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Yield Response of Chick Pea (*Cicer arietinum* L.) Varieties to NPS Fertilizer

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Abstract**—** *Low soil fertility status and reduced biological nitrogen fixation are some of the major constraints in limiting chickpea yield. Thus, an experiment was conducted with the objective of assessing the effect of blended NPS fertilizer rates on the yield and yield components and economic advantages of chickpea varieties. The experiment was done using randomized complete block design with five NPS rates (0, 50, 75, 100 and 125 kg ha^{-1}) and three chick pea varieties (Arerty, Shasho and Teketay) in three replications. The result showed that the main effect of variety had significant effect on days to 50% flowering, days to maturity, plant height, population at harvest, number of secondary branches, number of pods per plant, number of seed per pod, 100 seed weight, biological yield, grain yield and harvest index. Application of NPS significantly influenced number of pod per plant, biological yield, grain yield and harvest index. In addition, the pooled effect of the two factors showed highly significant differences on days to 50% germination, population at emergence and primary plant branches. Hence, Arerty variety showed an increased yield throughout the applied rates and attained its highest yield (3166.70 kg) at 125 kg ha^{-1} NPS applied along with the highest profit gaining. Shasho variety also showed a positive yield response at all treated plots as compared to the control; but attained maximum yield (2861 kg ha^{-1}) at 100 kg ha^{-1} NPS applied. However, maximum profit was attained at rate of 75 kg ha^{-1} NPS. Teketay variety attained highest yield (3138.70 kg ha^{-1}) at 100 kg ha^{-1} NPS applied; however its highest benefit to cost ratio (1.73) with highest economic benefit was reached at 50 kg ha^{-1} NPS applied. Thus, based on results obtained from this study, it can be concluded that using 100kg, 75kg and 50kg of NPS fertilizer ha^{-1} application for Arerty, Shasho, and Teketay varieties respectively improved productivity of chickpea with economically significant amount at the vicinity of the research area.*

Keywords**— Chickpea, NPS levels, growth, yield, varieties.**

I. INTRODUCTION

Chickpea (*Cicer arietinum* L.) is a legume crop grown in more than 50 countries in the world and is third in production after dry bean and field pea. It is the second most important food legume crops in the world grown on 11 million ha worldwide with a total production of 9 million tons in 2006-08. South Asia is by far the largest producer of chickpea (76%) in the world with a share of more than 80% of area harvested. The developing world's share in total area and production of chickpea is 95% and 93% respectively. The region of Middle East and North Africa (MENA) is the second most important region for chickpea area and production followed by SSA. The SE Asia and LAC as a region have more than 100 thousand ha of chickpea, but are relatively insignificant players from the global perspective. Africa accounts for 5% of world's chickpea production, mostly from Ethiopia, Malawi, Tanzania and Kenya in Eastern Africa and Morocco in North Africa (FAOSTAT, 2014).

Ethiopia is among the top five world producers of chickpea (FAO, 2014), and the largest producer of chickpea in Africa, accounting for about 60% of the continent's production in 2014. Amhara and Oromia regions cover more than 90% of the entire chickpea area and constitute about 92% of the total chickpea production (Menale *et al*., 2009). In Ethiopia, chickpea is mainly grown in the central, northern and eastern highland areas of the country at an altitude of 1400-2300 m.a.s.l., where annual rainfall ranges between 700 and 2000 mm (Anbessa and Bejiga, 2002). Chickpea, locally known as *shimbra*, is one of the major pulse crops and in terms of production, & it is the second most important legume crop after faba beans (Menale *et al*., 2009).

The crop has a major role in the daily diet of the rural community and poor sectors of urban population and its straw is used for animal feed. The high nutritive value of chickpea can be judged by the fact that it contains 20% protein, 5% fats and 55% carbohydrates (Hassan and Khan, 2007). Malunga *et al*. (2014) and Sarker *et al*. (2014) also reported chickpea and its residues are a source of protein and can reduce malnutrition and/or increase livestock productivity (Macharia *et al.*, 2012). It has high protein content (20-22%), chickpea is rich in fiber, minerals (phosphorus, calcium, magnesium, iron and zinc) and β-carotene. Its lipid fraction is high in unsaturated fatty acids. Chickpea also fetch good price when sold in local market and hence generate cash to farmers. Moreover, the crop is being exported to Asia and Europe contributing positively to the country's foreign exchange earnings. The growing demand in both the domestic and export markets provides a source of cash for smallholder producers (Shiferaw *et al*., 2007; Abera, 2010).

In Ethiopia chickpea is grown in rotation with cereals (primarily teff and wheat) and does not directly compete for land and labor with these cereals. In addition, chickpea are considered environmentally friendly due to their capacity to fix atmospheric nitrogen and reduce chemical fertilizer use and costs in subsequent cereal crops (Giller, 2001). In Ethiopia like any developing country, agricultural productivity of the country is low as a whole; and in particular chickpea, actual productivity is as low as 1.9 tons ha-1 (FAOSTAT, 2015) which is below half of the potential productivity (5.5 tons ha^{-1}on experimental stations). This yield gap between average and potential yield of chickpea could be due to many factors like poor agronomic practices, low soil nutrient, absence of compatible strains and low population numbers of rhizobia in the soil.

In addition, chick pea is believed to use atmospheric nitrogen for its growth and development that the portion of N derived from N fixation in chickpea averaged 57% (range: 4 to 79%) (Marcellos *et al*., 1998). However, it needs starter N and all other essential crop nutrients like other crops do so. Nitrogen, Phosphorus and sulfur in particular are among the deficient nutrients in the soil in the case of our country and assumed to influence the crop productivity significantly, Yifru and Taye (2011). Hence, this experiment was carried out under field condition in rain fed season of 2017/18 production year at East Showa, Adea district, particular place known as Denkaka with the objective of evaluating the effect of NPS fertilizer rates on yield and yield components and economical feasibility for chickpea varieties and relative comparison of their responses.

II. MATERIALS AND METHODS

2.1 Descriptions of the Study Area

The field experiment was conducted during 2017/18 cropping season under rain fed condition on farmer's farm at Adea district, Denkaka farmers association, located in East Showa zone, Oromya regional state at a distance of 60 km East of Addis Ababa and its geographical extent ranges from $08^0$45'15" to $08^0$46'45" north latitude and $38^0$46'45" to $39^0$01'00" east longitude. Denkaka area had the mean annual rainfall of 801mm with monthly temperatures ranging from 23.7 in July to 27.7^{0}C in May, respectively during cropping season. The mean annual maximum and minimum temperature of 25.5 ^{0}C and 10.5^{0}C respectively, and monthly values was ranged between 7.4 in December and 12.1^{0}C in July and August. It has an altitude of 1850m a.s.l and hot to warm sub-humid climate. Selected physico-chemical properties were analyzed for composite soil (0-30 cm) samples collected from experimental site before planting.

2.2 Treatments and Experimental Design

The experiment was conducted by using two factors, chickpea varieties and NPS fertilizer rates. Three chickpea varieties (Arerty, Shasho and Teketay) and five NPS fertilizer levels (0, 50, 75, 100 and 125 kg ha^{-1}) were arranged in factorial arrangements and the experiment was laid out in randomized complete block design in three replications.

2.3 Description of Experimental Materials and Crop Management

The experiment was conducted during the rain-fed season of 2017/18 cropping year at Denkaka. One “Desi” type chickpea variety (Teketay) and two “Kabuli” type chickpea varieties (Arerty and Shasho) improved seeds were obtained from Megertu Seed Producing Farmers Association. Teketay is characterized by having purple antocine color on its stem and leaf borders during growth. The flower is also purple. Seed color is brown and has relatively hard seed coat. Arerty has shorter stand height and more tiller during growth. It also has white flower and creamy seed color. Shasho has relatively erect standing and less tillering nature. It also has white flower and creamy seed color. Planting was done during the end of rainy season in August 2017/18. Plot size was prepared in 1.8m by 2m containing 6 rows. Each row was 30cm from one another and spacing between plants was 10cm. Each rate of NPS treatment was applied by broadcasting on the prepared seed bed and thoroughly mixing. After planting, all agronomical practices weeding, diseases and pests management was carried out uniformly.

2.4 Data Collected

Growth and phenology parameters like days to 50% of seedling emergence, days to 50% flowering, days to physiological maturity, plant height (cm) and stand count at emergence and at harvest were recorded. Yield and yield related characters data were collected randomly from each plot from ten plants in the central two rows like number of primary branches per plant, number of secondary branches per plant, number of pods per plant, number of seeds per plant, number of seeds per pod, 100 seed weight (g), above ground biomass (yield kg ha^{-1}), seed yield (kg ha^{-1}) adjusted to 12.5% moisture content, and harvest index(%) which was calculated as a ratio of total seed yield to total above ground biomass yield harvested multiplied by 100.

2.5 Economic Analysis

In order to determine the possible economic advantage that could be obtained in chickpea productivity in response to different levels of NPS application, the economic analysis in terms of variable cost of production and additional income because of extra production was compared. Chickpea production cost during 2017/2018 was computed for the factors such as input (seed, fertilizer, insecticide), machinery (plowing, disking...), labor (weeding, crop guarding...) and land rent. The variable cost according to each treatment was determined and summed up to the subtotal and then benefit-cost ratio (BCR) was calculated using gross income divided by total direct cost. Net income was also calculated by deducting the total expenditure from the gross income for each treatments rate individually.

2.6 Statistical Analysis

The collected data for each character were subjected to analysis of variance (ANOVA) using SAS statistical software package version 9.0 (SAS, 2004). Means were separated for statistical significance using Fisher’s least significant difference (LSD) test at 5% probability level.

III. RESULTS AND DISCUSSION

3.1 The Soil Physco-chemical Properties of the Experimental Site

The result of soil analysis in the site indicated that texture of particle size distributions of the soil contained 18% sand, 24.40% silt and 57.60% clay (Table 1). According to the soil textural class determination triangle, soil of the experimental site was found to be clay. The texture indicated that the degree of weathering, nutrient and water holding capacity of the soil. High clay content might indicated that the better water and nutrient holding capacity of the soil in the experimental site. The soil reaction of the experimental site was nearly neutral where the pH in 1:2.5 (weight/volume) soil samples to water was 6.90. According to Mahler *et al*. (1988) suitable pH range for chickpea is between 5.7 and 7.2 in which the availability of nutrient is optimum. This indicated that suitability of the soil reaction in the experimental site for optimum chickpea growth and yield.

The Netherlands commissioned study by Ministry of Agriculture and Fisheries (1995) classified soil contents as follows: For total N (%) > 0.300, 0.226-0.300, 0.126-0.225,0.050-0.125 and < 0.050 as very high, high, medium, low and very low, respectively. For OC contents (%) >3.50, 2.51-3.5, 1.26-2.50, 0.60-1.25 and <0.60 as very high, high, medium, low and very low, respectively. Moreover, Tekalign (1991) classified soil total N availability of <0.05% as very low, 0.05-0.12% as poor, 0.12-0.25% as moderate and >0.25% as high. According to this classification analysis of soil samples from planting depth indicated low level of total N (0.092%) indicating that the nutrient is a limiting factor for optimum crop growth. Organic carbon content of the soil was 2.33% (Table 1). This showed that the soil had medium organic carbon content indicating inadequate potential of a soil to supply N to plants as it can be used as an index of N availability. The analysis revealed that the soils available P were 10.031 mg/kg (Table 1). Tekalign (1991) described soils with available P <10, 11-31, 32-56, >56 mg/kg as low, medium, high and very high, respectively. Thus, the soils of the experimental sites are considered as approximately low in an available P content which is not satisfactory for optimum chickpea growth and yield. According to Foster (1973), P response is likely in soils with less than 20 mg/kg soil of soil extractable P. Cation exchange capacity (CEC) is an important parameter of soil, because it gives an indication of the type of clay mineral present in the soil and its capacity to retain nutrients against leaching. According to Landon (1991), top soils having CEC greater than 40 cmol (+)/kg are rated as very high and 25-40 cmol (+)/kg as high, 15-25, 5-15 and < 5 cmol (+)/kg of soil are classified as medium, low and very low, respectively in CEC. According to these classification the soil have very high CEC of (29.43 meq/100g soil) indicating its better capacity to retain the cations.

Table 1. Selected physico-chemical properties of the experimental soil before planting

Physical Properties				**Chemical properties**					
Particle size Distribution (%)			**Textural Class**	**pH**	**OC (%)**	**Total N (%)**	**Av. P (mg/kg)**	**Av.S (mg/kg)**	**CEC (cmol (+)/kg)**
Sand	Silt	Clay	Clay	6.90	2.33	0.092	10.031	13.78	29.43
18	24.40	57.60		**Methods utilized**					
By Hydrometer				1:2.5 (soil/H_2O)		Kjeldhal	Olsen	Turbidimetric	Ammonium acetate

3.2 Effect of NPS Levels on Phonology and growth Characters of Chickpea

Application of NPS fertilizer rates to chickpea varieties was not significantly influenced the days to 50% flowering at 5% probability level. However, the main effect due to varietal difference of chickpea varieties on days to 50% flowering was significant at 5% probability level (Table 2). Thus, Arerty variety has taken 53.93 days to 50% flowering time without significant variation from Shasho variety which might be due to the varieties are kabuli types with similar characteristics. Teketay variety has taken lowest (52.07) days to 50% flowering. This result may give a clue that the varieties are genetically determinate in their days to flowering of the population. However, previous works suggested that, application of nitrogen increased the leaf area which in turn increased the amount of solar radiation intercepted and consequently increased days to flowering, days to physiological maturity, plant height and dry matter production of different plant parts (Krshnappa, 1989).

The main effects of chickpea varieties showed significant (P<0.05) difference among them; the highest number of days to maturity period (97.60) was recorded on “Arerty” variety (Table 2). “Shasho” variety has taken lowest (95.40) days to maturity, while “Teketay” was matured in duration of 96.40 days. However, application of different levels of NPS fertilizer didn’t cause significant difference on days to maturity among varieties. Nevertheless, Thies *et al.* (1995) and Gan *et al.* (2009) reported that appearance of phenological stages and growth period was increased with an increasing nitrogen rates in chickpea and soybean.

Table 2. Main effects of varieties difference on phonological characteristics of chickpea

Variety	**Days to 50% flowering**	**Days to harvest maturity**
Arerty	53.93^{a}	97.60^{a}
Shasho	53.93^{a}	95.40^{c}
Teketay	52.07^{b}	96.40^{b}
LSD(5%)	0.34	1.81
CV (%)	0.83	3.34

Interaction effect of variety with NPS rates showed significant (P<0.05) difference on chickpea plant height; “Arerty” variety produced lowest height (49.39cm) on the control plot and maximum mean height (57.09cm) was recorded from Shasho at 100 kg NPS ha^{-1} application with an improvement of 13.5% than the lowest on the control (Table 3). This might be due to varietal differences with the application of blended NPS fertilizer rates. Hence, these results were in line with the results obtained by Seid *et al.* (2013) in which maximum plant height (39.25cm) was recorded from the plot received 60 kg P_2O_5 ha^{-1}; while minimum plant height (32.5) was obtained from the control plot.

Table 3. Main effects of varieties difference on plant height (cm) of chickpea

Treatments	Variety		
NPS Fertilizer Rate (kg ha^{-1})	**Arerty**	**Shasho**	**Teketay**
0	49.39^{g}	53.37^{cde}	54.82^{abcd}
50	50.04^{fg}	56.33^{ab}	55.71^{abc}
75	49.12^{g}	55.42^{abc}	55.63^{abcd}
100	52.51^{def}	57.09^{a}	53.77^{bcde}
125	51.62^{efg}	57.17^{abcd}	53.39^{cde}
LSD(5%)		**2.71**	
CV(%)		**3.03**	

3.3 Effect of NPS Levels on Yield and Yield Components of Chickpea

The interaction effect of blended NPS fertilizer rates and variety showed significant (P<0.05) differences on number of secondary branches, number of pods per plant and number of seeds per pod of chickpea varieties (Table 4). Arerty variety produced many secondary branches and pods per plant and fewest from shasho variety; but, highest number seeds per pod from shasho and lowest from arerty variety at all levels of NPS applied. Highest branching performances and pods per plant and lowest seeds per pod were produced at 100 kg NPS ha^{-1} from Arerty variety; but lowest branching performances and pods per plant and highest seeds per pod were produced at 100 kg NPS ha^{-1} applied to shasho variety. The relative abundance of Arerty variety secondary branches and pods per plant numbers was greater by 42% and 30% as compared to shasho variety and by 21.5% and 20.5% as compared to Teketay variety, respectively. This indicated that availability of genetical variation across the chickpea varieties. Also pervious works showed that application of phosphorus increased the availability of nitrogen and potassium which resulted in better plant growth and more number of branches per plant (Saeed *et al.*, 2004). Jain and Singh, 2003 have also reported that number of branches per plant in pea increased with phosphorus application.

Table 4. Interaction effects of NPS fertilizer rats with different varieties of chickpea on yield and yield parameters

Variety	NPS (kg ha^{-1})	Number of secondary branches	Number of pods per plant	Number of seed per pod
Arerty	0	15.93^{a}	41.70^{bcd}	1.00^{d}
	50	16.00^{a}	42.27^{bcd}	1.00^{d}
	75	15.60^{a}	42.63^{bcd}	1.00^{d}
	100	16.30^{a}	53.55^{a}	0.99^{d}
	125	16.11^{a}	50.50^{ab}	0.99^{d}
Shasho	0	9.07^{d}	27.67^{f}	1.10^{abc}
	50	9.31^{d}	29.97^{ef}	1.10^{abc}
	75	9.71^{d}	34.87^{def}	1.11^{ab}
	100	9.44^{d}	37.50^{cde}	1.113^{a}
	125	10.60^{c}	38.60^{cde}	1.113^{a}
Teketay	0	11.93^{bc}	40.73^{cd}	1.01^{cd}
	50	12.20^{bc}	40.90^{cd}	1.03^{cd}
	75	12.53^{bc}	41.20^{bcd}	1.04^{bcd}

100	12.80^b	42.57^bcd	1.07^abcd
125	12.78^b	44.67^abc	1.05^abcd
LSD(5%)	**2.13**	**9.41**	**0.07**
CV(%)	**10.07**	**13.84**	**4.28**

The interaction between variety and applications of NPS fertilizer levels showed significant (P<0.05) difference in 100 seed weight (Table 5). The highest hundred grains mean weight (30.42 gm) was obtained from Shasho variety at 125 kgha^{-1} NPS applied; while, Teketay and Arerty followed by 28.75gm and 26.16gm at 100 and 125 kgha^{-1} NPS applied, respectively. The relative hundred seed weight at their maximum response at 125 kg ha^{-1} on Shasho variety was improved by 19% and 10% as compared to Arerty and Teketay varieties, respectively with similar NPS level. Thus, the variation in hundred seed weight was more of sourced from varietal difference rather than the effect of NPS applications at different levels. However, previous works reported that application of 50 kg ha^{-1} N affected highly significantly 1000 seed weight, Mckenzie and Hill (1995).

Similarly, the interaction of variety and NPS fertilizer rates significant (P<0.05) affected above ground biomass of chickpea. The highest biomass (6062.20 kg ha^{-1}) was obtained at 100 kg ha^{-1} NPS application from "Arerty" which was improved by 26.78% as compared to the lowest biomass yield obtained from control on shasho variety (Table 5). The essence behind this variability and extent of their response in biomass seems to be their branching capacity (Table 3), that more branching nature provides higher leaf area index to the plant. This enables it to utilize more mineral nutrients and solar radiation which eventually enable it to accumulate much dry mater. Study of Alam and Haider (2006) also reported that, the effects of N fertilizer on growth attributes of barley and found that total dry matter (TDM), leaf area index (LAI), crop growth rate (CGR) and net assimilation rate (NAR) increased due to N fertilization. Harvest index was also significantly (P<0.01) influenced by the interaction effect of variety and NPS fertilizer rates (Table 5). Arerty variety gave lowest HI (38.39) on the control plot and highest HI from Teketay variety followed by Shasho variety at all NPS fertilizer rates. This reinforces that desi type chickpea responds very little to NPS treatments.

Similarly, chickpea grain yield was significantly (P<0.05) affected by interaction of variety and NPS rates (Table 5). Highest yield (3166.70 kg ha^{-1}) was obtained from Arerty at 125 kg ha^{-1} NPS applied; while lowest yield (2050.30 kg ha^{-1}) was recorded from the control on the same variety; with an improvement by 35% over the control. The three varieties showed significant increment in grain yields along the rates of NPS fertilizer; which indicated that availability of the crop responsiveness to NPS application. This result showed that, kabuli type (Arerty and Shasho) chickpea varieties were better responded to NPS fertilizer than the desi type (Teketay) did. Similarly, Gan *et al.* (2003) also reported that Starter N at the rate of 15 kg N ha^{-1}, compared to non-N check, increased seed yield significantly for kabuli type chickpea. Walley *et al.* (2005) also investigated chickpea response to starter N (0, 15, 30 & 45 kg N ha$^{-1)}$ and stated that application of 45 kg ha^{-1} enhanced seed yield by as much as 221 kg ha^{-1} over control. Hussain *et al.* (2011) and Islam (2012) also reported that application of sulfur resulted in an increasing yield hectar^{-1} of chickpea.

Table 5. Interaction effects of NPS fertilizer rates with different varieties on yield and yield associated characteristics of chickpea

Variety	**NPS (kg ha^{-1})**	**HSW(g)**	**BY(kg ha^{-1})**	**GY(kg ha^{-1})**	**HI**
Arerty	0	24.42^e	5355.60^abcde	2050.30^f	38.39^f
	50	24.17^e	5216.70^cde	2493.30^def	47.95^e
	75	26.16^de	5300.00^bcde	2667.00^cde	50.09^de
	100	24.88^de	6062.20^a	3028.00^abc	50.27^cde
	125	24.57^e	5966.70^ab	3166.70^a	53.10^abcd
Shasho	0	29.20^abc	4438.90^f	2277.70^ef	51.07^bcde
	50	29.09^abc	4744.40^ef	2444.30^def	51.41^bcde
	75	30.35^ab	5355.60^abcde	2833.00^abcd	52.89^abcd

	100	29.51[abc]	5550.00[abcd]	2861.00[abcd]	51.53[bcde]
	125	30.42[a]	5411.10[abcde]	2694.30[bcde]	49.69[de]
Teketay	0	27.76[cd]	4900.00[def]	2755.70[abcd]	56.33[a]
	50	27.98[bcd]	5605.60[abc]	3111.30[abc]	55.69[ab]
	75	27.89[cd]	5661.10[abc]	3111.30[abc]	54.93[abc]
	100	28.75[abc]	5661.10[abc]	3138.70[ab]	55.52[ab]
	125	27.36[cd]	5883.30[abc]	3083.30[abc]	52.30[abcde]
LSD(5%)		**2.39**	**683.03**	**450.01**	**4.69**
Significance		**	**	**	**
CV(%)		**5.21**	**7.56**	**9.67**	**5.46**

HSW: hundred seed weight; BY: biological yield (above ground biomass); GY: grain yield; HI: harvest index.

3.4 Economic Analysis

Cost of production was categorized in to three different components and finally summed up, to total cost (Table 6) of production at each treatment levels. Data regarding economic analysis for various rate of application revealed that the highest return was obtained from Arerty variety at 125 kg ha^{-1} NPS applied. This also had the highest benefit cost ratio (BCR 1.90). Arerty variety showed increasing net income throughout all treatment levels. It had the highest net income (30,051.00 birr ha^{-1}) at 125 kg NPS ha^{-1}. However, when we compare the marginal profit (2405 birr) with the marginal cost (300 birr), the difference was much higher to fulfill the condition of profit maximization. Shasho reached its highest BCR (1.74) with its highest net return per hectare (24143 birr) at 75 kg NPS ha^{-1} of application rate (Table 6). Its marginal revenue (7279 birr) was also mach higher than its marginal cost (300 birr) at this point. At 100 kg NPS ha^{-1} of application the marginal income (246 birr) was lower than the marginal cost (300 birr) which showed loss. This means, the producer increased the revenue by 246 birr by utilizing an input that costs 300 birr. Teketay showed its highest BCR (1.73) at 50 kg ha^{-1} NPS applied with net profit of 23647.40 birr per hectare (Table 6). Further increment in NPS rate (75,100 and 125 kg ha^{-1}) did not show economically profitable contribution to productivity. Nonetheless, the marginal profit at this point (5622.80 birr) was too higher than marginal cost (300 birr).

Table 6. Production cost and economic indices in economic analysis of chickpea production

S. No	Variety	NPS levels (kg ha^{-1})	Mean grain Yield (kg ha^{-1})	Chickpea (Unit price kg^{-1})	Income ha^{-1} (Eth. Birr)	Total Cost ha^{-1} (Eth. Birr)	Benefit Cost Ratio (CBR)	Net income (Eth. Birr)	Marginal income (Eth. Birr)	Marginal cost
1	Arerty	0	2050.30	20	41006	31225	1.31	9781		0
2		50	2493.30	20	49866	31447	1.56	17819	8038	600
3		75	2667.00	20	53340	31534	1.64	20906	3087	300
4		100	3028.00	20	60560	31714	1.84	27646	6740	300
5		125	3166.70	20	63334	31783	1.90	30051	2405	300
6	Shasho	0	2277.70	20	45554	31339	1.45	14215		0
7		50	2444.30	20	48886	31422	1.53	16864	2649	600
8		75	2833.00	20	56660	31617	1.74	24143	7279	300
9		100	2861.00	20	57220	31631	1.74	24389	246	300
10		125	2694.30	20	53886	31547	1.63	20839	-3550	300
11	Teketay	0	2755.70	18	49602.60	31578	1.57	18024.6		0
12		50	3111.30	18	56003.40	31756	1.73	23647.4	5622.8	600

13	75	3111.30	18	56003.40	31756	1.71	23347.4	-300	300
14	100	3138.70	18	56496.60	31769	1.71	23527.6	180.2	300
15	125	3083.30	18	55499.40	31742	1.67	22257.4	-1270.2	300

IV. CONCLUTIONS AND RECOMMENDATIONS

From the study results both growth, yields and the economic analysis of the study due application of NPS fertilizer at different levels revealed that all the three varieties were performed profitably at certain particular level of NPS application as compared to the control. Arerty was best performed at 125 kg NPS ha^{-1} with an increment of 1116.40 kg yield than the control; however, the highest yield (2861kg ha^{-1}) was produced at 100 kg NPS per hectare. But, application of 75 kg ha^{-1} (2833 kg ha^{-1}) NPS for the production of Shasho variety was higher. The findings of the research also reviled that Teketay attained higher production (3138.70 kg ha^{-1}) at 100 kg NPS per hectare applied; however, from the economic analysis 50 kg NPS per hectare gave better (3111.30 kg ha^{-1}) yield. Thus, based on the analysis of the study result and highest yields along economic advantages obtained, it is better to conclude that it is better for the production of chickpea to increase yield and productivity with economically significant amounts at 100, 75 and 50 kg ha^{-1} NPS fertilizer application for Arerty, Shasho and Teketay chickpea varieties respectively.

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