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Effect of Nitrogen and Phosphorus Fertilizer Rates on Growth, Yield and Yield Components of Sun Flower Varieties

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Abstract
The experiment was carried out for two successive years (2017 and 2018) at to evaluate the effect of different levels of phosphorus and nitrogen fertilizer application on yield and yield components of sunflower. One released variety Oissa and two pipe lines Adadi- 1 and NK ferti; five fertilizer rates (F1= No fertilizer, F2= 11.5 kg N/ha & 11.5 P2O5 kg/ha, F3= 23 kg N/ha & 23 kg P_2O_5 /ha), F4= 34.5 kg N/ha & 34.5 kg P_2O_5/ha and F5= 46 kg N/ha & 46 kg P_2O_5/ha) were arranged in RCBD with factorial combination and three replication. The main effect of fertilizer rate significantly affected all yield and yield related traits except seed oil content at both locations. Oissa have almost the same seed yield response both sites with an average seed yield of 1653kg/ha and 1641 kg/ha respectively. The partial analysis result showed out of the five tasted fertilizer rates application of 34.5 kg N/ha and 34.5 kg P_2O_5/ha becomes profitable than others and can be recommended for sun flower production. This preferable fertilizer rate record high net benefit for all varieties but it needs a variety preference for locations. Using the same fertilizer rate, Adadi 1 and 'Nk fert' varieties gave high seed yield at Adadi than Holetta sites.
Keywords: sunflower, variety, fertilizer rate, seed yield, seed oil
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INTRODUCTION

Sunflower (Helianthus annuus L.) is a member of the family composite. Sunflower is an important oilseed crop which ranks third after soybean and peanut along with other oil seed crops like (canola, and cotton) which contributes considerably to edible oil in the world (Thavaprakash *et al*., 2002). Evidences suggested that sunflower was introduced to the North Horn of Africa including Ethiopia by the Italians some 160 years ago. Although the crop is not widely grown in Ethiopia, the country has immense potential for sunflower production. The current demand of sunflower for edible oil both locally and abroad raises the growing interest of private farmers to produce the crop. In oil seed crops, quality criteria are fatty acid composition of the seed oil and the intended use of the oil. Polyunsaturated cooking oils have been the driving force for the sunflower industry. The oleic acid (a monounsaturated fatty acid) content of oil seeds has important implications for product preference and consumer health. High oleic varieties have provided the opportunity for repositioning sunflower products at the premium end of the growing monounsaturated market. Sunflower oil is gaining popularity in European and East Asian countries for salad and cooking oil and margarine production, which are based on oil composition and the absence of cholesterol. Ryland (2003) compared different vegetable oils and found that sunflower oil to be the healthiest due to its high oleic acid content. Sunflower can improve edible oil production due to its high oil contents and wide adaptability to soils and climatic conditions. Abbadi and Gerendas (2009) noted that optimal supply of N fertilizer in sunflower result in grain yield more efficiently than low supply of Nitrogen. Regina (2008) concluded that Nitrogen is the most important element to increase grain protein content. Increasing Nitrogen rates reduced seed oil percentages but increased seed yields and consequently increased oil yield per unit area (Zheljazkov *et al*., 2009). The importance of supplemental Phosphorus fertilizer in enhancing sunflower yield has been well documented (Muralidharudu *et al*., 2003). Because further increases in yield (flower diameter) diminish with further increases in the amount of fertilizer Phosphorus beyond 60kg/ha, the efficiency of nutrient utilization declines as yield increases (Muralidharudu *et al*., 2003). Therefore, the aim of this study was to evaluate the effect of different levels of phosphorus and nitrogen fertilizer application on yield and yield components of sunflower in order to achieve the optimum use of resources.

MATERIALS AND METHODS

The experiment was conducted for two years (2017 - 2018 in main cropping seasons) at Holeta main research station and Adadi sub center. Holeta is located between 09° 03 ′ N latitude and 38° 3 0 ′ E longitude, 29 km west of Addis Ababa, at an altitude of about 2400 m above sea level. The long- term average annual rainfall is 1144 mm, about 85% of which is received from June to September with the remainder from January to May. The average minimum and maximum air temperatures are 6.2°C and 22.1°C respectively. Adadi site is 67 km away from Addis Ababa on the road to Butajira. It is located at 08° 038 ′ N and 38° 3 0 ′ E with an altitude 2050 meters above sea levels and with an average annual rain fall of 900 mm. Soil of Adadi area is characterized as Eutric Luvisol with organic carbon (1.16%), Total nitrogen (0.15%), phosphorus (8.7ppm), and pH (6.32) (Gemechu, 2007). Simple

partial budget analysis was done to identify the profitable treatment.

The experiment was laid in a randomized complete block design with three replication The treatments were a factorial combination of three varieties: One released variety Oissa and two pipe lines (Adadi- 1 and NK ferti) and five fertilizer rates (F1= No fertilizer, F2= 11.5 kg N/ha & 11.5 P_2O_5 kg/ha, F3= 23 kg N/ha & 23 kg P_2O_5 /ha), F4= 34.5 kg N/ha & 34.5 kg P_2O_5/ha and F5= 46 kg N/ha & 46 kg P_2O_5/ha). A gross plot size of 2m width and 3m long was used. The seedbed was plowed well before planting. Spacing used for the sunflower varieties was 75cm between rows and 25cm between plants. Urea and NPS were used as source of N and P_2O_5 nutrients. All NPS and half of urea fertilizers were applied at planting according to the treatment levels assigned to each plot. The remaining half of urea fertilizer was applied 45 days after planting soon after weeding on the same date. All recommended cultural practices and controlling bird attack were done for managing the experimental field.

Data collection and analysis

Composite soil sample will be collected before planting at both locations for analysis of pH, OM, total N and available P. Crop data collected include: date of emergence, stand count, date of flowering, plant height, head diameter, date of physiological maturity, seed yield, biomass yield and seed oil content. Finally, data was subjected to analysis of variance using SAS/STAT (Windows 9) (SAS Institute, 2004) software. Mean separation were done using list significant difference (LSD test).

RESULSTS AND DISCUSSION

The soil of the experimental area at Holeta site was characterized as slightly acidic pH (5.06) with low total nitrogen content (0.115%) and available P (8.287 ppm) and with organic matter content of (2.41%). But the Adadi site soil has pH = 7.76, a total nitrogen content of 0.11%, available p of (9.7 ppm) and organic matter content of 2.1%. The current research result was indicated that year effect was significant to alter most of the parameters tasted as there was a rain shortage occurred in the second year of the experiment. The two year data analysis of variance indicated that all parameters tasted (plant height, Head diameter, grain yield and seed oil content) were significantly different for different varieties tasted (Table 1).

Table 1. Main Effects of fertilizer rates and varieties on yield and yield parameters of sun flower (2017-2018)

	Holeta			Adadi		
	Parameters tasted			Parameters tasted		
Factors	Plant height(cm)	Head diameter (cm)	Oil content (%)	Plant height(cm)	Head diameter (cm)	Oil content (%)
Year						
2017	213.84a	18.87a	30.26a	230..37a	18.12a	32.08b
2018	177.17b	15.99b	24.4b	194.92b	17b	35.9a
LSD(0.05)	9.53	0.66	1.945	10.26	0.509	1.55
Varieties						
Oissa	218.1a	18.5a	32.64a	237.1a	19.12a	37.5a
Adadi 1	204.7b	18.3a	29.72b	225.4a	18.77a	36.6a
NK feti	163.6c	15.39b	19.7c	175.4b	14.8b	27.7b
LSD(0.05)	11.67	0.81	2.38	12.56	0.623	1.9
Fertilizer Rate(kg N/ha & kgP_2O_5/ha)						
F1= No fertilizer	177.8c	15.2c	27.57g	197.8c	15.5d	34.57a
F2= 11.5 kg N/ha & 11.5 kgP_2O_5/ha	184.9bc	16.52b	29.21a	197.8c	17.07c	34.32a
F3= 23 kg N/ha & 23 kgP_2O_5/ha	196.9ab	18.13a	26.6a	216.7b	17.72bc	34.03a
F4= 34.5 kg N/ha & 34.5 kgP_2O_5/ha	209.04a	18.62a	26.35a	217.8ab	18.22b	33.08a
F5= 46 kg N/ha & 46 kgP_2O_5/ha	208.7a	18.7a	27.0a	233.5a	19.3a	33.0a
LSD(0.05)	15.07	1.048	3.07	16.22	0.805	2.45
CV(%)	11.55	9	16.85	11.43	6.86	10.82

Means followed by the same letter within a table are not significantly different at 5% level of significance

The main effect of fertilizer rate significantly affect all yield and yield related parameters tasted except seed oil content at both locations. Interaction effect of sun flower varieties and fertilizer rates affect grain yield only but any of other parameters tasted were significantly affected interaction effect at both locations (Table 2 and Table 3). As fertilizer rates increases plant height and head diameter shows an increment. Hiray *et al*. (1992) also reported

significant increase in all yield contributing characters with increase in dose of nitrogen to sunflower up to 80 kg N ha-1. The importance of Phosphorus fertilizer in enhancing sunflower yield has been also well documented by Muralidharudu *et al*., 2003. Similarly Akhtar *et al*. (1992) reported that N application increased plant height, head diameter, number of seeds per head and seed yield and this could be due to the positive effect of N in stimulating vegetative growth, root growth and better absorption of other nutrients (Ali *et al*., 2004).

Table 2. Interaction effect of fertilizer rates and variety on seed yield (kg/ha) of sun flower at Holeta site (2017-2018)

	Fertilizer rate					
Variety	F1(0)	F2(11.5)	F3 (23)	F4(34.5)	F5(46)	Mean
Oissa	968f	1518d	1793bc	2036a	1951ab	1653
Adadi 1	818fg	1234e	1542d	1593cd	1608cd	1359
NK fert	383h	611g	744g	732g	713g	637
Mean			1216			
LSD(0.05)			210.9			
CV(%)			15			

Table 3. Interaction effect of fertilizer rates and variety on seed yield (kg/ha) of sun flower at Adadi site (2017-2018)

				Fertilizer rate		
Variety	F1(0)	F2(11.5)	F3(23)	F4(34.5)	F5(46)	**Mean**
Oissa	829cd	1495b	1870.6a	2008a	2004a	**1641**
Adadi 1	752cde	1537b	2007a	2179a	1908a	**1677**
NK fert	470e	714de	944cd	1030c	989cd	**829**
Mean	**1382**					
LSD(0.05)	**276.6**					
CV(%)	**17.3**					

All varieties tasted have different average yield response at different locations except the variety named 'Oissa'. Oissa have almost the same performance and seed yield response both at Holeta and Adadi sites with an average seed yield of 1653kg/ha and 1641kg/ha respectively. But the rest two pipe line varieties: 'Adadi 1' and 'NK ferti' recorded high average seed yield at Adadi site than Holetta site based on the tables above (Table 2 and Table 3). The analysis of variance indicated that statistically there is a significant seed yield difference observed due to the interaction effect of varieties and fertilizer rates tasted. Partial economic analysis was also done for the profitability test of the fertilizer rates to be recommended is indicated below.

Table 4. Partial budget Analysis for fertilizer application

Treatments			Location							
			Holeta				Adadi			
No	Variety	Fertilizer rate (kg N/ha+kgP_2O_5/ ha)	Adjusted GY(kg/ha)	TVC (Birr/ha)	Gross profit(Birr/ha)	Net benefit (Birr/ha)	Adjusted GY(kg/ha)	TVC (Birr/ha)	Gross profit (Birr/ha)	Net benefit (Birr/ha)
1	Oissa	0 + 0	967.6	0	19352	19352	828.5	0	16570	16570
2	Oissa	11.5 + 1.5	1518.5	242	30370	30128	1494.9	242	29898	29656
3	Oissa	23 + 23	1792.6	1084	35852	34768	1870.5	1084	37410	36326
4	Oissa	34.5 + 34.5	2036.5	1611	40730	39119	2007.6	1611	40152	38541
5	Oissa	69 + 69	1951.4	2148	39028	36880	2004.1	2148	40082	37934
6	Adadi 1	0 + 0	817.6	0	16352	16352	751.5	0	15030	15030
7	Adadi 1	11.5 + 11.5	1234.2	242	24684	24442	1537.07	242	30741.4	30499.4
8	Adadi 1	23 + 23	1542.1	1084	30842	29758	2007.3	1084	40146	39062
9	Adadi 1	34.5 + 34.5	1593.02	1611	31860.4	30249.4	2179.2	1611	43584	41973
10	Adadi 1	69 + 69	1607.7	2148	32154	30006	1907.5	2148	38150	36002
11	NK fert	0 + 0	383.19	0	7663.8	7663.8	470.1	0	9402	9402
12	NK fert	11.5 + 11.5	610.6	242	12212	11970	713.6	242	14272	14030
13	NK fert	23 + 23	743.8	1084	14876	13792	944.4	1084	18888	17804
14	NK fert	34.5 + 34.5	731.8	1611	14636	13025	1029.73	1611	20594.6	18983.6
15	NK fert	69 + 69	713.15	2148	14263	12115	989.09	2148	19781.8	17633.8

Where, price of sunflower grain per 100 kg=2000 birr, the price of 100 kg Urea=1193Birr and the price of 100 kg NPS= 1332 Birr was considered.

According to the partial budget analysis, out of the five tasted fertilizer rates application of 34.5 kg N/ha and 34.5 kg P_2O_5 /ha (F4) becomes profitable than others and can be recommended for sun flower production at the study area due to the fact that it gave the highest net benefit (Table 4). This preferable fertilizer rate record high net benefit for all varieties but it needs a variety preference for locations. Using the same fertilizer rate, Adadi 1 and 'Nk fert' varieties gave high seed yield at Adadi than Holetta (Table 4).

CONCLUSION

This field experiment was carried out for two years to study the fertilizer requirements of three sun flower varieties. Based on the statistical analysis, all parameters tasted (plant height, Head diameter, grain yield and seed oil content) were significantly different for different varieties tasted. The main effect of fertilizer rate significantly affect all yield and yield related parameters tasted except seed oil content at both sites. According to the statistical analysis and partial budget analysis, out of the five tasted fertilizer rates application of 34.5 kg N/ha and 34.5 kg P_2O_5 /ha becomes profitable than others and can be recommended for sun flower production at the study area due to the fact that it gave the highest net benefit. Besides, it is recommended that this experiment would be further confirmed in other areas and soil types for sun flower production in general.

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