

## Response of Nitrogen and Phosphorus Fertilizer and Plant Spacing on Growth and Yield Contributing Character of Sunflower

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### Abstract

The plant spacing of 20, 25 and 30 cm were used for the study. The doses of nitrogen and phosphorus were 80, 100, 120 and 45, 60, 75 kg/hectare respectively. The experiment was carried out in a randomized block design with three replications. 20 cm plant spacing produced the highest plot yield. Maximum number of seeds per head and yield were produced by the application of 120 kg N + 75 kg P<sub>2</sub>O<sub>5</sub> per hectare. In case of plant spacing x fertilizer interaction effect, 20 cm plant spacing with 120 kg N + 75 kg P<sub>2</sub>O<sub>5</sub> per hectare treatment produced the highest head diameter and seed yield.

### Introduction

Sunflower (*Helianthus annus L.*) is relatively proved a good oil seed crop in Bangladesh. It is a potential source of high quality edible oil, ranges second next to soybean as an oil crop in the world (FAO).<sup>1</sup> Due to the increasing edible use of this oil crop, its production has been enhanced rapidly all over the world. Sunflower's seed contains 48 % - 52 % of good quality edible oil and 40 % - 50 % of protein in meals. The oil cake from sunflower is also useful for cow and fish feeding. At present, sunflower is grown in many district of Bangladesh without proper care. The average production of sunflower per unit area in our country is comparatively poor.<sup>2</sup> The total cultivation area of this particular oil crop is limited. The progress in sunflower production is slow due to the lack of proper

production technologies and management practices. Among the several agro-techniques which can enhance the production of yield are the use of proper land preparation, irrigation, fertilizer application, proper plant spacing and other related factors are important. Robinson *et al.*, Reddy *et al.* and Villalobos *et al.* assessed that better seed yield of sunflower was greatly influenced by proper plant spacing.<sup>3-5</sup> According to Kharga *et al.*, Sharma *et al.* and Vivck *et al.*, nitrogen fertilizer has a positive effect on sunflower yield.<sup>6-8</sup> Several authors observed that the application of nitrogen fertilizer in conjunction with phosphorus fertilizer resulted in increased seed yield of sunflower.<sup>9-11</sup> (Chariara *et al.*, Singh *et al.* and Ujjinaiah *et al.*). The information regarding the effect of

plant spacing and nitrogen-phosphorus fertilizer on sunflower is meagre in our local climate condition. So, an attempt has been made to study the effect of plant spacing and nitrogen-phosphorus fertilizer for getting maximum yield of sunflower.

### Materials and Methods

The investigation was made in the experimental field of BCSIR (Bangladesh Council of Scientific and Industrial Research) Dhaka, during the winter season of 2002-2003. The soil of the experimental field was sandy clay loam having pH 5.8, 1.5 % organic matter and 0.04 % total nitrogen. The pH of moist soil was determined by using a corning glass electrode pH meter (model-7).<sup>12</sup> Organic matter content was calculated by multiplying the rules of organic carbon with conventional factor 1.74.<sup>13</sup> The total nitrogen were determine Microkjeldahl method as described by Jakson.<sup>12</sup> The unit plot size was 3m x 3m. The variety used for the study was Kironi. The experiment was carried out in a randomized block design with three replications.

The row spacing was 30 m. The plant spacing of 20, 25 and 30 cm were used for study.

The nitrogen fertilizer doses under study were 80 kg N/ha ( $N_1$ ), 100 kg N/ha ( $N_2$ ), 120 kg N/ha ( $N_3$ ) and that of phosphorus 45 kg  $P_2O_5$ /ha ( $P_1$ ), 60 kg  $P_2O_5$ /ha ( $P_2$ ), 75 kg  $P_2O_5$ /ha ( $P_3$ ). The sources of nitrogen and phosphorus were urea and triple super phosphate respectively. At the time of land preparation, nitrogen and phosphorus were applied in the soil and nitrogen was applied to the field in two equal installments. All the inter-cultural operation were done in proper time. At the harvest time, 10 plants were selected at random from each plot to collect data on plant height and different yield contributing characters. Yield was recorded from the plot. The collected data was statistically analyzed and mean values were adjudged by Duncan's New Multiple Range Test (Steel and Torrie).<sup>14</sup>

### Results and Discussion

The data on the effect plant spacing and nitrogen - phosphorus fertilizer and their interaction have been presented in the Table I, II and III, respectively.

**Table I. Effect of plant spacing on the yield contributing character of sunflower.**

Plant spacing (cm)	Plant height (cm)	Head diameter (cm)	Number of seed per head	100 seed weight (g)	Seed yield (t / ha)
20	50.1c*	13.4 a	303.4 a	5.31 a	1.96 a
25	57.8 b	12.5 ab	290.3 b	5.34 a	1.68 b
30	60.8 a	12.0 b	289.4 b	5.33 a	1.56 b

\* Means with the same letter are not different from one another at 5 % level of significance.

**Table II. Effect of nitrogen–phosphorus fertilizer on the yield contributing charcter of sunflower.**

Nitrogen- Phos- phorus fertilizer	Plant height (cm)	Head diameter (cm)	Number of seed per head	100 seed weight (g)	Seed yield (t / ha)
Control	49.6 e*	9.7 a	261.3 e	5.01 c	1.78 b
N <sub>1</sub> P <sub>1</sub>	51.2 d	10.2 a	280.3 cd	5.39 abc	1.80 b
N <sub>1</sub> P <sub>2</sub>	53.3 cd	10.3 a	271.6 de	5.38 abc	1.81 ab
N <sub>1</sub> P <sub>3</sub>	58.5 ab	10.1 a	273.2 de	5.39 abc	1.82 ab
N <sub>2</sub> P <sub>1</sub>	59.0 ab	12.4 ab	280.4 cd	5.60 ab	1.83 ab
N <sub>2</sub> P <sub>2</sub>	58.2 ab	11.4 b	285.8 c	5.36 abc	1.97 ab
N <sub>2</sub> P <sub>3</sub>	59.0 ab	12.4 ab	313.2 b	5.60 ab	1.86 ab
N <sub>3</sub> P <sub>1</sub>	59.1 ab	12.7 a	314.8 b	5.61 ab	1.97 ab
N <sub>3</sub> P <sub>2</sub>	62.1 a	13.3 a	337.5 a	5.73 a	2.01 ab
N <sub>3</sub> P <sub>3</sub>	61.7 ab	13.2 a	339.8 a	5.73 a	2.08 a

\* Means with the same letter are not different from one another at 5 % level of significance.

### Plant Spacing Effect

The plant height of sunflower increased progressively with the increase of plant spacing. The widest plant spacing produced the highest plant height (60.8 cm) among other spacing. It was significantly different from other treatments. The results were in agreement with the result of Bindra and Kharwara who found increased plant height with increase of spacing.<sup>15</sup> They observed the same spacing of 30 cm in the case of plant height of sunflower. The lowest highest (50.1 cm) plant was obtained from 20 cm plant spacing treatment. The plant grown with closer spacing produced maximum head diameter and the highest number of seeds than of those other spacing. The variation in plant spacing caused a significant difference in sunflower seed yield. The highest seed

yield of 1.96 t/ha was recorded from 20 cm plant spacing. The highest and lowest yield were 1.96 t/ha and 1.65 t/ha respectively. The positive effect of closer plant spacing on seed yield as obtained in the present study agreed well to the findings of Islam *et al.* and Zaffaroni *et al.* where they found highest yield at closer plant spacing.<sup>16-17</sup> Rao *et al.* also reported the reduction in sunflower yield under higher plant density.<sup>18</sup> The other two plant spacing treatment produced near about the same seed yield without any significant change.

### Nitrogen - Phosphorous Fertilizer Effect

In fertilizer treatment the maximum plant height (62.1 cm.) was obtained by N<sub>3</sub>P<sub>2</sub>. The second highest plant height was resulted from N<sub>3</sub>P<sub>3</sub> treatment. This was closely

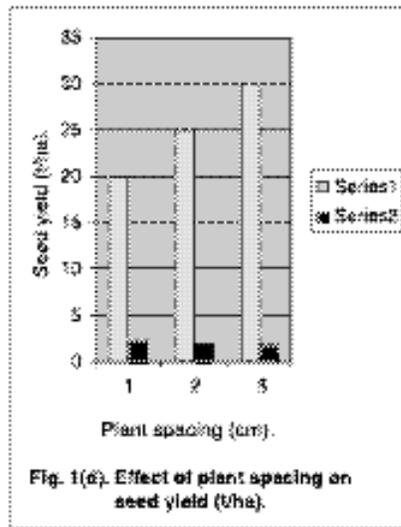
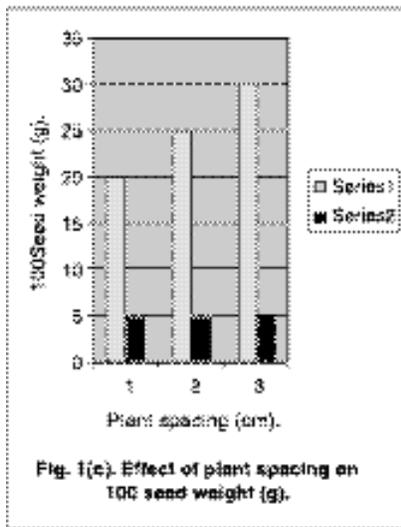
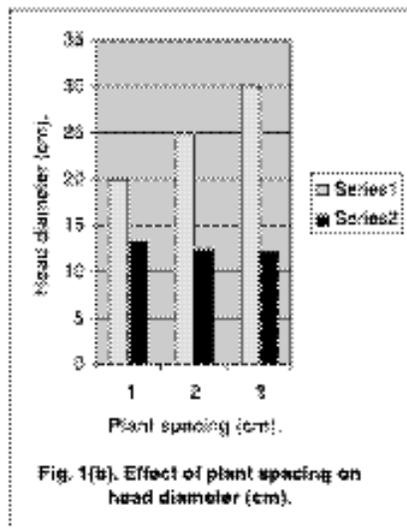
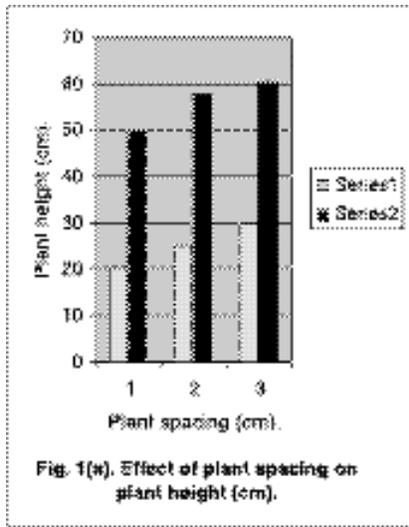
**Table III. Interaction effect of plant spacing and fertilizer on the yield of sunflower.**

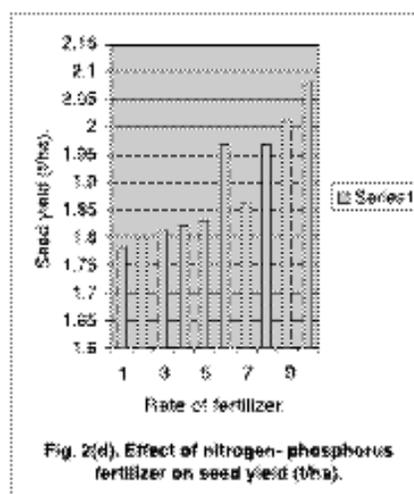
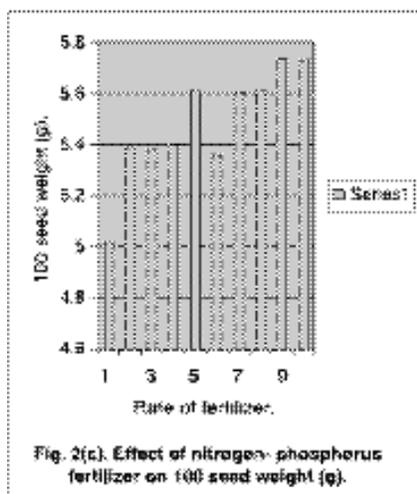
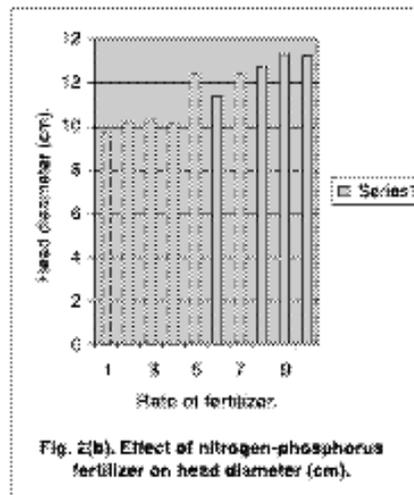
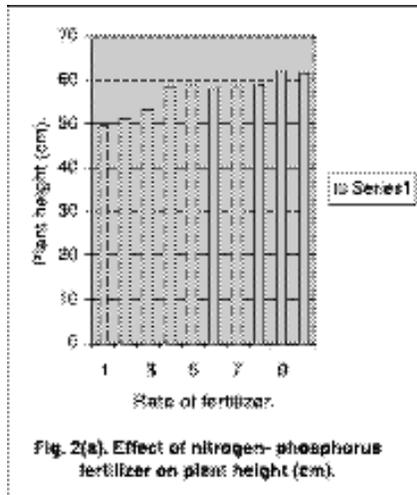
Plant spacing x N-P fertilizer treatment		Plant height (cm)	Head diameter (cm)	Number of seeds per head	100 seed weight (g)	Seed yield (t/ha)
20 cm	Control	53.3 c*	11.8 c	265.2 e	4.99 f	1.91 c
	N <sub>1</sub> P <sub>1</sub>	54.5 bc	13.4 ab	329.1 ab	5.58 b	2.16 bc
	N <sub>1</sub> P <sub>2</sub>	54.5 bc	13.5 b	339.1 a	5.78 b	2.16 bc
	N <sub>1</sub> P <sub>3</sub>	54.3 bc	13.5 b	328.1 ab	5.67 b	2.38 ab
	N <sub>2</sub> P <sub>1</sub>	54.4 bc	14.2 ab	317.7 b	5.67 b	2.32 ab
	N <sub>2</sub> P <sub>2</sub>	60.7 abc	13.7 ab	329.6 ab	5.68 b	2.40 ab
	N <sub>2</sub> P <sub>3</sub>	59.9 abc	14.3 ab	317.8 b	5.74 ab	2.30 ab
	N <sub>3</sub> P <sub>1</sub>	60.2 abc	14.4 a	340.1 a	5.66 b	2.41 ab
	N <sub>3</sub> P <sub>2</sub>	62.1 ab	14.4 a	340.9 a	5.67 b	2.50 a
	N <sub>3</sub> P <sub>3</sub>	59.9 abc	14.5 a	329.4 ab	5.63 b	2.55 a
25 cm	N <sub>1</sub> P <sub>1</sub>	60.1 abc	13.4 b	318.2 b	5.58 b	2.32 ab
	N <sub>1</sub> P <sub>2</sub>	59.8 abc	13.5 b	318.1 b	5.57 b	2.30 ab
	N <sub>1</sub> P <sub>3</sub>	54.4 bc	13.7 ab	317.9 b	5.63 b	2.17 bc
	N <sub>2</sub> P <sub>1</sub>	59.9 abc	13.7 ab	328.0 ab	5.69 b	2.16 bc
	N <sub>2</sub> P <sub>2</sub>	62.0 ab	13.5 b	329.5 ab	5.67 b	2.39 ab
	N <sub>2</sub> P <sub>3</sub>	61.9 ab	13.8 ab	317.5 b	5.68 b	2.18 ab
	N <sub>3</sub> P <sub>1</sub>	62.0 ab	13.7 ab	317.6 b	5.78 a	2.32 ab
	N <sub>3</sub> P <sub>2</sub>	62.1 ab	14.2 ab	314.8 b	5.80 a	2.32 ab
	N <sub>3</sub> P <sub>3</sub>	62.2 ab	14.2 ab	317.3 b	5.59 b	2.37 ab
30 cm	N <sub>1</sub> P <sub>1</sub>	61.9 ab	11.8 c	281.1 cd	5.22 de	1.95 c
	N <sub>1</sub> P <sub>2</sub>	62.2 ab	11.9 c	279.9 cd	5.07 ef	1.97 c
	N <sub>1</sub> P <sub>3</sub>	60.1 abc	12.2 bc	279.9 cd	5.59 b	2.19 bc
	N <sub>2</sub> P <sub>1</sub>	63.5 a	12.1 bc	277.4 cd	5.58 b	2.18 bc
	N <sub>2</sub> P <sub>2</sub>	62.1 ab	13.3 b	271.7 de	5.67 b	2.15 bc
	N <sub>2</sub> P <sub>3</sub>	59.9 abc	13.4 b	28.2 c	5.58 b	2.17 bc
	N <sub>3</sub> P <sub>1</sub>	60.4 abc	13.3 b	287.1 c	5.39 cd	2.17 bc
	N <sub>3</sub> P <sub>2</sub>	60.5 abc	13.7 ab	288.4 c	5.38 cd	2.15 bc
	N <sub>3</sub> P <sub>3</sub>	60.0 abc	13.5 b	285.2 c	5.59 b	2.16 bc

\* Means with the same letter are not different from one another at 5 % level of significance.

followed by  $N_3P_1$ . The minimum plant height was obtained from control treatment. The value was significantly lower than other treatments. The maximum head diameter was obtained from the plot receiving fertilizer at  $N_3P_2$  treatment. The maximum number of seeds (339.8) per head was found with the application of N - P fertilizer at the rate of

$N_{120}P_{75}$  kg/ha. The results were in close conformity with those of Nayak *et al.* who observed that the number of seeds per head in sunflower was increased progressively due to higher doses of nitrogen-phosphorus fertilizer application.<sup>19</sup> 100 seed weight of sunflower was found to vary from 5.01 - 5.73 g. The plot which received fertilizer at the rate 120





kg N + 75 kg P<sub>2</sub>O<sub>5</sub> per hectare produced the highest seed yield of 2.08 t/ha. The results are in close agreement with the findings of Tomar *et al.* but disagreed with Tripathi *et al.* who found maximum seed yield of sunflower with lower dose of nitrogen (40 kg/ha) with conjugation of phosphorus.<sup>20-21</sup>

#### Interaction Effect

In the interaction effect of the fertilizer and plant spacing, the highest plant was produced

from the plot which was fertilized at the rate of N<sub>2</sub>P<sub>2</sub> per hectare with plant spacing of 30 cm. The second highest plant height was obtained from N<sub>2</sub>P<sub>2</sub> and N<sub>3</sub>P<sub>3</sub> treatments space at 30 and 25 cm plant spacing respectively. The value of head diameter per plant ranged from 11.8-14.5 cm. The highest number of head diameter produced from N<sub>3</sub>P<sub>3</sub> treatment with plant spacing of 20 cm. The variation in the number of seeds varied

from 340.9 - 265.2. Maximum number of seed (340.9) per head was obtained in combination with  $N_3P_2$  treatment with 20 cm plant spacing. The findings were in close conformity with the result of Kene *et al.* who obtained the maximum number of seeds higher rate of N-P application with closer plant spacing.<sup>22</sup> The next number of seeds per head of the sunflower plant was obtained by  $N_3P_1$  and  $N_1P_3$  treatment with mean number of 340.1 and 339.1, respectively with same plant spacing. The maximum plot yield of seed was produced from the plot receiving fertilizer at the rate of 120 kg N + 75 kg  $P_2O_5$  per hectare. The superiority of closer plant spacing with increasing nitrogen-phosphorus application in sunflower yield has been reported by Hedge *et al.* and Sharma *et al.*<sup>23-24</sup> The next higher seed yield was obtained from  $N_3P_2$  treatment.

### Conclusion

The findings of the study indicate that the plant spacing and nitrogen-phosphorus fertilizer application treatment improved the yield contributing character efficiency of sunflower leading to higher seed yield. So, the further research is needed in this direction with other varieties of sunflower to establish the present findings.

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