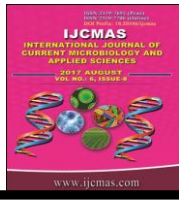
Int.J.Curr.Microbiol.App.Sci (2017) *6*(8): 980-986

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 6 Number 8 (2017) pp. 980-986**
Journal homepage: http://www.ijcmas.com



Original Research Article https://doi.org/10.20546/ijcmas.2017.608.120

Response of Sunflower to Different N/P Fertilizer Ratios and Levels of Nitrogen and Phosphorus

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Keywords

Sunflower, N/P fertilizer ratios, Growth, Seed yield, Oil yield, Quality and Economics.

Article Info

Accepted:
14 June 2017
Available Online:
10 August 2017

A B S T R A C T

A field experiment was conducted to study the effect of different ratios and levels of nitrogen and phosphorus fertilizer on the productivity of hybrid sunflower (cv. RSFH 130) on medium deep black soil under protective irrigation at Agricultural Research Station, Hagari, Ballari, University of Agricultural Sciences, Raichur, Karnataka. Treatments consisted of different N/P fertilizer ratios (0.80, 1.00, 1.20, 1.30 and 1.40) with different levels of N (60 to 126 kg N ha^{-1}) and P (60 to 90 kg P_2O_5 ha^{-1}) in addition to K fertilization at 60 kg K_2O ha^{-1}. Results revealed that N/P fertilizer ratio of 1.40 with application of nitrogen @ 126 kg ha^{-1} and phosphorus @ 90 kg ha^{-1} produced higher plant height, stem girth, total dry matter production, head diameter, seed yield per plant, thousand seed weight, seed yield, oil content, oil yield and economics of sunflower when compared to other N/P fertilizer ratios with different nitrogen and phosphorus levels.

Introduction

Sunflower is a new introduction to India in seventies and emerged as a promising potential oilseed crop because of its special characteristics *viz.*, wider adaptability to varied climatic conditions, photo insensitivity, low seed rate, high yield potential, short duration, response to applied nutrients, high quality oil content, high seed multiplication ratio and its easy cultivation. Presently in India sunflower is grown over an area of 0.55 million hectares with a production of 0.42 million tonnes and a productivity of 753 kg ha^{-1} (Anon, 2016) which is far below than its potential. Karnataka accounts majority of the sunflower production (0.21 million tonnes) in India with an area of 0.36 million hectares and productivity of 597 kg ha^{-1}. The lower productivity of crop is mainly ascribed to cultivation of sunflower in less fertile marginal lands under low and uncertain rainfall situations with low and imbalanced use of fertilizers (Ramulu *et al.*, 2011).

Sunflower is an important fast growing and high yielding oilseed crop which removes considerable amount of nutrients. Sunflower has a high nitrogen requirement that must be supplied throughout its growth and a shortage of nitrogen prior to flower initiation reduces the yield. Phosphorus is the second major

nutrient after nitrogen in limiting the sunflower production as phosphorus is more prone for fixation rendering it as non-available to plants due to many soil reactions and interactions with other elements. Differential influence of N/P fertilizer ratios with same and different levels of nitrogen and phosphorus exists with respect to the crops, varieties and climate (NAAS, 2009). Further, Biradar *et al.,* (2012) indicated wide variation in the current nutrient management practices and nutrient levels/ratios for obtaining potential yields. Therefore, nutrient management in sunflower assumes importance for increasing productivity. Thus, an experiment was conducted to evaluate the response of sunflower to different N/P fertilizer ratios on growth, yield and quality.

Materials and Methods

A field experiment was carried out during post rainy season of 2013 at Agricultural Research Station, Hagari, Ballari which lies between $15^0$30' and $15^0$50', North latitude and $75^0$40' and $77^0$11' East longitude with an altitude of 449 m above the mean sea level. It is situated in the Northern Dry Zone (Zone-3) of agro-climatic zones of Karnataka.

The soil was medium black clayey in texture, low in organic carbon (0.48%), low in available nitrogen (191.0 kg N ha^{-1}), medium in available phosphorus (34.30 kg P_2O_5 ha^{-1}) and high in available potassium (480.0 kg K_2O ha^{-1}) with pH of 8.2. Sunflower hybrid RSFH-130, with duration of 100 days was used in the trial.

The experiment was laid out in randomized complete block design (RCBD) with three replications with gross plot size of 21.60 m^2 and grown with common cultivation practices. The experiment consisted of fourteen treatments with varying N/P* (*P_2O_5 is referred as P) fertilizer ratios (0.80 to 1.40) by keeping potassium at a common dose of 60 kg K_2O ha^{-1} for all the treatments. The pretreated seeds with Imidacloprid and Ridomyl MZ were hand dibbled at a spacing of 60 x 30 cm. The fertilizer nitrogen, phosphorus and potassium were applied in the form of urea, di-ammonium phosphate and muriate of potash, respectively. Seventy five per cent of nitrogen and entire quantity of phosphorus and potassium fertilizers were applied as per the treatments at the time of sowing. Top dressing (in band placement) of remaining twenty five per cent of nitrogen in the form of urea was applied at 40 days after sowing (DAS). The experimental plots were kept weed free by integrated weed management practices involving pre-emergence herbicide application of Pendimethalin 30 EC @ 4.5 l ha^{-1} with two inter cultivations (25 and 40 DAS) and one hand weeding at 40 DAS. The crop was kept disease and insect free by appropriate plant protection measures. Periodic observations on growth attributes were recorded at 25, 50, and 75 DAS, at harvest and yield attributes were recorded at harvest. Oil content was estimated through Nuclear Magnetic Resonance (NMR) spectrometer against standard reference sample. Data collected at different stages were subjected to statistical analysis as described by Gomez and Gomez (1984). Treatment means were compared using Duncan's Multiple Range Test (DMRT).

Results and Discussion

Effect of N/P fertilizer ratios, levels of nitrogen and phosphorus on growth and yield attributes

It is well known from numerous nutrient studies that yield of a crop strongly depends on the supply of nutrients and among the fertilizer nutrients, nitrogen (N) is critical, as it is a component of proteins, enzymes, nucleic acids and chlorophyll. High rates of

nitrogen application leads to more rapid leaf area development, prolongs life of foliage, increases leaf area duration after flowering and enhances crop assimilation consequently contributing to higher yield. Sunflower is an important fast growing and high yielding oilseed crop which removes considerable amount of nutrients to the extent of 63.3 kg N, 19.1 kg P_2O_5 and 126.0 kg K_2O to produce one ton (Hegde and Sudhakarababu, 2009). Sunflower has a high nitrogen requirement that must be supplied throughout its growth and a shortage of nitrogen prior to flower initiation reduces the head diameter, number of seeds head^{-1}, seed and oil yield.

Phosphorus is the second major nutrient after nitrogen in limiting the sunflower production as phosphorus is more prone for fixation rendering it as unavailable to plants due to many soil reactions and interactions with other elements. Phosphorus is vital for plant growth and involved in energy transfer, photosynthesis, transformation of sugars, starches and nutrient movement within the plant. Adequate phosphorus supply results in better root penetration and proliferation contributing to production of photosynthates and their translocation to sink. When phosphorus is limiting the most striking effects is reduction in leaf expansion, leaf surface area and number of leaves (Hemalatha *et al.,* 2013).

It is evident from the results that, growth and yield components of sunflower increased with increasing N/P fertilizer ratio from 0.80 to 1.40 (Tables 1, 2 and 3). Results revealed that treatments receiving N/P fertilizer ratio of 1.4 with application of nitrogen @ 126 kg ha^{-1} and phosphorus @ 90 kg ha^{-1} produced higher plant height (30.37, 138.17, 176.07 and 178.27 cm at 25, 50, 75 DAS and at harvest, respectively), stem girth (3.23,7.10, 8.10 and 7.03 cm at 25, 50, 75 DAS and at harvest, respectively), leaf area (7.00, 70.40, 58.63 and 16.60 dm^2/plant at 25, 50, 75 DAS and at harvest, respectively). Similarly higher leaf area duration (53.75, 89.63, and 52.29 days at 25 DAS to 50 DAS, 50 DAS to 75 DAS and 75 DAS to harvest, respectively), total dry matter production (6.83,72.13,143.30 and 130.03 g/plant at 25, 50, 75 DAS and at harvest, respectively), head diameter (15.90 cm), and thousand seed weight (63.01 g) when compared to control and remained on par with application of 117 kg N ha^{-1} and 90 kg P_2O_5 ha^{-1} with N/P fertilizer ratio of 1.30 and application of 108 kg N ha^{-1} and 90 kg P_2O_5 ha^{-1} with N/P fertilizer ratio of 1.20.

Improvement in yield attributing parameters could be attributed to better growth parameters in addition to total dry matter production at different stages of the crop growth and it's partitioning into different parts due to application of higher levels of nitrogen and phosphorus fertilizers (Khakwani *et al.,* 2014, Bakth *et al.,* 2015). These results are in conformity with the findings of Yasin *et al.,* (2013) and Yadav *et al.,* (2009), where they observed that in treatments receiving N/P fertilizer ratio of > 1.00 produced larger head size, higher seed yield/ plant, 1000 seed weight, higher total number of seeds/head.

Effect of N/P fertilizer ratios, levels of nitrogen and phosphorus on yield, oil content, oil yield and economics

Results of the experiment indicated that seed yield was increased due to increasing N/P fertilizer ratio from 0.80 to 1.40. In general the treatments receiving N/P fertilizer ratio (P_2O_5 is referred as P in this text) of >1.0 produced higher seed yield when compared to the other treatments receiving N/P fertilizer ratio of <1. Among the treatments, application of 126 kg N ha^{-1} and 90 kg P_2O_5 ha^{-1} with N/P fertilizer ratio of 1.40 recorded significantly higher seed yield (2650 kg ha^{-1}) when compared to the seed yield (1539 kg ha^{-1}) observed in the control treatment.

Table.1 Plant height and number of leaves per plant of sunflower at different growth stages as influenced by Different ratios and rates of fertilizers

Sl. No.	Treatments							Plant height (cm)				Stem girth (cm)			
	Nutrient ratios				Rates of nutrients (kg ha^{-1})										
	N	P_2O_5	K_2O	N/P_2O_5 ratio	N	P_2O_5	K_2O	25 DAS	50 DAS	75 DAS	At harvest	25 DAS	50 DAS	75 DAS	At harvest
T_1	0.00	0.00	1.00	0.00	0.00	0.00	60.0	18.87 g	96.43 f	140.50g	142.13g	1.83g	4.27j	5.20i	4.70i
T_2	1.00	1.25	1.00	0.80	60.0	75.0	60.0	24.50d-f	113.50c-e	153.50d-g	154.77d-g	2.20d-g	5.60f-i	6.30e-h	5.50e-i
T_3	1.50	1.50	1.00	1.00	90.0	90.0	60.0	27.20a-e	128.60ab	161.20a-f	162.80b-f	2.67a-e	6.20c-e	7.10b-e	6.20a-e
T_4	1.25	1.25	1.00	1.00	75.0	75.0	60.0	25.17c-f	124.50 a-c	157.77c-f	159.30c-f	2.40c-g	5.87d-g	6.73d-g	5.83c-g
T_5	1.00	1.00	1.00	1.00	60.0	60.0	60.0	22.13fg	100.60ef	146.57fg	147.67fg	1.93fg	5.03i	5.80hi	4.90hi
T_6	1.80	1.50	1.00	1.20	108.0	90.0	60.0	28.73a-c	133.63ab	170.20a-c	172.90a-c	3.07ab	6.80ab	7.80ab	6.70ab
T_7	1.50	1.25	1.00	1.20	90.0	75.0	60.0	26.30b-e	126.90ab	159.93b-f	160.97c-f	2.53b-f	6.00d-f	6.90c-f	6.07b-f
T_8	1.20	1.00	1.00	1.20	72.0	60.0	60.0	23.53ef	104.73ef	148.40e-g	149.63fg	2.00fg	5.20hi	5.93g-i	5.10g-i
T_9	1.95	1.50	1.00	1.30	117.0	90.0	60.0	29.70ab	134.90a	174.00ab	176.00ab	3.13a	6.97ab	7.93ab	6.87ab
T_{10}	1.62	1.25	1.00	1.30	97.5	75.0	60.0	27.57a-e	130.10ab	163.37 a-e	165.03a-e	2.77a-d	6.43b-d	7.33a-d	6.43a-d
T_{11}	1.30	1.00	1.00	1.30	78.0	60.0	60.0	23.93ef	109.13d-f	150.83e-g	152.00e-g	2.10e-g	5.40g-i	6.20f-h	5.30f-i
T_{12}	2.10	1.50	1.00	1.40	126.0	90.0	60.0	30.37a	138.17a	176.07a	178.27a	3.23a	7.10a	8.10a	7.03a
T_{13}	1.75	1.25	1.00	1.40	105.0	75.0	60.0	28.40a-d	132.70ab	167.80a-d	169.30a-d	2.93a-c	6.63a-c	7.60a-c	6.60a-c
T_{14}	1.40	1.00	1.00	1.40	84.0	60.0	60.0	24.90c-f	120.90b-d	155.00c-g	156.37d-g	2.33d-g	5.73e-h	6.50d-h	5.70d-h
Mean								25.81	121.06	158.94	160.51	2.51	5.95	6.82	5.92
S.Em. ±								1.21	4.14	4.67	4.53	0.18	0.22	0.26	0.26
LSD (p = 0.05)								3.54	12.05	13.58	13.18	0.53	0.64	0.75	0.76

Table.2 Leaf area/plant and leaf area duration of sunflower at different growth stages as influenced by Different ratios and rates of fertilizers

Sl. No.	Treatments							Leaf area/plant (dm^2)				Leaf area duration (days)		
	Nutrient ratios				Rates of nutrients (kg ha^{-1})									
	N	P_2O_5	K_2O	N/P_2O_5 ratio	N	P_2O_5	K_2O	25 DAS	50 DAS	75 DAS	At harvest	25 DAS- 50 DAS	50 DAS-75 DAS	75 DAS-Harvest
T_1	0.00	0.00	1.00	0.00	0.00	0.00	60.0	4.07h	40.60i	37.40h	11.00 e	31.00i	54.13k	33.63 h
T_2	1.00	1.25	1.00	0.80	60.0	75.0	60.0	5.13ef	52.37ef	44.67e-g	12.37c-e	39.96ef	67.38gh	39.58 e-g
T_3	1.50	1.50	1.00	1.00	90.0	90.0	60.0	5.90cd	60.90cd	50.70b-e	13.50bc	46.42cd	77.46de	44.58 b-d
T_4	1.25	1.25	1.00	1.00	75.0	75.0	60.0	5.40d-f	55.33e	48.47d-f	13.10b-d	42.13e	72.08f	42.75 c-f
T_5	1.00	1.00	1.00	1.00	60.0	60.0	60.0	4.50gh	44.27hi	41.60gh	11.50de	33.88hi	59.63j	36.88 gh
T_6	1.80	1.50	1.00	1.20	108.0	90.0	60.0	6.50ab	66.90ab	56.37ab	15.50a	50.96ab	85.63ab	49.92 a
T_7	1.50	1.25	1.00	1.20	90.0	75.0	60.0	5.67de	57.23de	49.57c-e	13.60bc	43.63de	74.17ef	43.92 c-e
T_8	1.20	1.00	1.00	1.20	72.0	60.0	60.0	4.87fg	46.03gh	42.57f-h	12.23c-e	35.42gh	61.54ij	38.00 f-h
T_9	1.95	1.50	1.00	1.30	117.0	90.0	60.0	6.73ab	68.10ab	57.90a	16.13a	51.96a	87.50ab	51.42 a
T_{10}	1.62	1.25	1.00	1.30	97.5	75.0	60.0	6.23bc	63.17bc	53.50a-d	14.83ab	48.21bc	81.00cd	47.46 a-c
T_{11}	1.30	1.00	1.00	1.30	78.0	60.0	60.0	5.03fg	49.93fg	44.50e-g	12.43c-e	38.17fg	65.58hi	39.54 e-g
T_{12}	2.10	1.50	1.00	1.40	126.0	90.0	60.0	7.00a	70.40a	58.63a	16.60a	53.75a	89.63a	52.29 a
T_{13}	1.75	1.25	1.00	1.40	105.0	75.0	60.0	6.40bc	65.87a-c	54.80a-c	15.37a	50.17ab	83.79bc	48.71 ab
T_{14}	1.40	1.00	1.00	1.40	84.0	60.0	60.0	5.30ef	54.13ef	47.10e-g	12.97cd	41.25ef	70.29fg	41.71 d-g
Mean								5.62	56.80	49.13	13.65	43.35	73.56	43.60
S.Em. ±								0.2	1.63	1.92	0.59	1.18	1.52	1.52
LSD (p = 0.05)								0.59	4.74	5.58	1.71	3.42	4.42	4.41

Table.3 Total dry matter production, head diameter, 1000 seed weight and seed yield of sunflower at different growth stages as Influenced by different ratios and rates of fertilizers

Sl. No.	Treatments							Total dry matter production (g/plant)				Head Diameter (cm)	1000 seed weight (g)
	Nutrient ratios				Rates of nutrients (kg ha^{-1})								
	N	P_2O_5	K_2O	N/P_2O_5 ratio	N	P_2O_5	K_2O	25 DAS	50 DAS	75 DAS	At harvest		
T_1	0.00	0.00	1.00	0.00	0.00	0.00	60.0	3.70 i	41.43 k	86.87 i	80.67 k	12.00 c	37.77d
T_2	1.00	1.25	1.00	0.80	60.0	75.0	60.0	4.83 fg	51.63 g-i	110.67 fg	97.8 g-i	12.90 bc	45.88b-d
T_3	1.50	1.50	1.00	1.00	90.0	90.0	60.0	5.73 de	60.57 c-f	123.37 c-e	110.07d-f	13.40 bc	49.92bc
T_4	1.25	1.25	1.00	1.00	75.0	75.0	60.0	5.37 ef	56.07 e-g	117.33 d-f	103.83 fg	13.20 bc	47.63b-d
T_5	1.00	1.00	1.00	1.00	60.0	60.0	60.0	4.20 hi	44.03 jk	94.40 hi	86.17 jk	12.37 c	41.66cd
T_6	1.80	1.50	1.00	1.20	108.0	90.0	60.0	6.33 a-c	66.97 a-c	135.57 ab	122.9 a-c	15.67 a	61.70a
T_7	1.50	1.25	1.00	1.20	90.0	75.0	60.0	5.57 de	58.40 d-f	120.73 c-f	107.3 e-g	13.30 bc	48.14b-d
T_8	1.20	1.00	1.00	1.20	72.0	60.0	60.0	4.43 gh	46.07 i-k	98.80 h	89.00 i-k	12.70 bc	43.43cd
T_9	1.95	1.50	1.00	1.30	117.0	90.0	60.0	6.57 ab	69.13 ab	139.77 a	127.0 ab	15.80 a	62.39a
T_{10}	1.62	1.25	1.00	1.30	97.5	75.0	60.0	5.97 cd	62.77 b-e	127.63 b-d	114.9 c-e	14.97 ab	55.34ab
T_{11}	1.30	1.00	1.00	1.30	78.0	60.0	60.0	4.60 gh	48.73 h-j	105.27 gh	93.03 h-j	12.77 bc	44.24cd
T_{12}	2.10	1.50	1.00	1.40	126.0	90.0	60.0	6.83 a	72.13 a	143.30 a	130.03 a	15.90 a	63.01a
T_{13}	1.75	1.25	1.00	1.40	105.0	75.0	60.0	6.10 b-d	64.33 b-d	132.03 a-c	118.97 b-d	15.50 a	60.03a
T_{14}	1.40	1.00	1.00	1.40	84.0	60.0	60.0	5.20 ef	54.37 f-h	114.83 e-g	100.83 f-h	13.10 bc	46.30b-d
Mean								5.39	56.90	113.21	105.92	13.83	50.53
S.Em. ±								0.19	2.13	3.62	3.07	0.67	3.16
LSD (p = 0.05)								0.56	6.2	10.54	8.92	1.97	9.19

Table.4 Oil content, oil yield and economics of sunflower at different growth stages as influenced by Different ratios and rates of fertilizers

Sl. No.	Treatments							Seed yield (kg/ha)	Seed oil content (%)	Oil yield (kg/ha)	Gross Returns ('000 Rs./ha)	Cost of cultivation ('000 Rs./ha)	Net returns ('000 Rs./ha)	B- C Ratio
	Nutrient ratios				Rates of nutrients (kg ha^{-1})									
	N	P_2O_5	K_2O	N/P_2O_5 ratio	N	P_2O_5	K_2O							
T_1	0.00	0.00	1.00	0.00	0.00	0.00	60.0	1539d	35.77 b-d	554 d	41.56d	22.65	18.91c	1.83c
T_2	1.00	1.25	1.00	0.80	60.0	75.0	60.0	1944b-d	36.20a-d	699 cd	52.50 b-d	26.25	26.25bc	2.00 a-c
T_3	1.50	1.50	1.00	1.00	90.0	90.0	60.0	2060bc	37.23a-d	763 b-d	55.62 bc	27.24	28.39bc	2.04 a-c
T_4	1.25	1.25	1.00	1.00	75.0	75.0	60.0	2014b-d	36.30a-d	728 cd	54.37 b-d	26.41	27.96bc	2.06 a-c
T_5	1.00	1.00	1.00	1.00	60.0	60.0	60.0	1806cd	35.23d	633 cd	48.75 cd	25.65	23.10c	1.90c
T_6	1.80	1.50	1.00	1.20	108.0	90.0	60.0	2569a	39.90a-c	1029 a	69.37a	27.43	41.94a	2.53 ab
T_7	1.50	1.25	1.00	1.20	90.0	75.0	60.0	2049bc	37.33a-d	767 bc	55.31 bc	26.57	28.75bc	2.08 a-c
T_8	1.20	1.00	1.00	1.20	72.0	60.0	60.0	1875b-d	35.60cd	670 cd	50.62 b-d	25.78	24.84bc	1.96 bc
T_9	1.95	1.50	1.00	1.30	117.0	90.0	60.0	2604a	40.13ab	1043 a	70.31a	27.53	42.78a	2.55 ab
T_{10}	1.62	1.25	1.00	1.30	97.5	75.0	60.0	2373ab	39.20a-d	933 ab	64.06 ab	26.65	37.41ab	2.40a-c
T_{11}	1.30	1.00	1.00	1.30	78.0	60.0	60.0	1910b-d	35.90b-d	687 cd	51.56 b-d	25.85	25.72bc	2.00 a-c
T_{12}	2.10	1.50	1.00	1.40	126.0	90.0	60.0	2650a	40.50a	1074 a	71.56a	27.63	43.94a	2.59a
T_{13}	1.75	1.25	1.00	1.40	105.0	75.0	60.0	2528a	39.43 a-d	994 a	68.25a	26.74	41.51a	2.55 ab
T_{14}	1.40	1.00	1.00	1.40	84.0	60.0	60.0	1979b-d	36.17a-d	714 cd	53.44 b-d	25.91	27.53bc	2.06a-c
Mean								2136	37.49	806	53.01	26.31	31.36	2.18
S.Em. ±								152	1.3	064	4.09	-	4.09	0.14
LSD (p = 0.05)								441	3.79	187	11.9	-	11.9	0.45

The seed yield (2604 kg ha^{-1}) recorded with application of 117 kg N ha^{-1} and 90 kg P_2O_5 ha^{-1} with N/P fertilizer ratio of 1.30 and the seed yield (2569 kg ha^{-1}) noticed with application of 108 kg N ha^{-1} and 90 kg P_2O_5 ha^{-1} with N/P fertilizer ratio of 1.20 remained on par with N/P fertilizer ratio of 1.40 (Table 4). Increased seed yield of sunflower could be directly attributed to response of crop to application of higher level of nutrients resulting in better morphological, growth and yield attributing characters (Malligawad *et al.*, 2004 and Hussain *et al.*, 2011). Similar kind of results were also obtained by Yadav *et al.*, (2009) and Khakwani *et al.*, (2014) who recorded higher seed yield of sunflower with a N/P fertilizer ratios of >1.00 ranging from 1.25 to 1.80. Thus, owing to the integration of all the favourable yield components such as larger head size, higher head weight, seed yield/plant, 1000 seed weight, number of filled seeds and total number of seeds/head resulted in higher seed yield in sunflower.

Results of present investigation revealed that significantly higher seed oil content (40.50 %) and oil yield (1074 kg ha^{-1}) was recorded in the treatment with application of 126 kg N ha^{-1} and 90 kg P_2O_5 ha^{-1} with N/P fertilizer ratio of 1.40 when compared to the seed oil content (35.77 %) and oil yield (554 kg ha^{-1}) observed with control and other treatments (Table 4).

The seed oil content (40.13 %) and oil yield (1043 kg ha^{-1}) recorded with application of 117 kg N ha^{-1} and 90 kg P_2O_5 ha^{-1} with N/P fertilizer ratio of 1.30 and seed oil content (39.90 %) and oil yield (1029 kg ha^{-1}) recorded with application of 108 kg N ha^{-1} and 90 kg P_2O_5 ha^{-1} with N/P fertilizer ratio of 1.20 remained on par with application of 126 kg N ha^{-1} and 90 kg P_2O_5 ha^{-1} with N/P fertilizer ratio of 1.40. These results are in close association with the findings of Malligawad *et al.*, (2004) and Yasin *et al.*, (2013).

Effect of different N/P fertilizer ratios indicated that application of 126 kg N ha^{-1} and 90 kg P_2O_5 ha^{-1} with N/P fertilizer ratio of 1.40 realised significantly higher net returns (43.94 thousand rupees ha^{-1}) and B: C ratio (2.59) when compared to net returns (18.91 thousand rupees ha^{-1}) and B: C ratio (1.83) realised with control and other treatments (Table 4). However, net returns (42.78 thousand rupees ha^{-1}) and B:C ratio (2.55) observed with application of 117 kg N ha^{-1} and 90 kg P_2O_5 ha^{-1} with N/P fertilizer ratio of 1.30 and net returns (41.94 thousand rupees ha^{-1}) and B:C ratio (2.53) realised with application of 108 kg N ha^{-1} and 90 kg P_2O_5 ha^{-1} with N/P fertilizer ratio of 1.20 remained on par with application of 126 kg N ha^{-1} and 90 kg P_2O_5 ha^{-1} with N/P fertilizer ratio of 1.40. The higher net returns were mainly due to higher economic yield associated with that treatment (Yadav *et al.*, 2009). Banerjee *et al.*, (2014) and Khakwani *et al.*, (2014) also reported that with increasing N/P fertilizer ratios of >1.0 increased the net returns and B: C ratio.

References

Anonymous, 2016, State of Indian Agriculture 2016, Directorate of Economics and Statistics, Ministry of Agriculture and Farmers welfare, Department of Agriculture, Co-operation and Farmers Welfare, GOI. pp. 119.

Bakth, J., Mohammad. S. and Mohammad, Y., 2015, Effect of various levels of NPK on crop growth and yield of sunflower hybrids grown under autumn seasons. *Pak. J. Bot.*, 47(SI): 171-180.

Banerjee, H., Dutta, S. K., Pramanik, S. J., Ray, K., Phonglosa, A. and Bhattacharyya, K., 2014, Productivity and profitability of spring planted sunflower hybrid with nitrogen, phosphorus and potassium fertilizer.

Annals Pl. Soil Res., 16(3): 250-256.

Biradar, D. P., Aladakatti, Y. R. and Basavanneppa, M. A., 2012, Enhancing the productivity and economic returns of field crops with balanced nutrient application through site specific nutrient management approach. Proc. 3rd National Conference on Agro-informatics and Precision Agriculture 2012 (AIPA, 2012) 1-3 August 2012, Hyderabad India. p. 146–151.

Gomez, K. A. and Gomez, A. A., 1984, *Statistical Procedures for Agricultural Research*, 2nd Edition, A Wiley-International Science Publ., New York (USA), pp. 125-130.

Hegde, D. M. and Sudhakarababu, S. N., 2009, Declining factor productivity and improving nutrient-use efficiency in oilseeds. *Indian J. Agron.*, 54(1): 1-8.

Hemalatha, S., Praveen, R., Padmaja, J. and Suresh, K., 2013, An over view on role of phosphorus on growth, yield and quality of sunflower. *Int. J. Applied Biol. Pharm. Technol.*, 4(3): 48-55.

Hussain, S. S., Misger, F. A., Amit, K., and Baba, M. H., 2011, Response of nitrogen and sulphur on biological and economic yield of sunflower. *Res. J. Agric. Sci.*, 2(2): 308-310.

Khakwani, A. A., Nr, S., Sadiq, M., Awan, I. U., Munir, M., Baloch, M. S., Ghazanfarullah, S. and Baksh, I., 2014, Impact of plant densities and NPK fertilization on growth and optimum economic return of sunflower. *Sarhad J. Agric.*, 30(2): 157-164.

Malligawad, L. H., Parameshwarappa, K. G. and Giriraj, K., 2004, Studies on the effect of ratios and level of NPK fertilizer nutrients on the productivity of hybrid sunflower under rainfed farming situations. *Proc. 16th International sunflower conference*, Fargo, USA. p. 377-386.

NAAS, 2009, Crop response and nutrient ratio. Policy paper 42. National Academy of Agricultural Sciences, New Delhi. Pp. 1-15.

Ramulu, N., Krishnamurthy, H. M., Jayadeva, M., Janardhan, C. and Ramachandra, C., 2011, Influence of different levels of nutrient on growth and yield on sunflower under irrigated conditions of eastern dry zone of Karnataka, India. *Plant Archives*, 11(2): 1025-1028.

Yadav, R. P., Tripathi, M. L. and Trivedi, S. K., 2009, Effect of irrigation and nutrient levels on productivity and profitability of sunflower (*Helianthus annuus* L.). *Indian J. Agron.*, 54(3): 332-335.

Yasin, M., Mahmood, A., Ali, A., Aziz, M., Javaid, M. M., Iqbal, Z. and Tanveer, A., 2013, Impact of varying planting patterns and fertilizer application strategies on autumn planted sunflower hybrid. *Cercetari Agronomice in Moldova*, XLVI, No. 2(154)/2013.

How to cite this article:

Ravishankar, G. and Malligawad, L.H. 2017. Response of Sunflower to Different N/P Fertilizer Ratios and Levels of Nitrogen and Phosphorus. *Int.J.Curr.Microbiol.App.Sci.* 6(8): 980-986.
doi: https://doi.org/10.20546/ijcmas.2017.608.120