



Evaluation of NPS Fertilizer on Yield and Economic Performance of New Variety of Hot Pepper (*Capsicaim Annum*) in Tanqua Abergelle, Central Tigray, Ethiopia

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ABSTRACT

Hot Pepper (*Capsicum annum* L.) is one of the major economically important horticultural crops in Tanqua-Abergelle district. However, its productivity is low mainly due to soil nutrient deficiency and using unappropriated rate of Fertilizer. NPS is one of the most deficient elements in the area. The experiments were designed to study the effect of NPS levels accompanied with one level of DAP as standard check (150, 200, 250kg/ha NPS and 200kg DAP/ha carried out in randomized complete block design (RCBD) with three replications. The analyzed result showed the growth yield and yield components of pepper (*Capsicum annum* L) were observed from 2014 to 2016 under irrigation. NPS levels was significantly affected on pepper fruit number per plant, total yield and marketable yields. However, on fruit length, plant height and unmarketable yields are not revealed significance difference. The level of 200kg/ha NPS Significantly showed highest marketable yield 101.97qt/ha than the other treatments (150kg/ha NPS, 250 kg/ha NPS and 200 kg/ha of DAP. Based on the economic feasibility 200kg/ha of NPS fertilizer gives a significant marginal rate of return (3013.8%). Thus, level have best profitability advantage over the other treatments. Therefore, according the result (yield and MRR) the conclusion is using the 200kg/ha important to increase yields for the growers in the study area. Thus, to fill the pepper production constraints resulted from nutrient deficiencies such as nitrogen, phosphorus and sulfur fertilizer, further research on NPS combination levels, nutrient use efficiencies, nutrient uptake rate and nutrient recovery is crucial. Moreover, further research across locations and years deemed important to validate the current result of this research work.

Key words: Hot pepper, NPS, DAP, Yield and yield Components

INTRODUCTION

Hot Pepper (*Capsicum annum* L.) is an important spice and vegetable crop in tropical areas of the world and it belongs to the Solanaceae family, and the genus *Capsicum*. It is closely related to tomato, eggplant,

potato and tobacco. The genus *Capsicum* is the second most important vegetable crop of the family after tomato in the world (Rubatzky and Yamaguchi, 1997; Berhanu *et al.*, 2011). The plant is an herbaceous annuals usually growing from 45cm – 65cm high.

It is one of the most important spice crops widely cultivated around the world for its pungent flavor and aroma (Ikeh *et al.*, 2012; Obidiebub *et al.*, 2012). Fine pungent powder of hot pepper ('berbere') is an indispensable flavoring and coloring ingredient in the daily preparation of different types of Ethiopian sauces ('wot'), whereas the green pod is consumed as a vegetable with other food items (MARC, 2004). In Ethiopia, hot pepper is commonly cultivated within an altitude ranges of 1400 to 1900 meter above sea level (MoARD, 2009; EIAR, 2007), which receives mean annual rainfall of 600 to 1200 mm, and has mean annual temperature of 25 to 28°C (EIAR, 2007).

In terms of total production the share of pepper is high as compared with other vegetables such as lettuce, tomatoes, head cabbage, onion and others (CSA, 2016). In Ethiopia, the total area under hot pepper for dry pod (Berbere) and for green pepper (Karia) in 2015 was estimated to be 142,795.16 ha, and 7,449.59 ha, respectively.

Farmers produce pepper in Abergele Gimtsuwa irrigation schemes widely. Hintsa *et al.* (2015) have

conducted an demonstration on two variety (melka shoate) to the district. However, the productivity is low due to nitrogen, phosphorus and other micronutrient as S, B, Zn deficiencies are the main constraint for vegetable and other crop production. Recently acquired soil inventory data from EthioSIS (Ethiopian Soil Information System) also revealed that in addition to N and P, nutrients such as S, B, Zn are deficient in Ethiopian soils and also abergelle area (ATA, 2013).

Application of the blanket recommendation rates without study the insufficiency of the soil, poor management practice and low soil fertility. NPS is recently introduced fertilizer having 38% P₂O₅, 19% Nitrogen and 7% sulfur and this situation is changing and the use of blended fertilizer which is known to be more closely matching with the specific needs of soils in Africa, including Ethiopia is coming up. Therefore, objective of this experiment was to evaluate and validate the appropriate rate of fertilizer to high yielding and good quality for market under irrigation scheme.

MATERIALS AND METHODS

2.1. Area Description:

The study was conducted from September, 2014 to April, 2016 at sheka tekli, Gimtsuwa irrigation schemes, central Tigray Zone (Northern Ethiopia).

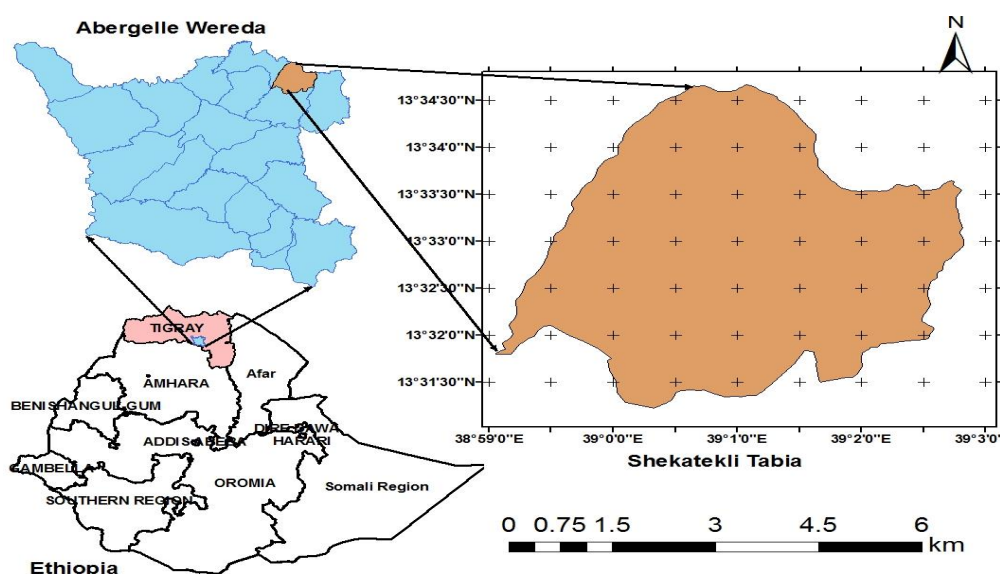


Figure 2.1: Map of the study site

It is located 13°14'06"N Latitude & 38°58'50"E longitudes. It is agro-ecologically characterized as hot warm sub-moist low land (SMI-4b) below 1500m.a.s.l.

The mean annual rainfall is 350mm - 700mm and with minimum and maximum temperature is 24°C and 41°C respectively (Gebreyesus Berhane, 2004).

2.2 Soil physical description of the Experimental Site

Table 2. 1: Some Physio-chemical properties of the soil at the experimental field

Properties	Values**	Remark*
Soil physical properties		
Sand (%)	88	
Clay (%)	4	
Silt (%)	8	
Soil texture		Loamy sand
Soil chemical properties		
pH (by 1:2.5 soil water ratio)	7.25	Almost neutral
Total nitrogen (%)	0.07	Very low
Organic carbon (%)	0.09	Very low
Available phosphorus (ppm)	7.72	Very low
Available Zn (ppm)	5.52	Very low
Cation exchange capacity (cmol(+)/kg/ha)	2.7	Very low
Electrical conductivity(ms/cm)	0.045	Very low

2.3. Plant Establishment

In nursery site, the seeds were planted in well prepared seed bed and the seed beds was covered and mulched with grass. After planting 3-4 true leaf stages, healthy and vigorous seedlings were transplanted to the field.

2.4. Experimental Design

The trial was conducted in rent farmers' field in RCBD design with three replications in a plot size of 3.5x3.6m (12.6m²). The treatment included three rate of NPS fertilizer and recommended rate of DAP as standard check for comparison. The Pepper was planted in a spacing of 70 X 30 cm where 70 cm was spacing between planting rows and 30cm spacing between plants. After transplanting all the treatments were applied, and 100kg/ha urea was 50% at fifteen days after planting and the remain 50% also applied at flowering stage.

2.5. Data collection

During two years of study period, number of fruits per plant, fruit length (cm), plant height (cm), total yield(qt/ha), unmarketable yield(qt/ha) and marketable yield (qt/ha) were collected.

2.6. Partial budget analysis

To consolidate the analysis of variance of the agronomic data, economic analysis was analysed for each treatment. For economic evaluation, cost and return, and benefit to cost ratio was calculated according to the procedure given by CIMMYT (1988). Actual marketable pod yield was adjusted downward by 10% to reflect the difference between the experimental pod yield and the pod yield that farmers would expect to get from the same treatment (CIMMYT, 1988). For the partial budget analysis, only costs that vary among all the treatments (fertilizer, transport and labour costs) were considered to obtain Total Varying Cost (TVC). Basically, partial budget

analysis is the computation of Marginal Rate of Return (MRR) compared with Acceptable Minimum Rate of Return (AMRR).

The minimum acceptable marginal rate of return used in this study was assumed to be 100 % for farmers recommendation domain. The economic analysis was based on the formula developed by CIMMYT (1988). Treatments (dominance analysis) were carried out first by listing the treatments in order of increasing cost variation to identify the economically preferable treatment.

3.7. Data Analysis

The collected data were subject to analysis of variance as per (Montgomery, 2005). SAS Statistical Software Package (SAS, 2001) was employed for analysis of variance. The statistical significance was determined by using F-test. List Significance Difference (LSD) was used to undertake mean separation in order to identify the most effective treatment.

RESULT AND DISCUSSION

Fruit number per plant

The analysis of data of the two cropping season showed that there was statistically significant difference at ($p=5\%$) among the treatment in fruit number per plant in the cropping season. The highest fruit number per plant (22.4) was observed in the 200kg/ha NPS (Table 1). This is may be due to the

treatments, which is the amount of sulfur from NPS rate, leads to contain high number of fruits per plant.

Fruit length (cm)

As fruit length of the pepper concerned, there was no statistically difference at that ($p=5\%$) but numerically revealed that a difference among treatments in fruit length at the result of combined analysis. The highest and lowest fruit lengths of pepper was observed in 200kg/ha DAP and 250kg/ha NPS which are 9 and 8.3cm respectively (Table 1). In this result, we observe that, may sulfur haven't effect in fruit growth.

Plant height (cm)

As far as plant height is concerned, there was no statistically significance difference at ($p=5\%$) among the treatments during the cropping season in plant height. However, numerical difference is stile showed. The highest and lowest plant height was observed in 150kg/ha and 250kg/ha NPS which is 61.68cm and 53.55 cm respectively (Table 1).

Marketable yield (qt/ha)

Regarding with yield of pepper, the analysis of data during the combined analysis showed that there was statistically significant difference at ($p=5\%$) among the treatments in marketable yield. The highest and lowest grain yield was observed in treatment using 200kg/ha and 150kg/ha NPS which is 101.97qt/ha and 91.4qt/ha in grain yield pepper, respectively (Table 1).

Table 3. 1. Effect of different fertilizer rate on yield and yield Components of pepper at irrigation schemes

Treatment	Fruit no/plant	Fruit length (cm)	Plant height (cm)	Marketable yield (qt/ha)	Unmarketable yield (qt/ha)	Total yield(qt/ha)
150kg/ha NPS	19.75 ^b	8.64	61.68	91.4 ^c	1.81	89.56 ^c
200kg/ha NPS	22.4 ^a	8.87	56.9	101.97 ^a	1.97	103.94 ^a
250kg/ha NPS	19.43 ^b	8.3	53.55	95.73 ^b	1.94	97.67 ^b
200kg/ha DAP	19.3 ^b	9	57.18	97.18 ^b	1.81	98.73 ^b
CV(%)	5.96	7.85	9.88	1.54	9.25	1.64
LSD(5%)	2.29	1.29	10.67	2.77	0.33	3.02

Table 4.1 Dominance analysis and marginal rate of return for the application of blended fertilizers rates (NPS) on hot pepper cultivars

Treatment	TVC Eth-birr ha kg-1	MY kg ha-1	AMY kg ha-1	GFB (ETB ha-1)	NB (ETB ha-1)	Dominance	B:C ratio	Marginal benefit Birr/ha	Marginal cost Birr/ha	MRR %
150 kg ha ⁻¹ NPS	1534.5	91.4	82.26	123390	121856					
200 kg ha ⁻¹ NPS	2046	101.97	91.773	137659	135613		66.28	13758	456.5	3013.8
250 kg ha ⁻¹ NPS	2557.5	95.73	86.157	129236	126678	D				
200 kg ha ⁻¹ DAP	2046	97.18	87.462	131193	129147	D				

D=dominated treatments; TVC=Total variable cost; NB=Net benefit; B:C ratio=Benefit cost ratio; MRR% =marginal rate of return, MRR = change in net benefit / change in cost x 100

The variation in marketable pod yield might be due to varying levels of fertilizers treatment and the nutrient status of the growing area. There was a yield decline at the highest rate of fertilizers supply. An increased in yield of pepper up to a certain optimum level by increasing fertilizer level and then a decrease afterwards similar work reported by (Roy *et al.*, 2011). The lower yield gained at the lower levels of fertilizers could be attributed to the decrease in yield and yield components leading to reduced yield.

Unmarketable yield:

Concerning the unmarketable yield of pepper, the analysis of data during the cropping season showed that there was no statistically significant difference at (p= 5%) among the treatments on unmarketable yield. However, numerically there is a difference, the highest and lowest grain unmarketable yield was observed in treatment using 200kg/ha NPS and 150 and 250 kg/ha which in the same result 1.97qt/ha and 1.81qt/ha in grain pepper yield respectively (Table.1). This may be due to the high content of fruit number and high marketable grain yields leads to more unmarketable yield of the pepper result.

Total yields:

Data presented in (table 1) indicating the total grain yield of pepper, the analysis of data during combined analysis showed that there was statistically significant difference at (p= 5%) among the treatments in total grain yield. The highest and lowest total grain yield was observed in the treatments using 200ka/ha and 150kg/ha NPS which is 103.94qt/ha and 89.56qt/ha in total grain yield of pepper respectively. As the result

showed that 200kg/ha NPS is an appropriate rate to enhance total grain yields of pepper.

4.2. Marginal rate of return (MRR%)

The percentage marginal rate of return (% MRR) between any pair of dominant treatments denotes the return per unit of investment in fertilizer expressed as a percentage. The marginal rate of return (3013.8) obtained was above the minimum acceptable marginal rate of return. In this study, 100% was considered as minimum acceptable rate of return for farmers recommendation. For instance for every 1.00 Birr invested at application of NPS fertilizer, farmers can expect to recover the 1.00 Birr, and obtain an additional 30.13.8 Birr ha⁻¹ per unit investment for hot pepper production was obtained from application of 200 kg NPS (Tables 4.1).

CONCLUSIONS AND RECOMMENDATIONS

The aim of this study was to identify appropriate rate of NPS fertilizer on pepper grain yield. It was done by executing an experiment on field with in two years. The combined analysis from the treatments using 200kg/ha were more significant in fruit number per plant, marketable fruit yield and total fruit yields. It is more appropriate than the other treatments as the result showed, the heights yield was recorded from this treatment. In general, from the result obtained, it could be concluded that using 200kg/ha NPS fertilizer rate was the most appropriate rate on pepper fruit yields. Based on MRR of 3013.8% could be achieved by the application of 200 kg/ha NPS fertilizer level. Therefore, farmers should apply these practices and it

should be scaled out to other pepper potential areas with similar agro-ecology to the study area. Another experiment should be also conducted on other agronomic practices (like use efficiency) of pepper production should be conducted to enhance the productivity of pepper.

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