International Journal of Agricultural Sciences
Volume **10** | Issue 1| January, 2014 | 360-364

RESEARCH PAPER

Effect of spacing and nutrient management on growth and yield of sunflower (*Helianthus annuus* L.) under south Gujarat condition

S.J. SANDHI*, J.G. PATEL[1] AND C.K. DESAI
Department of Agronomy, N.M. College of Agriculture, Navsari Agriculture University,
NAVSARI (GUJARAT) INDIA

Abstract : A field experiment was conducted at College Farm, Navsari Agricultural University, Navsari (Gujarat) during *Rabi* season of the year 2011-12 to study the effect of spacing and nutrient management on growth and yield of sunflower (*Helianthus annuus* L.) under South Gujarat condition. Almost all the growth and yield attributes such as maximum plant height at 30 DAS, 60 DAS and at harvest, higher seed and stover yields were recorded with spacing 30 cm x 20 cm. While, maximum head diameter, number of seeds per head and 100 seed weight were recorded with spacing 60 cm x 20 cm. The highest net realization of Rs. 29990 ha^{-1} with BCR value of 2.04 was accrued with spacing 30 cm x 20 cm. All the growth and yield attributes such as maximum plant height, seed and stover yields, head diameter, number of seeds per head and 100 seed weight were recorded with 125 per cent RDF *i.e.* 75: 37.5: 00 NPK kg ha^{-1} which were remained at par with 100 % RDF. Same results recorded with the use of biofertilizer (*Azotobacter*). Treatment receiving 125 % RDF realized the highest net realization of 30019 Rs.ha^{-1} with the highest BCR of 2.05. There was an appreciable increase in net realization due to biofertilizer.

Key Words : Spacing, Nutrient management, Growth, Yield, Sunflower

View Point Article : Sandhi, S.J., Patel, J.G. and Desai, C.K. (2014). Effect of spacing and nutrient management on growth and yield of sunflower (*Helianthus annuus* L.) under south Gujarat condition. *Internat. J. agric. Sci.*, **10** (1): 360-364.

Article History : Received : 27.08.2013**; Revised :** 11.11.2013**; Accepted :** 04.12.2013

INTRODUCTION

Sunflower *(Helianthus annuus* L.*)* is an important oilseed crop in arid and semi arid regions, ranking third in the world after soybean and groundnut in edible oil seed production. Sunflower is the largest source of vegetable oil in the world. It makes an ideal feed for poultry and livestock (Singh, 1967). In case of sunflower proper spacing provides sufficient interception of light and satisfactory absorption of nutrients and water from the soil due to the proper development of root system and results in higher crop yield. Nutrient management is an age old concept practice in traditional agriculture because of the low nutrient turns over in soil plant system (Meelu and Singh, 1991). Nutrient management approach involving inorganic fertilizers, biological sources and organic manure will go a long way in build up soil fertility on sustainable basis, since the system will supply almost all the nutrients in a judicious way, besides increasing the nutrient use efficiency and improving the physio-chemical properties of soil. The seed inoculation with strain of biofertilizer such as *Azospirillum* and *Azotobacter* are the low cost, non bulky agricultural inputs for enhancing crop yields. The role of biofertilizers is also well recognized which supplies macro and micro nutrients necessary for the plant growth. It also develops a sustainable agriculture system by maintaining soil fertility, soil physical properties, ecological balance and providing stability to the production without polluting soil, water and air. Considering the above facts and views, the present experiment was planned.

MATERIAL AND METHODS

A field experiment was conducted on plot no. D-16 of the College Farm, N.M. College of Agriculture, Navsari

*** Author for correspondence**
[1]Polytechnic in Agriculture (N.A.U.), NAVSARI (GUJARAT) INDIA

Agricultural University, Navsari during *Rabi* season of 2011-12. The soil of the experimental field was clayey in texture and showed low, medium and high rating for available nitrogen (175.00 kg ha^{-1}), phosphorus (30.95 kg ha^{-1}) and potassium (352.00 kg ha^{-1}), respectively. The soil was found slightly alkaline (pH 7.8) with normal electric conductivity. Total eighteen treatment combinations of three spacing [30 cm x 20 cm, 45 cm x 20 cm and 60 cm x 20 cm], three fertilizer doses [75 % RDF (*i.e.* 45**:**22.5**:**00 NPK kg ha^{-1}), 100 % RDF (*i.e.* 60 : 30 : 00 NPK kg ha^{-1}) and 125 % RDF (*i.e.* 75:37.5:00 NPK kg ha^{-1})] and two bio fertilizers [No bio fertilizer and *Azotobacter* 2 kg ha^{-1}] were tried in a factorial randomized block design with three replications. The experimental plot was manured by FYM @ 5 t/ha and application of biofertilizer and inorganic fertilizer as per treatments. *Azotobacter chroococcum* culture obtained from Department of Plant Pathology, N.M. College of Agriculture, Navsari. The required quantity of *Azotobacte*r @ 4 g for the each experimental plot. The culture inoculated with seed was uniformly as per treatments. The required quantity of inorganic fertilizer was applied through urea (46% N) and di ammonium phosphate as per treatments. 100 % phosphorus and 50 % nitrogen was applied as a basal dose and 50 % as top dressing after one month of sowing as per treatment. The seeds of sunflower variety GS-1 received from Main Oilseed Research Station, Amreli, (Gujarat) was used for this experiment. First irrigation was given just after sowing for proper germination whereas other three irrigations were applied uniformly to all the experimental plots.

RESULTS AND DISCUSSION

The results of the investigation with cause and effect relationship and supported with relevant references based on experimental evidences were mentioned below.

Effect of spacing:

So far maximum plant height was recorded with spacing 30 cm x 20 cm at 60 DAS and at harvest. It might be due to the plant height was remarkably accelerated at 30 cm x 20 cm spacing which might be due to tendency of plant to elongate toward light, when insufficient incidental solar radiation are intercepted in the plant canopy particularly lower one. Maximum head diameter (13.56 cm), number of seed per head (453.05), seed weight per head (22.84 g) and 100 seed weight (6.90 g) observed in spacing 60 x 20 cm as compared to spacing 30 x 20 cm and 45 x 20 cm (Table 1). It might be due to less competition exerted for light, moisture and nutrients. Sufficient interception of sunlight promotes

Table 1 : Effect of spacings and nutrient management on growth, yield and yield attributes

Treatments	Plant population per net plot		Plant height (cm)			Head diameter (cm)	Number of seeds $head^{-1}$	100 Seed weight (g)	Seed yield (q ha^{-1})	Stover yield (q ha^{-1})
	Initial at 20 DAS	At harvest	30 DAS	60 DAS	At harvest					
Spacing										
30 cm × 20 cm	214.71	214.4	21.68	163.74	190.42	11.58	331.5	5.08	14.23	30.76
45 cm × 20 cm	128.83	128.53	21.14	160.21	186.08	12.57	386.75	5.61	13.61	29.38
60 cm × 20 cm	85.95	85.5	20.84	158.19	183.6	13.56	453.05	6.9	13.21	28.47
S. E. ±	2.45	2.81	0.24	0.62	0.67	0.24	2.28	0.11	0.26	0.6
C.D. (P=0.05)	7.03	8.08	NS	1.79	1.92	0.68	6.55	0.31	0.76	1.73
Inorganic fertilizer										
75 % RDF	136.7	136.31	20.75	157.89	181.59	12.14	369.23	5.39	13.28	28.63
100 % RDF	143.12	142.74	21.32	160.95	187.13	12.57	390.43	5.8	13.51	29.14
125 % RDF	149.68	149.38	21.59	163.3	191.38	13	411.63	6.4	14.26	30.84
S. E. ±	2.45	2.81	0.24	0.62	0.67	0.24	2.28	0.11	0.26	0.6
C.D. (P=0.05)	7.03	8.08	NS	1.79	1.92	0.68	6.55	0.31	0.76	1.73
Biofertilizer										
No Bio fertilizer	142.82	142.39	20.99	160.38	186.2	12.48	385.13	5.58	13.42	28.83
Azotobacter	143.51	143.23	21.45	161.05	187.2	12.65	395.73	6.14	13.95	30.24
S. E. ±	2	2.29	0.19	0.51	0.55	0.19	1.86	0.09	0.21	0.49
C.D. (P=0.05)	NS	NS	NS	NS	NS	NS	5.34	0.25	NS	NS
S X F	NS	NS	NS	NS	NS	NS	S	S	S	NS
S X B	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
F X B	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
S X F X B	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
C.V. %	7.25	8.35	4.71	16.39	15.21	7.95	2.47	7.76	8.14	8.65

NS=Non-significant

efficient photosynthesis activities and ultimately greater accumulation of photosynthates under wider spacing. Narrow spacing with dense plant population resulted in the lower values of yield attributes. The reduction in yield at with increase in plant density could be attributed to keen competition for moisture, photosynthesis and solar radiation. In wider spacing might be attributed to relatively less inter-plant competition because of more space availability to individual plants. A progressive increase in yield with narrow spacing was observed due to higher number of plant per unit area. The same trend was observed by Sen *et al.* (2002) also reported an increase in seed yield of sunflower by increasing the plant population. The higher seed and stover yields were recorded with 30 cm x 20 cm as compared to 45 cm x 20 cm and 60 cm x 20 cm. It might due to better utilization of available resources *viz.*, mineral, nutrients, water, solar radiation etc. These findings were corroborated the results of Nehra and Yadav (2010), Patel *et al.* (2009) and Kumar and Badiyala (2004). Maximum net return of 29990 Rs. ha^{-1} and BCR value of 2.04 were recorded under 30 cm x 20 cm spacing over 45 cm x 20 cm and 60 cm x 20 cm spacings. This was due to higher yields of seed and stover registered under 30 cm x 20 cm spacing treatment. Similar results were also reported by Basak *et al.* (1995) and Gunri *et al.* (2010).

Effect of inorganic fertilizer:

The plant height of sunflower was found non-significant at 30 DAS. but the treatments having 125 per cent RDF recorded significantly the higher plant height (163.30 cm) and (191.38 cm) at 60 DAS and at harvest, respectively (Table 1). This was because of nitrogenous fertilizer induce the growth of the plant through active protein metabolism,

Table 2 : Economics influenced by spacing, inorganic fertilizers and biofertilizer treatments

Treatments	Yield (q/ha)		Gross realization (Rs./ha)	Total cost of cultivation (Rs./ha)	Net realization (Rs./ha)	BCR
	Seed	Stover				
Spacing						
30 cm × 20 cm	14.23	30.76	44568	14668	29990	2.04
45 cm × 20 cm	13.61	29.38	42632	14518	28114	1.94
60 cm × 20 cm	13.21	28.47	41368	14368	27000	1.88
Inorganic fertilizer						
75 % RDF	13.28	28.63	41587	13941	27646	1.98
100 % RDF	13.51	29.14	42303	14292	28011	1.96
125 % RDF	14.26	30.84	44678	14659	30019	2.05
Biofertilizer						
No biofertilizer	13.42	28.83	41998	12868	29139	2.26
Azotobacter	13.95	30.24	43718	12918	30798	2.38

Selling price of Sunflower : Seed – Rs. 27 / kg, Straw – Rs. 2.0 / kg

Table 3 : Interaction effect of spacing and inorganic fertilizer on seeds $head^{-1}$

Spacing	Inorganic fertilizer			
	75 % RDF	100 % RDF	125 % RDF	Mean
30 cm x 20 cm	316.53	331.50	346.47	331.50
45 cm x 20 cm	365.94	386.75	407.56	386.75
60 cm x 20 cm	425.24	453.05	480.87	453.05
Mean	369.23	390.43	411.63	
S.E.±			3.94	
C.D. (P=0.05)			11.33	

Table 4 : Interaction effect of spacing and inorganic fertilizer on 100 seed weight (g)

Spacing	Inorganic fertilizer			
	75 % RDF	100 % RDF	125 % RDF	Mean
30 cm x 20 cm	7.16	5.01	6.69	6.89
45 cm x 20 cm	4.96	5.55	6.32	5.61
60 cm x 20 cm	4.04	6.83	6.17	5.07
Mean	5.39	5.80	6.40	
S.E.±			0.19	
C.D. (P=0.05)			0.53	

Table 5 : Interaction effect of spacing and inorganic fertilizer on seed yield (q ha^{-1})

Spacing	Inorganic fertilizer			
	75 % RDF	100 % RDF	125 % RDF	Mean
30 cm x 20 cm	13.90	13.91	14.87	14.22
45 cm x 20 cm	12.41	14.22	14.21	13.61
60 cm x 20 cm	13.52	12.39	13.71	13.21
Mean	13.28	13.50	14.26	-
S.E.±		0.45		
C.D. (P=0.05)		1.30		

transportation of photosynthates and synthesis of nucleic acid and proteins. Hence, during the vegetative stage, N nutrition of the plant to a large extent controls the growth of the plant. Phosphorus has important role in conversion of solar energy into chemical energy and it has also beneficial effect on root proliferation that increases the absorption of plant nutrient from the soil. This was obivious as phosphorus is closely associated with cell division and development of meristematic activities of the tissue in plant system is bound to increase morphological organs of the plant. These results confirmed the findings of Tahir (1996) and Malik *et al.* (2006). Significantly higher values of the yield and yield attributes *viz.*, head diameter, number of seeds per head, 100 seed weight, seed yield and stover yield were recorded under treatment receiving 125 per cent RDF over 100 per cent RDF and 75 per cent RDF treatment. This was largely attributed to better growth of plant height, and number of root which resulted in adequate supply of photosynthates for development of sink under adequate level of inorganic fertilizers. The significant increase in seed yield due to inorganic sources of nutrient might be due to improvement in reproductive (head diameter, total seed head^{-1}). Positive response in terms of yield attributes to inorganic fertilizers have also been reported by Patel *et al.* (2009) and Murliarthanari *et al.* (2010). The highest net return of 30019 Rs.ha^{-1} with BCR value of 2.05 was obtained under treatment receiving 125 per cent RDF (Table 2). This was due to higher yield with this level ultimately reflected into higher net realization and BCR. Similar results were also reported by Malik *et al.* (2006).

Effect of biofertilizer:

The periodical plant heights were noticed non-significant, might be due to slow rate of fixing atmospheric nitrogen and solubilizing the phosphorus. This is in close conference with Javahery and Rokhzadi (2011).Significantly higher values of the yield and yield attributes *viz.*, number of seeds per head and 100 seed weight were significantly influenced by biofertilizer treatments. While head diameter, seed yield and stover yield were found to be non-significant. As the biofertilizer treated plants are well nourshied. These plants are capable of transporting sufficient quantities of minerals and metabolites to the developing seeds. Hence, the seed weight registered was higher in the *Azotobacter* treatment. Seed inoculation of biofertilizers alone could not influence the head diameter and seed yield of sunflower. Same trend was reported with Santhi *et al.* (2012). The highest net return of 30798 Rs. ha^{-1} with BCR value of 2.38 was obtained under treatment receiving application of biofertilizer (*Azatobacter*). Similar finding was also reported by Patil (2001).

Interaction effect:

The combined effect of spacing and inorganic fertilizer was found significant in yield and yield attributes of sunflower. While other interaction effect was found non-significant. Maximum number of seeds per head and 100 seed weight were recorded under combination of 60 cm x 20 cm spacing and 125% RDF (Table 3 and 4), whereas maximum seed yield was recorded under combination of 30 cm x 20 cm spacing and 125% RDF (Table 5). Similarly findings were observed by Jahangir *et al.* (2006).

REFERENCES

Basak, N.C., Chowdhury, M.K. and Mia, F.U. (1995). Effect of spacing on the yield and economics of groundnut. *Legume Res.*, **18** (1): 45-49.

Gunri, S.K., Biswas, T., Mandal, G.S., Nath, R. and Kundu, C.K. (2010). Effect of spacing on improved cultivars of summer growing groundnut (*Arachis hypogaea* L .) in red and laterite zone of West Bengal. *Karnataka J. Agric. Sci.*, **23**(5): 687-688.

Jahangir, A.A., Mondal, R.K., Katrun Nada, Sadia Afoze and Hakim, M.A. (2006). Response of nitrogen and phosphorus fertilizer and plant spacing on growth and yield contributing character of sunflower. *Bangladesh J. Scientific & Industrial Res.*, **41**(1): 33-40.

Javahery, M. and Rokhzadi, A. (2011). Effect of biofertilizer application on phenology and growth of sunflower cultivars. *J. Basic. Appl. Sci. Res.*, **1**(11): 2336-2338.

Kumar, J. and Badiyala, V. (2004). Studies on the effect of seed rate, row spacing and sowing time on drymatter accumulation and nutrient uptake in soybean [*Glycine max* (L.) Merril]. *J. Oilseeds Res.*, **21**(2): 290-292.

Malik, M.A., Saleem, M.F., Mansur, Sona and Abdul Rahman (2006). Suitable level of N, P and K for harvesting the maximum economic returns of sunflower. *Internat. J. Agric. & Biol.*, **6**: 240-242.

Meelu, O.P. and Singh, Y. (1991). Integrated use of fertilizers and organic manures for higher returns. *Prog. Fing.*, Punjab Agric. Univ., **27** : 3-4.

Murliarthanari, P., Balasubramanian, T.N. and Mohamed, M.A. (2010). Impact of climate and nutrient management on yield components and yield of sunflower. *Green Fmg.*, **3**(1): 8-10.

Nehra, P. L. and Yadav, P. S. (2010). Integrated weed control in cotton. National Conference on Paradigm Shift in cotton Research and Cultivation, October 19-21.

Patel, H.M., Bafna, A.M. and Patel, Z.N. (2009). Response of integrated nutrient management to yield and nutrient uptake of *Rabi* castor. *GAU Res. J.*, **34**(1): 49-54.

Patil, U.M. (2001). Effect of FYM, biofertilizer and nitrogen levels on growth, yield and quality of mustard under south Gujarat condition. M.Sc. (Ag.) Thesis, Navsari Agricultural University, Navsari, GUJARAT (INDIA).

Santhi, J., Santhi, V., Ramya, S. and Balagurumathan, R. (2012). Effect of *Azotobacter* spp. and *Phosphobacteria* spp. bioinoculants on the growth of sunflower. *World J. Agric. Sci.*, **8**(2): 218-222.

Sen, A., Singh, R., Sharma, S.N., Mishra, P.J. and Singh, A.K. (2002). Effect of planting density on yield attributes, yield and nutrient uptake of restorer lines of sunflower, *Helianthus annuus* L. hybrid. *J. Oilseeds Res.*, **19**(1): 46-49.

Singh, H. (1967). Sunflower has a future in India. *Indian Farming*, **17**: 26-28.

Tahir, M.T. (1996). Effect of different levels of nitrogen and phosphorus on growth, yield and quality of spring planted sunflower. M.Sc. Thesis, Department of Agronomy, University of Agriculture, Faisalabad, PAKISTAN.