	N+K-FUE at 4 days interval	$\frac{T_7-T_1}{100}$	13.61	56.10
6	Fertigation	Drip	N+K-FUE at 8 days interval	$\frac{T_8-T_1}{100}$	11.75	48.76
7	Manual application	Drip	N+K-FUE by manual application + drip	$\frac{T_2-T_1}{100}$	8.96	36.94
8	Manual application	Furrow	N+K-FUE by manual application + furrow	$\frac{T_9-T_1}{100}$	5.33	19.83

T_1- Control (N_0K_0), T_2 - Manual application of N and K + drip
T_3 - Fertigation of only N at 4 days interval, T_4 - Fertigation of only N at 8 days interval
T_5 - Fertigation of only K at 4 days interval, T_6 - Fertigation of only K at 8 days interval
T_7 - Fertigation of N and K at 4 days interval, T_8 - Fertigation of N and K at 8 days interval
T_9 - Manual application of N and K + furrow

N = 75 kg ha^{-1}, K_2O = 30 kg ha^{-1} = 25 kg K ha^{-1}, N+K = 100 kg ha^{-1}, every one kg N+ K contain 0.75 and 0.25 kg N and K

4. CONCLUSION

Based on the results obtained in the present investigation, it can be concluded that the sunflower crop grown with drip fertigation at 100 % RD of N + K (75 kg N - 30 kg K_2O ha^{-1})

with 4 days interval recorded the highest plant growth parameters The K-FUE was found to be higher than N-FUE. Among different treatments, higher N-FUE and K-FUE was recorded in application of N+K at 4 days interval. The next best was observed to be N+K at 8 days interval.

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