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Short Communication

Stem Diameter and Head Diameter in Relation to Yield of Sunflower as Influenced by Nitrogen and Phosphorus Fertilizers

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Sunflower (*Helianthus annus* L.) is one of the important oil seed crops in India. It was introduced in early seventies in Karnataka, but its productivity is quite low (398 kg ha^{-1}) as compared to all India average (549 kg ha^{-1}) and world average (1233 kg ha^{-1}) (Anonymous, 1999). Cultivation on marginal fertility lands with inadequate plant protection measures is the main cause of its low productivity. Nitrogen and phosphorus are the primary limiting nutrients in sunflower yield and quality parameters (Dhoble, 1998; Mallikarjuna *et al.*, 2000). In sunflower, the over all yield is the sum total of all the different component characters, which are associated with seed yield. These relationships are either positive or negative and, hence, the selection for one component may bring about a simultaneous change in the other in the favorable direction or otherwise. Besides, the agronomists must identify specific characters that are having direct influence on seed yield of sunflower. Hence a study was initiated to know about the relationship of stem diameter and head diameter with seed yield of sunflower.

A field experiment was conducted during kharif 1999 under rainfed conditions at Main Research Station, University of Agricultural Sciences, Dharwad, to study the effect of different nitrogen and phosphorus levels and ratios on stem diameter, head diameter and seed yield of sunflower hybrid (DSH-1). The soil was medium black clay, having organic carbon content of 0.62%, available nitrogen 270.61 kg ha^{-1}, available phosphorus 40.85 kg ha^{-1} and available potassium 436.57 kg ha^{-} with pH 7.7. Total rainfall received during crop growth period (July 17 to October 25, 1999) was 271.9 mm with 22 rainy days. Gross and net plot size was 30.24 m^2 (7.2 x 4.2 m) and 21.60 m^2 (6.0 x 3.6 m), respectively. The experiment was laid out in randomized complete block design (RCBD) with four replications. The experiment consisted of nine treatments, with varying N/P ratios (0.67 to 2.00), along with control (no nitrogen and phosphorus), by keeping potassium level as constant (Table 1). The fungicide (metalaxyl + mancozeb @ 4 g kg^{-1} seed) pre-treated seeds were hand dibbled at a spacing of 60 x 30 cm. Nitrogen, phosphorus and potassium were applied at sowing. Top dressing (in band placement) of nitrogen was done 40 days after sowing (DAS). Plant protection measures were carried out to control the pests. Stem diameter was measured at the center of

the plant using vernier callipers at five different growth stages viz., seedling (25 DAS), button (45 DAS), flowering (65 DAS), seed formation (78 DAS) and maturity (87 DAS). Diameter of the head was recorded in the diagonal direction at maturity. The crop was harvested at maturity. The seeds were air-dried and weighed. The data were subjected to statistical analysis (Gomez and Gomez, 1984). Using Duncan's Multiple Range Test (DMRT) we compared the treatment means. Correlation coefficient was worked out to assess the nature of relation between seed yield and the characters (stem diameter and head diameter).

In the present investigation, seed yield increased due to increasing N/P ratio from 0.67 to 2.00 (Table 1). In general, the treatments receiving N/P ratio of >1.00 and 1.00 with 120 kg N ha^{-1} produced higher seed yield (3188 to 3554 kg ha^{-1}) as compared to N/P ratio of <1.00 and control (2761 to 3009 kg ha^{-1} and 1949 kg ha^{-1}, respectively). Further, the treatments receiving N/P ratio of >1.00 with 2.00: 1.25:1.00 and N/P ratio of 1.00 with 2.00: 2.00:1.00 fertilizer levels recorded higher

Table 1. Stem diameter head diameter and yields of sunflower as influenced by nitrogen and phosphorus

Treatments*			Stem diameter (cm)					Head diameter (cm)	Seed yield (kg ha^{-1})	Stalk yield (kg ha^{-1})
Ratios of nutrients			Seedling stage	Button stage	Flowering stage	Seed formation stage	Maturity stage			
N	P_2O_5	K_2O								
0.00 (0)	0.00 (0)	1.00 (60)	0.7	1.7	1.8	2.0	1.8	13.04	1949	4755
1.00 (60)	1.25 (75)	1.00 (60)	1.0	2.1	2.4	2.4	2.5	16.68	2800	6073
1.00 (60)	1.50 (90)	1.00 (60)	0.67	1.0	2.1	2.5	2.5	16.93	2761	6062
1.50 (90)	1.25 (75)	1.00 (60)	1.0	2.1	2.6	2.5	2.5	18.03	3009	6154
1.50 (90)	1.50 (90)	1.00 (60)	1.1	2.1	2.5	2.5	2.5	18.07	2875	6172
2.00 (120)	1.00 (60)	1.00 (60)	1.2	2.2	2.8	3.1	3.0	20.73	3188	6980
2.00 (120)	1.25 (75)	1.00 (60)	1.2	2.2	2.8	3.1	2.9	20.69	3397	7026
200 (120)	1.50 (90)	1.00 (60)	1.2	2.2	2.8	3.1	3.0	20.76	3220	7046
200 (120)	2.00 (120)	1.00 (60)	1.2	2.2	2.8	3.1	3.0	20.91	3554	6800
CD at 5%			0.2	0.2	0.2	0.2	0.4	1.56	252	582

* Figures in parenthesis are amount of nutrients applied (kg ha^{-1}).

yields (3397 and 3554 kg ha^{-1}, respectively) over other treatments. Singh and Singh (1997) obtained higher yields of sunflower with N/P ratio of >1.00.

Stalk yield of sunflower also differed due to different ratios of nitrogen and phosphorus fertilizers. The treatments involving N/P ratio of 1.00 and >1.00 with higher doses of nitrogen (120 kg ha^{-1}) recorded higher stalk yield (6800 to 7046 kg ha^{-1}) as compared to other ratios (6062 to 6172 kg ha^{-1}) and control (4755 kg ha^{-1}). Hiremath (1984) also reported similar findings.

Higher seed and stalk yields of sunflower obtained with different treatments were mainly due to improvement in yield components. Among the yield components the head diameter had the direct influence on seed yield. Head size (Table 1) was larger (20.69 to 20.91 cm) in the treatments, involving N/P ratio of >1.00 and 1.00 with 120 kg N ha^{-1} as compared to other ratios (16.68 to 18.07 cm) and control (13.04 cm). The highest head diameter (20.91 cm) was noticed in the treatment with 2.00:2.00:1.00 fertilizer ratio. These results were similar to those obtained by Singh and Singh (1977) and Baldev Raj *et al.* (1999). The large heads provide higher head weight $plant^{-1}$, which will ultimately lead to higher production in sunflower.

Increase in head size due to increased N/P ratio from 0.67 to 2.00 may be due to more growth of sunflower. The stem diameter is often correlated directly with head size. The stem diameter increased (Table 1) with the increasing growth up to seed formation stage and thereafter decreased. Stem diameter at seedling stage remained unaltered due to different ratios of nitrogen and phosphorus fertilizers, except control. However, at all the other stages nitrogen and phosphorus fertilization in N/P ratios of >1.00 and 1.00 with higher doses of nitrogen (120 kg ha^{-1}) produced thicker stems as compared to other ratios and control. Higher stem diameter was found in the treatment with 2.00:2.00:1.00 fertilizer level at all the stages. Thicker stem might be due to the higher and balanced dose of nitrogen and phosphorus, which might have enhanced the growth of plant. The beneficial effect of higher dose of nitrogen and phosphorus on stem diameter of sunflower has been observed by Sarmah *et al.* (1992) and Singh and Singh (1977). The higher stem girth will influence the head size, which will have direct influence on head weight $plant^{-1}$ and stalk yield, and in turn increase the seed yield of sunflower.

Correlation coefficient between seed yield and stem diameter at all the stages were positive and significant at all five growth stages (0.860** at seedling, 0.836** at button, 0.890** at flowering, 0.841** at seed formation and 0.853** at maturity stages). Similarly, head diameter (0.965**) also correlated positively and significantly with seed yield of sunflower. This is a clear indication that improvement of stem diameter and head diameter will be needed for better sunflower production.

Thus the experiment revealed that application of nitrogen and phosphorus at N/P ratio of >1.00 and 1.00 with higher level of nitrogen (120 kg ha^{-1}) produced thicker stems, which resulted in large heads and in turn seed yield and stalk yield of

sunflower. Correlation between these characters with seed yield showed positive and significant relationship.

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