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Response of nitrogen on growth and yield parameters of sunflower hybrids (*Helianthus annus* L.)

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Abstract

One year field study was conducted to determine the effect of different application rates of nitrogen fertilizer on growth, development, yield and its components of sunflower hybrids. A research study was conducted at Research Area of Agronomy Farm, University College of Agriculture, University of Sargodha, Punjab, Pakistan in spring season 2013. The results are indicated that increasing the levels of nitrogen are positive effect on crop growth rate and net assimilation rate, the highest net assimilation rate was observed in Sunflower-33 as compared to S-78. and statistically significant results were observed for plant height (cm), 1000- achene weight (g) and harvest index (%). The results showed that highest harvest index S-78 and lowest showed that Hysun-33.

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Introduction

Sunflower (*Helianthus annuus* L.) crop is belongs to family compositae and used as an ornamental plant but recently it has achieved the value of essential oil seed crop. According to oil point of view the oil of different vegetable play beneficial role in budget of country. In Pakistan the production of sunflower seed is very low as compared to other crops therefore our demand is high as compared to our production. Thus our demand is high when compare with production then need to import edible oil in large quantities involving huge expenditure in foreign exchange. In world Pakistan is third importer of vegetable oil cannot afford such a huge amount indeed. At present conditions the Pakistan is producing 30% of vegetable oil of its necessities and left over 70% fulfilled by imports. Amongst oilseed sunflower crop never be neglected as its adapts to environmental conditions of Pakistan and rich in nutrition. Locally the edible oil production stood at 7, 78000 instead of 20, 68000 (GOP, 2103). Sunflower is drought tolerant crop grown in spring and autumn season in semi-arid conditions, needed 90 to 120 days to mature. It contain vitamins such are A, D, E and K but its seed oil contain ranging from 40 to 47 percent. Sunflower cake ranging of protein 20-40 percent (Gandhi *et al.*, 2008).

In Pakistan sowing of local sunflower hybrids are not produced a good yield when compare with importer hybrids, therefore suggest to famer to cultivate an exotic sunflower hybrids but they are not produced a good production of yield because these are not well adapted to the agro climatic conditions. Therefore, need a such kind of hybrids who have ability to early maturation potential, high oil contents and high seed yielding potential under summer temperature and drought conditions became (Bakhat *et al.*, 2006). The sunflower is considered potential source of high edible quality in the world after soybean crop, In Pakistan total cultivation area is limited and also production is low due to lack of farmer knowledge about improper management practices and production technologies (Jahangir *et al.*, 2006). The cultivation of sunflower is low in Pakistan as result of poor cultivation practices as well as planting and nurturing techniques (Suzer, 2010).

In Pakistan farmer cultivate exotic hybrids because the newly local developed hybrids have not produced high yield due to lack of seed sector. Sunflower is consider important oil seed crop in many countries but in Pakistan major growing areas are under staple food crops.

In Pakistan farmer have no good knowledge of crop from sowing to harvesting, the not only one factor of yield is low due to hybrids but also other big problems such as nutrient management in our country as compared to other countries. The all nutrients have important for high yield but nitrogen is more essential for increasing growth, development and achene yield of sunflower Nitrogen play imperative role in maximization of crop yield (Massignam *et al.*, 2009) and improved the yield and as well as improve the quality of all crops (Ullaha *et al.*, 2010; drecer *et al.*, 2000) Additionally, increasing the level of nitrogen fertilizer have positive effect on photosynthesis, leaf area, crop growth rate and net assimilation rate. The development of individual leaf area and it total leaf area of crop plant and ultimately enhance the harvest index and grain yield (Cheema *et al.*, 2001). The increasing the rates of nitrogen application have increases the growth and development. The total amount of dry matter production by sunflower was potential to intercepted photo synthetically active radiation, noted that by utilization of 1MJ of PAR produced to 3.5g of above ground matter was produced in sunflower (Kiniry *et al.*, 1989).

Previously different studies were conducted to check the effect of nitrogen on sunflower growth and yield some of which results manifest that nitrogen effect is positively correlated with growth of sunflower, while few studies were inversely correlated. However present study showed the best results in terms of nitrogen effects of sunflower growth and proposed to be an appropriate and effective method to enhance the growth and yield, maintained the quality.

Materials and methods

Description of experimental area

The research study was carried out in the Agronomic Research Area, university College of Agriculture University of Sargodha (32°05"N, 72°67"E), during the spring season 2013. The characteristic of soil are given in Table 1.

Treatment and experimental design

The arrangement of experimental design RCBD under spilt plot with 3 replications. The plot area of research was 4.2m × 6m with row to row spacing 70cm and plant to plant distance 20cm. The hybrids was keep in main plots factor and sub plot factor of nitrogen levels

(0, 45, 90,135 and 180kg/ha). The crop was sown by dibbler method using seed rate 5kg/ha.

The fertilizer arrangement of phosphorus and potash were applied at the rate of 80-40 kg/ ha in all plots. The fertilizer arrangement of nitrogen, phosphorus and potash were used in the form of urea, DAP and Potassium (k₂So₄), the nitrogen was used with 3 splits, one split of nitrogen and whole recommended phosphorus and potash was applied at the time of sowing. Remaining 2 dose of nitrogen was applied at the time of first irrigation and flowering stage.

All other cultural practices of insect, diseases and weed control was same in whole experiment.

Table 1. Physico- chemical soil analysis of crop area.

Characteristic	Soil sample depth			
	10 cm	15 cm	20 cm	Mean
Soil pH	7.9	7.9	8.0	7.33
Organic Matter(%)	1.32	1.32	1.04	1.22
Total Nitrogen (%)	0.066	0.066	0.052	0.061
Available P (mg kg ⁻¹)	4.6	7.5	10.2	7.43
Available K (mg kg ⁻¹)	188	164	144	165.33
Texture	Sandy loam	Sandy loam	Sandy loam	

Statistical analysis

The data was collected of growth and yield components analyzed statistically by employing the Fisher’s analysis of variance technique and significant of treatments means was tested using least significant difference variance technique and significant of treatment means was tested using least significance difference (LSD) test at 5% probability level (Stell *et al.*, 1999) calculating Root Mean Square error Value (RMSE) i.e. Residual variation among observed and stimulated data tested accuracy of model.

Results and discussion

Growth parameters

Net assimilation rate (g m⁻² d⁻¹)

Net assimilation rate is a value that relates plant productivity to plant size. It is obtained by dividing rate of increase in dry weight by leaf size. Data in Table 2 illustrates that statistically significant differences were observed between sunflower hybrids regarding net assimilation rate.

The hybrid H₂ (S-78) showed maximum assimilation rate (4.21) as well as lowest (3.35) was recorded in Hysun-33. As regards of nitrogen, maximum net assimilation rate (4.60) was achieved at application level of 135 kg N ha⁻¹ statistically at par with treatments of N₁ (control), N₂ (45kg ha⁻¹) showed value 3.98 and 3.98, respectively.

Minimum net assimilation rate (2.06) was found at applying nitrogen rate of 180 kg ha⁻¹. These results are line par with of (Jahangir *et al.*, 2006; Abelado *et al.*, 2002; Miralles *et al.*, 1997). They stated that response of nitrogen fertilizer was positive on net assimilation rate of oil seed sunflower crop.

The Data reported in Table (3) indicate that statistically significant interaction was noted in hybrids Hysun-33 and S-78 with different treatments of nitrogen fertilizer. Maximum net assimilation rate (3.63) was attained in hybrid S-78 with nitrogen application rate of 180kg ha⁻¹, followed by Hysun-33 at same level of treatment.

Crop growth rate (g m⁻² d⁻¹)

Crop growth rate is important parameter which shows that how crop is efficiently utilizing the input resources and produce assimilates which are used by plant for production of economic yield. The data (Table 2) showed statistically significant results were observed between two sunflower hybrids. Maximum crop growth rate (9.76g m⁻² d⁻¹) was noted in hybrid S-78 and lowest crop growth rate (8.20g m⁻² d⁻¹) was noted in hybrid Hysun-33.

The results are line with (Bakaht *et al.*, 2010; Nasim *et al.*, 2011). who observed significant difference between two sunflower hybrids. The various nitrogen rates were effected on crop growth rate. Treatment N₄ (145kg ha⁻¹) produces maximum crop growth rate value (11.72g m⁻² d⁻¹), followed by application of nitrogen fertilizer rate 180 kg ha⁻¹ (4.64g m⁻² d⁻¹).

The crop growth rate (8.08g m⁻² d⁻¹) was recorded untreated plot statistically at par with treatment at nitrogen application level of 45kg N ha⁻¹ achieved value (8.97g m⁻² d⁻¹). These results are in line with the earlier scientist, (Bakaht *et al.*, 2010; Nasim *et al.*, 2011) Who concluded that effect of nitrogen was positive on sunflower crop.

The interaction between hybrids Hysun-33 and S-78 with different nitrogen application affecting the crop growth rate was significant. The data in table 3 showed that highest crop growth rate 13.40g m⁻² d⁻¹ noted in hybrid S-78 at nitrogen application level 135kg ha⁻¹ which was statistically at par with Hysun-33 at treated level of 90kg N ha⁻¹ (12.99g m⁻² d⁻¹).

Table 2. Effect of hybrids and nitrogen levels on net assimilation rate and crop growth rate.

Treatments	net assimilation rate	crop growth rate
Hybrids		
H ₁ = Hysun-33	3.35 b	8.20
H ₂ = S-78	4.21 a	9.76
Tukey HSD 0.16 0.26		
Nitrogen Levels		
N ₁ = 0 kg ha ⁻¹	3.98 ab	8.08 ab
N ₂ = 45 kg ha ⁻¹	3.98 ab	8.97 ab
N ₃ = 90 kg ha ⁻¹	4.60 a	11.48 a
N ₄ = 135 kg ha ⁻¹	4.26 a	11.72 a
N ₅ = 180 kg ha ⁻¹	2.06 b	4.64 b
Tukey HSD 2.05 6.56		
Interaction * *		

Mean having different letters differ significantly from each other by Tukey HSD (P=0.05).

*= Significant

Table 3. Interaction between hybrids and nitrogen levels affecting the net assimilation rate.

Treatments	Net assimilation rate	Crop growth rate
H ₁ N ₁	3.98 a	8.40 ab
H ₁ N ₂	3.97 a	9.37 ab
H ₁ N ₃	4.86 a	12.99 a
H ₁ N ₄	3.41 ab	10.04 ab
H ₁ N ₅	.51 b	0.18 b
H ₂ N ₁	3.98 a	7.75 ab
H ₂ N ₂	4.00 a	8.57 ab
H ₂ N ₃	4.34 a	9.96 ab
H ₂ N ₄	5.10 a	13.40 a
H ₂ N ₅	3.63 a	9.10 ab
Tukey HSD 3.10 11.03		

Mean having different letters differ significantly from each other by Tukey HSD (P=0.05)

Yield Components

Plant height at maturity (cm)

The height of plant is considered and yield contributing parameter. The Data in Table 4 demonstrated that the more plant height was noted for Hysun-33(171.07cm) as compared to S-78 hybrid (136.60cm) result are supported by [16]. The response of different nitrogen treatments on sunflower was also statistically significant. Treatment N₅ (180 kg N ha⁻¹) produced taller plants (177.5cm) as compared with other levels, N₁ (0kg ha⁻¹), N₂ (45kg ha⁻¹), N₃ (90kg ha⁻¹) and N₄ (135kg ha⁻¹). These results are similar with the findings of (Solemani *et al.*, 2012), who concluded that with the increase rates, the height of plants increases. The nonsignificant interaction was observed between hybrids and nitrogen levels for plant height.

1000-achenes weight (g)

The results are display in Table (4). A non-significant difference was noted between hybrids for 1000-achenes weight. The maximum 1000-achenes weight 51 g and 46g was noted in Hybrid S-78 and Hysun-33 respectively. Application of different rates of nitrogenous fertilizer on sunflower crop, results are found that the maximum 1000-achenes weight (56g) was observed I treatment. (180 kg N ha⁻¹) which was statistically at par with those plots (54g) were fertilized with treatment of nitrogen 135kg N ha⁻¹. These results are supported by the findings of researchers (Solemani *et al.*, 2012) interaction between sunflower cultivars and nitrogen was non-significant for 1000-achenes weight.

Harvest index (%)

The harvest index is an essential parameter indicating photosynthetic efficiency of crop and transformation of photosynthetic into its economic yield. The results are presented in table (4). indicate that hybrid S-78 gave the highest as well as Hysun-33 have lowest harvest index 43.57 and 35.77% respectively, which was statistically differ from each other. The application of different nitrogen levels are, 0, 45, 90, 135 and 180kg N ha⁻¹ attained harvest index 40.41%, 40.42%, 40.45%, 38.69% and 38.11% respectively, which are statistically similar with each other (Zhelijazkov *et al.*, 200; Gholinezhad *et al.*, 2009). The results (Table 5) concluded that the hybrid S-78 at 45kg N ha⁻¹ attained the maximum value of harvest index was noticed (44%) which is statistically at par with the nitrogen rate of 90kg ha⁻¹ (44%), as well as the lowest value was recorded in hysun-33 at 180kg N ha⁻¹(34%). This is enlightened by several investigations undertaken on harvest index was notable being (Nasim *et al.*, 2011; Connor *et al.*, 1993; English *et al.*, 1979).

Table 4. Effect of hybrids and nitrogen levels on plant height, 1000- achene weight and Harvest index.

Treatments	Plant height	1000. Achene weight	Harvest index
Hybrids			
H1 = Hysun-33	171.07 a	46.0 a	35.77 b
H2 = S-78	136.60 b	51.85 a	43.57 a
Tukey HSD 23.88 8.76 2.57			
Nitrogen Levels			
N ₁ = 0 kg ha ⁻¹	131.00 e	40.16 c	40.41 a
N ₂ = 45 kg ha ⁻¹	141.17 d	45.00 b	40.42 a
N ₃ = 90 kg ha ⁻¹	152.50 c	38.33 b	40.45 a
N ₄ = 135 kg ha ⁻¹	167.00 b	54.50 a	38.96 a
N ₅ = 180 kg ha ⁻¹	177.50 a	56.66 a	38.11 a
Tukey HSD 8.09 3.92 4.24			
Interaction NS NS **			

Mean having different letters differ significantly from each other by Tukey HSD (P=0.05).

Table 5. Interaction between hybrids and nitrogen levels affecting the harvest index (%).

Treatments	Harvest index (%)
H ₁ N ₁	37.70 abc
H ₁ N ₂	36.09 abc
H ₁ N ₃	36.09 abc
H ₁ N ₄	34.96 bc
H ₁ N ₅	34.02 c
H ₂ N ₁	43.12 ab
H ₂ N ₂	44.75 a
H ₂ N ₃	44.82 a
H ₂ N ₄	42.97 ab
H ₂ N ₅	42.20 abc
Tukey HSD 10.20	

Mean having different letters differ significantly from each other by Tukey HSD (P=0.05).

Conclusion

The comparison of the different sunflower hybrids with varying nitrogen levels was evaluated for sunflower crop and it was concluded that nitrogen level 45kg N ha⁻¹ with hybrid S-78 was recorded higher value of harvest index as well as Hysun-33 at 180kg N ha⁻¹ lowest value was recorded.

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