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Response of nitrogen and phosphorus levels and ratios on seed filling and seed yield of sunflower hybrid

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Abstract: A field experiment was conducted at Main Research Station, University of Agricultural Sciences, Dharwad, India during *kharif* 1999 under rainfed conditions on medium black clay soils, to study the impact of nitrogen and phosphorus levels and ratios on seed filling and seed yield of sunflower hybrid. Experiment was laid out in randomized block design with nine treatments comprising of varied N/P ratios (0.67 to 2.00) alongwith control. The results revealed that total number of seed rows and seeds head^{-1} were unaffected due to treatments except control. However, higher per cent of filled rows (84.5) and lower per cent of unfilled seed rows (15.5) were noticed in the treatment receiving N/P ratio of 1.00 with 2.00:2.00 fertilizer level. Similarly, more per cent of filled seeds (92.8) and less per cent of unfilled seeds (7.2) were also noticed in the same treatment. Thus, due to the higher per cent of filled seed rows and per cent of filled seeds, the treatment consisting of N/P ratio of 1.00 with 2.00:2.00 (120 kg N and 120 kg P_2O_5 ha^{-1}) fertilizer level produced higher seed yield (3554 kg ha^{-1}) as compared all other fertilizer levels and control. Correlation coefficient between per cent of filled rows, per cent of filled seeds and seed yields were also positive and significant.

Key words : Sunflower, Seed filling, Nitrogen, Phosphorus, Yield.

Introduction

Sunflower (*Helianthus annuus* L.) is an important oilseed crop that ranks third next to soybean and groundnut as a source of edible oil in the world. It was introduced in India during early seventies and promises a bright future during the present oil crisis and is distinctly superior over other oilseed crops. Sunflower has been well accepted by the farming community because of its desirable attributes such as early maturity, adaptability to wide range of soil and climatic conditions, photo and thermo insensitiveness, drought tolerance, high water use efficiency and higher oil yield ha^{-1}. Though, sunflower is being grown widely, its productivity in India is very low (397 kg ha^{-1}) as compared to world average (1333 kg ha^{-1}). It is mainly due to the fact that crop is grown under rainfed conditions with poor fertile soils and inadequate plant protection measures. Sunflower is often considered as a soil-depleting crop (El-Syed *et al.* 1984) and it responds very well to applied fertilizers (Tomar *et al.* 1997). Several studies indicated that among macronutrients, nitrogen and phosphorus are likely to be the primary yield limiting nutrients in sunflower (Mallikarjuna *et al.* 2000).

Seed filling is an important parameter in sunflower. At any environment the unfilled seeds will reduce the production potentiality of sunflower. Hittinahalli (1998) reported that application of nitrogen fertilizer to sunflower decreased the number of unfilled seeds head^{-1}. Phosphorus is playing a major role in seed filling in sunflower. Application of phosphorus @120 kg ha^{-1} decreased the unfilled seeds head^{-1} (Megur *et al.* 1993). However, there is very little information available regarding the combined effect of nitrogen and phosphorus fertilizer that too in ratios (N/P ratios) on seed filling of sunflower. Thus, the present

Table 1. Seed rows of sunflower as influenced by nitrogen and phosphorus fertilization

Sl. No.	Treatments: Nutrient ratios N	Nutrient ratios P_2O_5	N/P_2O_5	Quantity of nutrients (kg ha^{-1}) N	Quantity of nutrients (kg ha^{-1}) P_2O_5	Rows Head^{-1} (No.) Filled	Rows Head^{-1} (No.) Unfilled	Rows Head^{-1} (No.) Total	Rows Head^{-1} (%) Filled	Rows Head^{-1} (%) Unfilled
1	0.00	0.00	0.00	0	0	15.0d	8.4c	23.4b	63.8c	36.1a
2	1.00	1.25	0.80	60	75	18.3c	6.2b	25.0a	73.2b	26.8b
3	1.00	1.50	0.67	60	90	20.2b	5.7b	25.9a	77.9b	22.0b
4	1.50	1.25	1.20	90	75	18.5c	6.5b	25.0a	74.0b	26.0b
5	1.50	1.50	1.00	90	90	20.3b	5.6b	25.9a	78.3b	21.6b
6	2.00	1.00	2.00	120	60	18.5c	6.8b	25.3a	73.3b	26.6b
7	2.00	1.25	1.60	120	75	20.7b	5.8b	26.5a	78.1b	21.8b
8	2.00	1.50	1.30	120	90	20.7b	5.7b	26.4a	78.4b	21.5b
9	2.00	2.00	1.00	120	120	22.5a	4.0a	26.5a	84.5a	15.5c
				CD at 5%		1.5	1.5	1.6	5.9	6.0

In a column mean values followed by the same letter do not differ significantly at P=0.05 by DMRT

study was undertaken to know the respon of nitrogen and phosphorus levels ar ratios on seed filling and seed yie of sunflower.

Materials and Methods

A field experiment was carri out during *kharif* 1999 at Main Researc Station, University of Agricultur Sciences, Dharwad. Dharwad is situate at 15°26'N latitude, 75°07'1E longitu and at an altitude of 678 m abov mean sea level. The soil was mediu black clay in texture, medium in organ carbon (0.62%), low in available nitrog (270.61 kg N ha^{-1}), medium in availa phosphorus (40.85 kg P_2O_5 ha^{-1}) a high in available potassium (436 kg K_2O ha^{-1}) with pH of 7.7. Mechani analysis of the soil showed 6.0, 14 25.6 and 54.2 per cent coarse sa fine sand, silt and clay respectivel Sunflower hybrid DSH-1, with a fie duration of 90 days was used in th trial.

The experiment was laid out randomized block design (RBD) wi four replications. The experime consisted of nine treatments (Table with varying N/P* (*P_2O_5 is referr as P) fertilizer ratios (0.67 to 2.0 by keeping potassium with a comm dose of at 60 kg K_2O ha^{-1}. The fungici (metalaxyl + mancozeb 4g kg^{-1} seed pretreated seeds were hand dibbled a spacing of 60 x 30 cm. The fertiliz nitrogen, phosphorus and potassium we applied in the form of urea, di-ammoniu phosphate and muriate of potas respectively. Fifty per cent of nitrog and entire quantity of phosphorus an potassium as per the treatments we applied at the time of sowing. To dressing (in band placement) of nitrog in the form of urea was done at days after sowing (DAS). The plo were kept weed free by integrated we

management practices involving pre-emergence application of metalachlor (30% EC) 1.0 kg ha^{-1} with two inter cultivation (20 and 35 DAS) and one hand weeding (30 DAS). Plant protection measures were given to control the pests.

The heads were harvested and the number of filled, unfilled rows were counted manually by pressing the seeds randomly by hand and looking the colour and size of the seeds from five randomly selected plants in each plot at harvest. Then from the total number of rows, per cent filled and unfilled rows head^{-1} were calculated. Similarly, the number of filled and unfilled seeds were counted after drying based on the seed filling. The total number of seeds and per cent filled and unfilled seeds head^{-1} were calculated. Seed yield from each net plot area was recorded and expressed as kg ha^{-1}. The data were subjected to statistical analysis as described by Gomez and Gomez (1984). The treatment means were compared by using Duncan's Multiple Range Test (DMRT). Data were also used to calculate the correlation coefficient between the per cent filled rows head^{-1}, per cent filled seeds head^{-1} and seed yield of sunflower. Their direct and indirect effects were observed.

Results and Discussion

N and P ratios influenced the seed filling. Irrespective of the treatment except control, total number of seed rows is unaltered due to different nitrogen and phosphorus ratios (Table 1). The treatments involving higher quantity of phosphorus produced higher number of filled rows and lower number of unfilled rows head^{-1}. Th maximum number of filled rows (22.5) and minimum number of unfilled rows (4.0)

Table 2. Seed filling and seed yield of sunflower as influenced by nitrogen and phosphorus fertilization

Sl. No.	Treatments					Seeds head^{-1} (No.)			Seeds head^{-1} (%)		Seed yield (kg ha^{-1})
	Nutrient ratios			Quantity of nutrients (kg ha^{-1})		Filled	Unfilled	Total	Filled	Unfilled	
	N	P_2O_5	N/P_2O_5	N	P_2O_5						
1	0.00	0.00	0.00	0	0	668.5d	331.8a	1000.3b	66.8c	33.2a	1949e
2	1.00	1.25	0.80	60	75	977.3bc	311.3a	1288.6a	75.7ab	24.2b	2800d
3	1.00	1.50	0.67	60	90	1045.0bc	122.3e	1167.3a	89.8abc	10.1ef	2761d
4	1.50	1.25	1.20	90	75	1007.5bc	221.5bc	1229.0a	81.9abc	18.0def	3009cd
5	1.50	1.50	1.00	90	90	1048.0bc	141.5de	1189.5a	87.8ab	12.1def	2875d
6	2.00	1.00	2.00	120	60	942.0c	281.8ab	1223.3a	79.2abc	20.7bc	3188bc
7	2.00	1.25	1.60	120	75	1088.0ab	149.5de	1237.5a	83.9ab	16.0def	3397ab
8	2.00	1.50	1.30	120	90	1076.5ab	141.3de	1217.8a	88.2ab	11.7def	3220bc
9	2.00	2.00	1.00	120	120	1177.3a	91.0e	1268.3a	92.8a	7.1f	3554a
					CD at 5%	104.7	67.1	108.4	14.3	5.6	252

In a column mean values followed by the same letter do not differ significantly at P=0.05 by DMRT

head^{-1} were noticed in the treatment involving N/P ratio of 1.00 with 2.00:2.00 fertilizer level. But the total number of rows head^{-1} did not vary much between the treatments except control. Similarly, the highest per cent of filled rows (84.5) and the lowest per cent of unfilled rows (15.5) head^{-1} were noticed in the same treatment. The treatment control recorded the least per cent of filled (63.8) and the highest per cent of unfilled (36.1) seeds head^{-1}. All the other treatments had shown no difference. Better seed setting and seed filling might be due to the increased metabolic activity. This better metabolic activity might be due to the higher utilization of phosphorus in the presence of nitrogen, which inturn might have resulted in increased filled and decreased unfilled rows head^{-1}.

Total number of seeds did not vary significantly except control due to nitrogen and phosphorus fertilization (Table 2). Number of filled seeds head^{-1} were more in the treatments receiving more quantity of phosphorus in sunflower. The maximum number of filled seeds (1177.3) was obtained in the treatment receiving N/P ratio of 1.00 with the fertilizer level of 2.00:2.00. However, it was on par with N/P ratio of 1.30 (2.00:1.50) and 1.60 (2.00:1.25). Similarly, lower number of unfilled seeds (91.00) was also noticed in the same treatment. But it was at par with N/P ratio of 1.00 (1.50:1.50) and 1.60 (2.00:1.25). Similarly the highest per cent of filled seeds (92.8) and the lowest per cent of unfilled seeds (7.1) head^{-1} were noticed in the same treatment. Megur (1988) also obtained higher per cent filled seeds in the treatment with N/P ratio of 1.00 (2.00:2.00 fertilizer level). So, more number of filled rows head^{-1} with decreased per cent unfilled seeds resulted in increased seed weight plant^{-1} which inturn resulted in increased seed yield of sunflower.

Seed yield of sunflower was increasing from N/P ratio of 0.67 to 2.00 (Table 2). The treatments with N/P ratio of 1.00 and >1.00 produced higher seed yields (3009 to 3554 kg and 2875 to 3397 kg ha^{-1}, respectively). Further, among the N/P ratio of >1.00, the treatment with 2.00:1.25 fertilizer level recorded significantly higher seed yield (3397 kg ha^{-1}) over other ratios. Similarly between the N/P ratio of 1.00 the treatment with 2.00:2.00 fertilizer level recorded higher seed yield (3554 kg ha^{-1}) over fertilizer level of 1.50:1.50. The increased seed yield with N/P ratio of >1.00 fertilizer level was documented by many workers (Sarmah *et al.* 1992; Singh and Singh, 1997; Devidayal and Agarwal, 1998 and Baldev Raj *et al.* 1999).

Direct and indirect effects of seed filling on seed yield of sunflower can be estimated by separating the correlation coefficients (r values) and can be used to understand the exact relationship. In the present study, per cent filled rows head^{-1} and per cent filled seeds head^{-1} were positive and significantly correlated (0.677 and 0.836*, respectively) with seed yield. However there was a negative correlation between per cent unfilled rows head^{-1} (-0.680*) and per cent unfilled seeds head^{-1} (-0.742*) and seed yield was obtained. This gave clear picture about the positive relationship between seed filling and seed yield of sunflower.

Thus, the present study revealed that application of nitrogen and phosphorus at N/P ratio of 1.00 with 2.00:2.00 (120 kg N and 120 kg P_2O_5 ha^{-1}) fertilizer level could be beneficial for better seed filling and higher seed yield of sunflower under rainfed condition in Northern Transitional Zone (Zone 8) of Karnataka.

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