GROWTH AND POD YIELD OF HOT PEPPER (*CAPSICUM ANNUUM* L.) AS INFLUENCED BY FARMYARD MANURE AND NPS FERTILIZER AT DAMBI DOLLO, WESTERN ETHIOPIA

Chala Kitila[1], Abdisa Abraham[2], Soressa Shuma[3] and Habtamu Rufe[4]

[1]Department of Plant Sciences, College of Agriculture and Veterinary Medicine, Dambi Dollo University
[2]Department of Natural Resource Management, College of Agriculture and Veterinary Medicine, Dambi Dollo University
[3]Department of Animal Sciences, College of Agriculture and Veterinary Medicine, Dambi Dollo University
[4]Department of Agricultural Economics, College of Agriculture and Veterinary Medicine, Dambi Dollo University

ABSTRACT

Hot peppers are crucial vegetable crops in Ethiopia grown widely. Research regarding the nutritional and beneficial objectives of the pepper plant is very inadequate. Accordingly, a field experiment was conducted to evaluate the effect of NPS and FYM fertilizer on production at the Dambi Dollo, Western Ethiopia. The study was organized by Complete Randomized Block Design with three replication. A variety of Marako Fana hot pepper have been used. Four level of NPS fertilizer (0, 100, 200, 300kg N ha^{-1}) and four level of FYM (0, 2.5, 5, 7.5, 10 t ha^{-1} were allocated to the study area and a total of 20 treatments. The research has shown that FYM and NPS fertilizer interacts to affect suggestively ($P<0.05$) most parameters excluding unmarketable yield which is affected by the single effect of NPS and FYM. The maximum commercial pod yield (2.19 t ha^{-1}) and entire pod harvest (2.62 t ha^{-1}) was noted through NPS fertilizer rates of 100 kg ha^{-1} applied including 5 t ha^{-1} of FYM. Thus, it is possible to conclude that hot pepper growers can use NPS fertilizer rate of 100 kg ha^{-1} with 5 t ha^{-1} of FYM that would improve productivity of the hot peppers in the study area.

KEYWORDS

Hot Pepper, Marako Fana, NPS, FYM, inorganic fertilizer, Yield traits

1. INTRODUCTION

Hot pepper (*Capsicum annuum* L.) are the best imperative vegetable plant eaten as a raw fruit and dry spice in the world (Bosland and Votava, 2000) and it is an important among spice and vegetable herb in tropical regions of the global and categorized under the Solanaceae family *Capsicum* genus. It is the most important vegetable in the Solanaceae family after tomato worldwide (Berhanu *et al.*, 2011). It is a herbaceous tree that usually grows from 45cm - 65cm tall.

It is one of the best spice plants grown worldwide due to its content of spicy taste and fragrance (Ikeh *et al.*, 2012; Obidiebub *et al.*, 2012). Spicy pepper ('berbere') plays a major role ingredient in the daily Ethiopian pulps (wot), and the raw fruit is used as herbal and nutrition (MARC, 2004). Hot peppers are frequently cultivated at an elevation of 1400 to 1900 meter above sea level in Ethiopia (MoARD, 2009; EIAR, 2007) and the area receives a yearly precipitation of 600 to 1200 mm, with a temperature ranges of 25 to 28°C (EIAR, 2007).

Hot peppers the most important vegetable crop globally (Acquaah, 2004) because of its versatility, hot peppers are an important plant that is valued primarily for its redness and color. It is among the most valuable crops, the warm season for traditional sauces, Karia, berbere. It is vital for its coloring and raw materials in the market in the form of oleoresin in the processing industry (Bosland and Votava, 2000; Dessie and Birhanu, 2017).

Ethiopian climate and edaphic conditions favor *Capsicum* production under both rainy season and irrigated conditions (Dessie and Birhanu, 2017). Largest part of Ethiopian regions are suitable for hot peppers production (Rutgers, 2010). The planting of red peppers occupies180,701.46 hectares of lands and the cover of 9,832.28 ha green peppers received 1.83 t ha^{-1} red pepper and 6.3 t ha^{-1} green pepper in Ethiopia respectively (CSA, 2020/21).

The yield status of hot peppers expanded to 1.8 - 2.5 t ha^{-1} dried peppers and 15 - 20 t ha^{-1} green peppers under research fields (Lemma *et al.*, 2008). Conversely, the yield of hot peppers on average for smallholder farmers is relatively low in relation to the global average of dry and raw manufacture (2.2 t ha^{-1}) and (17.8 t ha^{-1}) respectively (FAO, 2016). Oleoresin capacity of *capsicums* varies amid 9.0% in 'PBC-776' and 21.8% in 'PBC-380' in (Pandey *et al*., 2008) and Marako fana variety of Ethiopia contain 3.5% of oleoresin which is very low in comparison at the international level (5-12%) (Rutgers, 2010).

Poor soil fertility is an additional factor that inhibits yields in the production of hot peppers (Alemu and Ermias, 2000). Most Ethiopian soils do not contain four macronutrients such as nitrogen, phosphorous, Sulfur and potassium and three other micronutrients namely; Zinc, Boron and Copper (EthioSIS, 2016). Hot peppers need a sufficient amount of nutrients large and small never the less N and P are widely used (Bosland and Votava, 2000). N is an important element directly affecting a many metabolic processes, especially photsonthesis (Marschner, 2012). It has contributed to the development and production of hot peppers (Ayodele *et al.*, 2015).

Suitable quantity of nitrogen are essential for good development, harvestable yield, and quality. However, Havlin *et al*. (1999), reported that excessive use of nitrogen delay plant maturation as compared to other nutrients such as phosphorous, potassium, and sulphur, can delay plant maturation. Too much use of nitrogen fertilizer enhances agro-ecology contamination and pointers to certain damage on soil productiveness (Fischer and Richter, 1984); necrotic abrasions which causes leaf removal (Hartz *et al.*, 1993); prominent to minimize yields (El-Shobaky, 2002).

Farmers produce peppers in the Dambi Dollo area during rainy season. It is not customary to use fertilizer in the production of hot peppers. As a result, production is low due to N, P and other trace elements as deficiency of S, B, Zn is a main factor for productivity. Based on the data obtained from Ethio-SIS (Ethiopian Soil Information System) nutrients such as S, B, and Zn are scarce in Ethiopian soil and also Dambi Dollo region next to nitrogen and phosphorous (ATA, 2013).

Nitrogen, Phosphorous and Sulphur (NPS) is the newly introduced fertilizer containing 38% P_2O_5, 19% Nitrogen and 7% sulfur and this situation is changing with the use of integrated fertilizers that are known to be closely related to specific African soil needs, including Ethiopia. Currently, in addition to the deficiencies of nitrogen and phosphorous, sulphur, boron and zinc are extensive in Ethiopian soil and other soils are also poor in potassium, copper, manganese and Fe (Laekemariam, 2016; Asgelil *et al.,* 2007). Inorganic fertilizers comprising major nutrients nitrogen, phosphorous, potassium and sulphur not merely intensification of yields never the less it also advance the nutritious quality of crop (Wang *et al*., 2008).

Application of organic fertilizer improves soil water holding, unhurried nutrient issue and contributes to the outstanding pool of organic nitrogen and phosphorus in the soil (Jen-Hshuan, 2006). Conversely, the use of farmyard manure (FYM) only as an additional to mineral fertilizer is not sufficient to sustain the current status of crop production (Efthimiadou *et al*., 2010).

In general, the recommended use of rate of NPS fertilizer are main factors that reduce the hot pepper yields (Ayodele *et al.,* 2015; Dessie and Birhanu, (2017) and the poor use of organic fertilizers. There are no studies conducted in the Dambi Dollo area to increase productivity of hot pepper and nutrient deficiency constraints are not sound addressed at Dambi Dollo area. Hot pepper production for development, great yield, quality, pest and disease resistance in the existing agro-ecology needs to be closely monitored and the NPS and FYM recommendation is an important issue to use crop potential in the study area which will ultimately contribute more production of hot pepper. In Dambi Dollo area, hot pepper is a main flavor and vegetable crop produced by the most of the farmers (Gebreyohannes *et al.,* 2010). Conversely, the yield of hot pepper is low due to depletion of the soil nutrient in the area and failure of applying optimum amount of organic and inorganic fertilizers by farmers. The current research was commenced with objectives:

- ✓ To assess the effect of Farmyard manure and NPS fertilizers on growth and phenology characteristics of Marako Fana pepper variety
- ✓ To assess the effect of farmyard manure and NPS fertilizers on yield and yield related traits of Marako Fana pepper variety

2. MATERIALS AND METHODS

2.1. Description of the Study Area

The trial were performed at Dambi Dollo University investigation site in 2021 cropping spell under irrigated condition. The area is situated in Dambi Dollo zone of west region of Ethiopia situated 640 km from Addis Ababa at 1580 m. a. s. l latitude. The area obtains an annual rainfall of 850 to 1200mm. The extreme and least temperatures of the zone are 25 to 32°c and 26 to 30°c respectively. The topsoil of the area is typically sandy loam (Degefa *et al.,* 2021).

2.2. Explanation of Treatments and Experimental Design

Marako Fana Variety of hot pepper were used in this experiment. Variety is more common and are recommended in Dambi Dollo area. The source of the experimental materials (Marako Fana) seeds were gained from the Malkassa Agricultural Research Center and disseminated in rows 15 cm from the nursery built into a ready seed bed and adequate number of plantlets were raised up to inspect the field.

The recommended country wide level of mineral fertilizer use of 82 kg N ha^{-1} + 92 kg P_2O_5 ha^{-1} for the crop and 10 t ha^{-1} FYM which was deliberated as optimal biological fertilizer proportion for hot peppers were the foundation to arrange the collective fertilizer treatment. By captivating the use of the whole mineral and biological fertilizers amounts in blend as extreme, the treatments were organized as 100, 75, 50 and 25 % of these amounts in all likely blends.

Field test was organized as Complete Randomized Block (RCB) which is replicated three times. The space between the plants and between the rows was 30 and 70 cm respectively. There were 15 plants in each row and a plot consists of 6 rows. And the entire number of plants per plot is 90. The plot magnitude is 4.5 m in dimension and 4.2 m in width. The border effects (plants on which data was not collected) were considered as leaving the plants found in the two rows at the extreme end of both sides of each plot and the two plants at the end of each row. The plot magnitude of 3.9 x 2.8 m (10.92 m^2) were considered as net plot and 52 plants occupied per net plot. The distance among plots and blocks was 1 m and 1.5 m respectively.

2.3. Descriptions of Experimental Materials

In this field experiment, cow dung was used to produce FYM fertilizer and NPS fertilizer was used. Soil samples were taken by auger to collect soil samples. The variety used in this study was Marako Fana released in 1976 by Malkassa Agricultural Research Center was used. Marako Fana pepper is characterized by greater and spicy pods with much required dark-red color. This variety is greatly favorite by the resident customers due to the pungency level, good-looking color and great powder yield. Marako Fana variety is the merely variety used for a long time by the local factories for the extraction of Capsicum oleoresin for the export market (MARC, 2003).

The production of Marako Fana peppers varies according to the agronomic practice and agro-ecological condition of the environment in Ethiopia. Marako Fana's marketable yield was between 1.5 t ha^{-1} to 2 t ha^{-1} (MARC, 2005) and Addisalem (2011) reported that the pepper response to use of N and K fertilizers at Agarfa, South-Eastern Ethiopia, the maximum saleable yield of Marako Fana was about 2.72 t $ha^{-1}$from supply of 100 kg N ha^{-1}+115 kg P_2O_5 ha^{-1}) in soil textural class of clay. Marako Fana pepper variety provided 2.83 t $ha^{-1}$of dry pod yield in Abergelle district (Kassa, 2015). The study from adaptation trial of Melaku *et al.* (2015), showed that Marako Fana pepper variety gave about 2.066 t ha^{-1} of marketable yield under Gedeo Zone of Dilla condition. Haileslassie *et al.* (2015), also stated that the green marketable yield of Marako Fana variety in Raya valley was 32.545 t ha^{-1}.

2.4. Experimental Procedures

To prevent evaporation of nutrients from cow dung (Farmyard manure) it was made in a ditch below shade. FYM decay is done as recommended by Sankaranarayanan (2004) who reported that the manure becomes ready for use after four to five months after plastering. FYM decomposed for about 6 months resulting standard procedures used in this test. All obtainable debris and waste were assorted with dung and placed in a ditch. Part of the ditch from the end was used for satisfying with everyday gathering of three successive days and after the section is occupied sufficient, the top of the heap was made into a dome and surfaced with a dung earth slurry. After 2 months of decay, the cow dungs were transported in to other well-arranged trench first in the morning. Then after, it was left for decay for about four more months.

The seed bed size of 1 x 5 m were prepared and the seeds were sown in 06 November 2019. Dry glass mulch was used to cover the seedbeds till appearance and irrigated using spraying cane as desirable.

After full seedling emerge, the covering is detached and the beds are covered by raised shade to guard the sprout from sturdy sun shine till eight days persisted for resettling. Irrigation is done with a well spraying cane in which the regularity varied according to the categories of seedlings and the seedbed was manually cleared.

Plantlets are planted in the field one and a half months (48 days) after sowing or in the stage after the sprouts have reached 20 to 25 cm in height. Arrangement of test units was finished one month before the seedlings were relocated on November 20, 2019. Thereafter, FYM applications for test units were made on FYM acquired sites. During Farmyard (FYM) fertilizer application was spread on the site one month beforehand seedlings transplanted. The well decomposed cow dungs were variegated with soil manually. Transplanting took place on December 21, 2019. Replenishing of deceased plantlets in the field was ready one week after transplanting on the place where the first seedlings were planted.

2.5. Properties of the Experimental Soil

The Physico-chemical properties of the experimental soil is explained in the following Table 1.

Table 1. Selected physicochemical properties of the soil at the experimental site before planting

Properties	**Result**	**Rating**
Depth (cm)	0-30	-
Sand, Silt, clay	40, 25, 35	-
Textural class	Clay loam	-
pH (1:2.5 H_2O)	5	Slightly acidic
Organic matter /OM/ (%)	4.99	Medium
Organic carbon /OC/ (%)	2.9	Medium
CEC (meq/100g soil)	43	Very high
Total nitrogen/TN (%)	0.27	Medium

2.6. Statistical Analysis of Data

The collected data were exposed to variance analysis (ANOVA) in overall rectilinear model of Genstat 16th edition statistical package. The least Significant Differences (LSD) at 5% probability level was used to compare the treatment rate at which ANOVA showed significant difference.

3. RESULTS AND DISCUSSION

3.1. Crop Phenology and Growth Traits

The variables like days to 50% flowering and plant heights are significantly affected by the main and collaboration effect of FYM and NPS fertilizers. Early flowering (69 days) was recorded at NPS fertilizer levels of 0 kg ha^{-1} and FYM rate of 0 t ha^{-1} (control treatment) and the late days to flowering (87 days) were observed at 300 kg ha^{-1} NPS stimulant rate and 10 t ha^{-1} FYM application (Table 2). This variation may be due to NPS fertilizer which has a positive effect on flowering initiation, where accelerating the germination phase by the accumulating effect of nutrients absorbed in the process of photosynthesis but the nitrogen contents slows flowering time due to metabolites by vegetative tissue.

Delays in flowering due to high levels of fertilizers application maybe due to the rich absorption of nutrients by plants which increases the vegetative growth and delays the reproductive stage. Flowering may delay or inhibited by the further production of new leaves and stems.

Likewise, Adhikari *et al.* (2016) noted that chemical fertilizers have a tendency to offer the plant with sustenance faster and promote vegetative development, thus, suspending the blossoming in pepper. High nitrogen levels promote vegetative development at the outflow of flowering (Mills and Jones, 1979). Correspondingly, Guohua *et al.* (2001) suggested that blossoming is hindereddue to increased N availability due to the alteration of photosynthate to vegetative development rather than towards reproductive growth of the plant.

The first flowering days (66.33 days) of the Marako Fana variety was noted from the design treated with 0 kg N ha^{-1} and 138 kg P_2O_5 ha^{-1}and the late blossoming (93.33 days) was obtained in plots that applied a mixture of 92 kg N ha^{-1} and 0kg P_2O_5 ha^{-1} (Amare *et al.*, 2013).

The highest plant height (62.01cm) is recorded in the NPS fertilizer of 200 Kg ha^{-1} of fertilizer and 5 t ha^{-1} of FYM and the low plant height (29.25 cm) was noted at control or unfertilized (0 NPS fertilizer and FYM) (Table 2). This may be due to better nutrient supply may be better plant growth. In agreement with Gonzalez *et al.* (2001) who stated that the use of biological manure and mineral fertilizer increased growth variables including plant height. Likewise, El-Tohamy *et al.* (2006) reported that increased plant height may be initiated due to more accessibility of soil nutrients in growing areas, particularly N and P, which contribute to plant development by cumulative cell division and elongation.

The reason that sulfur has an inorganic fertilizer application is not very different and that the highest plant height can be attributed to the fact that sulfur plays a main role in the functions of soil nutrients. Sulfur consumption may contribute to the availability of other nutrients to the plant in addition to its role. Likewise, Hassaneen (1992) found that application of sulfur plays an significant role in the soil used as a soil supplement to improve the accessibility of nutrients such as P, K, Zn, Mn and Cu and additionally Hassaneen (1992), suggests that the sulphur element lowered the pH of the soil and converted unrefined phosphorus into an available form for plant tissues. Furthermore, Awodun *et al.* (2007) also noted that NPK fertilizer significantly enlarged growth factors of pepper.

Table 2. Interaction effect of FYM and NPS fertilizer on days to 50% flowering and plant height

Farmyard manure (kg ha^{-1})	**NPS Rate (kg ha^{-1})**							
	Days to 50% flowering				Plant height (cm)			
	0	100	200	300	0	100	200	300
0	69.25^{i}	74.94^{fgh}	75.32^{efgh}	74.94^{fgh}	29.25^{f}	35.69^{ef}	35.39^{ef}	37.68^{e}
2.5	71.75^{hi}	74.95^{fgh}	79.25^{cde}	78.57^{def}	31.35^{ef}	36.08^{ef}	50.24^{cd}	50.91^{cd}
5	76.29^{efg}	83.05^{bc}	82.0^{bcd}	83.95^{ab}	32.80^{ef}	54.63^{bc}	62.01^{a}	52.38^{bcd}
7.5	75.45^{efgh}	73.40^{gh}	81.73^{bcd}	81.58^{bcd}	32.95^{ef}	47.74^{cd}	54.84^{bc}	51.45^{bcd}
10	75.7^{efgh}	76.56^{efg}	80.8^{bcd}	87.25^{a}	32.46^{ef}	45.61^{d}	58.29^{ab}	51.02^{cd}
LSD (0.05)	4.06				7.162			
CV (%)	3.2				9.8			

Means sharing the similar letters are not suggestively dissimilar at 5% level of implication, LSD (0.05) = Least Significant Difference at 5% level, CV= coefficient of variation,

3.2. Days to Maturity and Number of Pod Per Plant

The variables like days to maturity and number of pod per plant are suggestively influenced by the collaboration effect of FYM and NPS fertilizers. The early matured (124 days) hot pepper was recorded in 0 NPS kg ha^{-1} and 0 t ha^{-1} FYM application while the late matured (146 days) hot pepper was recorded in 300 NPSB kg ha^{-1} and 10 t ha^{-1} FYM. The highest number of fruit per plant (26.56) was noted in 200 NPS kg ha^{-1} and 5 t ha^{-1} of FYM, whereas the lowermost number of pod per plant (13.79) was recorded in 0 NPS kg ha^{-1} and 0 t ha^{-1} of FYM (control) (Table 3).

It may be due to combination of a high level of inorganic fertilizer with a low value compared to FYM which may result in the release of nutrients more easily than a high level of FYM. The result indicated that inorganic fertilizers had a profound effect on fruit number of Marako Fana pepper variety. Unless FYM is united with mineral fertilizers, the practice of farmyard manure only might not entirely content the nutrient requirements of the crop, especially in the application year (Patel *et al*., 2009). Likewise, Shuresh *et al.* (2013) studied the production of pepper using different sources of nitrogen in the subtropical climate and found that percentage of fruit set was highest on application of 50% FYM+50 UREA. This finding is concomitant with Aliyu (1997) who considered the effect of farmyard manure and poultry manure on growth of pepper and initiate that poultry manure at a rate of 9 t ha^{-1} significantly improved plant heights, number of fruits and fruit yield of pepper.

Bosland and Votava (2000) have shown that when assimilates from leaves is limited it affects the pods of pepper and the rates of fruits set are depressingly linked with the number of fruits growing on plants. When a plant produces more fruit, the level of flower production decreases.

Pepper benefits from a certain nitrogen, but too much nitrogen can stimulate growth leading to large plants with few first fruits. This is because the high nitrogen supply is likely to produce large, fruit bearing plants initially with a decrease in subsequent flowers production and as a result reduce the amount of fruit. It may also be due to salinity effect.

Table 3. Interaction effect of FYM and NPS fertilizer on days maturity and fruit number per plant

Farmyard manure (kg ha^{-1})	**NPS Rate (kg ha^{-1})**							
	Days to maturity				Number of fruit per plant			
	0	100	200	300	0	100	200	300
0	124.7^{g}	127.0^{g}	126.7^{g}	127.0^{g}	13.79^{k}	15.81^{hij}	16.78^{ghi}	18.88^{ef}
2.5	127.0^{g}	130.4^{f}	142.5^{bc}	138.0^{e}	14.25^{jk}	15.46^{ij}	23.85^{bc}	23.7^{bc}
5	125.3^{g}	139.1^{de}	141.6^{cd}	142.8^{bc}	14.31^{jk}	24.86^{b}	26.56^{a}	22.56^{cd}
7.5	126.7^{g}	144.7^{b}	144.7^{b}	143.6^{bc}	13.69^{k}	17.33^{fgh}	21.8^{d}	22.69^{cd}
10	130.7^{f}	139.1^{de}	144.0^{bc}	148.0^{a}	13.33^{k}	16.89^{ghi}	19.62^{e}	18.35^{efg}
LSD (0.05)	2.98				1.58			
CV (%)	1.3				5.1			

Means sharing the similar letters are not suggestively dissimilar at 5% level of significance, LSD (0.05) = Least Significant Difference at 5% level, CV= coefficient of variation

3.3. Yield and Yield Variables

Marketable and total pod yield were pointedly influenced by the interaction effect of FYM and NPS fertilizers. The maximum marketable yield of hot pepper (2.19 and 2.18 t ha^{-1}) were recorded from 100 and 200 NPS kg ha^{-1} fertilizer combined with 2.5 and 5 t ha^{-1} of FYM application which is 64.66% and 63.91% more than the lowest value recorded at unfertilized (control) treatment (Table 4).

The minimum and significantly different marketable dry fruit yield was seen in an area that did not receive fertilizer. Nonetheless, many of the plots that have treated a mixture of organic and inorganic fertilizers at lower rates and combinations with uppermost rate FYM (10 t ha^{-1}) produced statistically same amount of low marketable dry fruit yield. It may be because the release of FYM elements may be lower compared to other treatments or it may have a toxic effect on higher rate combinations. The production of low marketable yields from high rate combination of mineral and biological fertilizers may be owing to the toxic effect of excessive fertilization. Harmful effects on undeveloped plants notable to backward development or cease have been noted when biological matter in the form of manure or farmyard manure is added at high rates in pot trials under greenhouse circumstances (Gupta *et al.*, 1990).

Bosland and Votava (2000) reported that too much salt in the soil can cause compaction of small leaves in the soil and small seedling can die when little rain moves salt to the younger tender roots. High nitrogen fertilizer is unable to translocate adequate calcium to the pod and as the result the yield could be low.

Likewise, Siti *et al.* (1993) observed that entire commercial fruit weight per plant reduced by 0.5 kg per plant as nitrogen level enlarged from 112 to 448 kg ha^{-1} in pepper. Similarly, Addisalem (2011) found that the marketable yield of Marako Fana reduced as nitrogen level improved from 100 Kg $ha^{-1}$to 150 kg ha^{-1}**.** The production of lower marketable yield from lower rate combinations might also because of that the phosphorus level of FYM released to the crop might be lower in relative to other treatments. The use of essential nutrients increases vegetative growth and this has led to the formation of healthy, attractive and acceptable pods in markets. Furthermore, Matta and Cotter (1994) pointed out that commercial pod yield rise in retaliation to toting of nutrients in nutrient lacking soils.

The highest total pod yield of hot pepper (2.41 t ha^{-1}) was noted from 200 NPS kg ha^{-1} fertilizer mixed with 2.5 and 5 t ha^{-1} of FYM application which is 57.5% more than the lowest value recorded at 0 level application of FYM combined with 100 NPS kg ha^{-1} fertilizer rates (Table 4). The low yield of fresh and dry fruit seen in plots with low levels of inorganic and organic fertilizers in combination may be owing to the low accessibility and captivation of nutrient in the plants to produce high yields. However, the low yields of fruit found in areas where combined inorganic and organic fertilizer at highest rates may be owed to the toxic effect of nutrients supplied at highest rates.

Plants with high nitrogen content are usually dark green in color, have many leaves, but usually have limited root, flowering and seed production can be reduced (Anonymous, 1999). Therefore, the use of recommended levels of 100% NP + very high FYM levels (10 t ha^{-1}) may allow plants to absorb too much nitrogen and phosphorus and with the combination of this slightly salinity problem of the experimental field results in less yield of fruit. Jen-Hshuan (2006) reported that dense use of biological manure to farming soils may consequence in salt, nutrient or weighty metal buildup and may harmfully affect plant development, soil creatures and water quality. Pam and Brain (2007) reported that high levels of nitrate in ground water can become toxic to plants.

High levels of nitrate in groundwater can become toxic. Therefore, excess organic fertilizer may not release nutrients more than at other levels to increase fruit yields instead the negative effect of increased salinity and toxic ground water may reduce and decrease fruit yield.

This mean that the supply of NPS fertilizer in nutrient-free soils is vital to promote the growth of aspects that affect the yield of hot pepper varieties and may be due to sufficient availability of macronutrients by incorporating NPS fertilizers combined with varietal genetic potential, enabling plants to produce energy to get better yield parts. Thus, it shows that the adequate supply of essential nutrients through the efficient use of compound NPS fertilizers for hot pepper varieties shows a main role in improving the components of their yield.

Likewise, Kassa *et al*. (2018) and Kanneh *et al.* (2017) noted that the combined use of N and P had a major impact on the amount of fruits per plant in hot pepper. Furthermore, the use of inorganic fertilizers containing sulfur elements improves the yield of chili. Proper supply of essential nutrients is essential for strong vegetative growth, thus creating better pepper seeds; in contrast, the deficiency of macronutrients has led to poor seed growth thus having a small amount of seed obtained and reduce yields (Uchida, 2000).

Table 4. Interaction effect of FYM and rates of NPS fertilizer on marketable and total pod yield

Farmyard manure (kg ha^{-1})	**NPS Rate (kg ha^{-1})**							
	Marketable yield (t ha^{-1})				**Total pod yield (t ha^{-1})**			
	0	100	200	300	0	100	200	300
0	1.33^{i}	1.39^{i}	1.35^{i}	1.54^{fg}	1.58^{hi}	1.53^{i}	1.59^{hi}	1.72^{fgh}
2.5	1.56^{efg}	1.50^{gh}	2.18^{a}	2.18^{ab}	1.77^{fg}	1.7^{fgh}	2.36^{b}	2.28^{b}
5	1.66^{de}	2.19^{a}	2.17^{ab}	2.10^{ab}	1.81^{ef}	2.62^{a}	2.26^{b}	2.35^{b}
7.5	1.52^{g}	1.60^{efg}	2.07^{b}	1.86^{c}	1.7^{fgh}	1.74^{fgh}	2.22^{b}	2.00^{cd}
10	1.40^{hi}	1.64^{def}	1.67^{de}	1.74^{d}	1.63^{ghi}	1.84^{def}	1.94^{cde}	2.05^{c}
LSD (0.05)	0.11				0.16			
CV (%)	4.0				5.1			

Means sharing the similar letters are not suggestively dissimilar at 5% level of significance, LSD (0.05) = Least Significant Difference at 5% level, CV= coefficient of variation

Unmarketable pod yield was greatly influenced by NPS fertilizer and FYM. The maximum unmarketable yield of hot pepper (0.22 t ha^{-1}) was noted from 300 NPS kg ha^{-1} fertilizer combined whereas the minimum unmarketable yield (0.2 t ha^{-1}) was documented at 0 NPS kg ha^{-1} of fertilizer. On the other hand, the highest unmarketable yield (0.25 t ha^{-1}) at FYM use of 10 t ha^{-1} while the minimum unmarketable yield (0.15 t ha^{-1}) was noted at 7.5 t ha^{-1} of FYM application (Table 5).

The maximum FYM (10 t ha^{-1}) application alone also produced a second very different unmarketable dry fruit yield. Most other combined mineral and biological fertilizers have formed approximately the same quantity of unmarketable dry fruit yields. Treatment with an adequate level of phosphorus may initiate the development of fruit set and thus produce acceptable pods in the market. Fruits harvested from low-phosphorous treated fields may be smaller in size, less firm, lesser in shininess and show a higher proportion of more impairment compared to high phosphorous treated plots. There may also be phosphorus deficiencies in compost treated areas to produce a high yield that can be sold due to improper pod color

Table 5. Main Effect of FYM and NPS fertilizer on unmarketable tuber yield

NPS (kg ha^{-1})	**Unmarketable Yield (t ha^{-1})**
0	0.20^{a}
100	0.14^{b}
200	0.21^{a}
300	0.22^{a}
LSD (0.05)	0.04
FYM (t ha^{-1})	
0	0.20^{b}
2.5	0.17^{bc}
5	0.19^{bc}
7.5	0.15^{c}
10	0.25^{a}
LSD (0.05)	0.043
CV (%)	26.7

Means sharing similar letters are not suggestively dissimilar at 5% level of implication, LSD (0.05) = Least Significant Difference at 5% level, CV= coefficient of variation,

4. Conclusion

From this research, it be able to be decided that the hot pepper development and yield fluctuations react differently to the flexible doses of NPS and FYM fertilizers. According to the current study, the maximum yield was noted from 200 kg NPS ha^{-1} in combination with 5 t ha^{-1} of FYM. Thus, 200 kg ha^{-1} of NPS with 5 t ha^{-1} was instigated to be an optimal and effective fertilizer for farmers planting hot peppers for the study area. Thus, it may be suggested that different types of hot pepper produce better yields.

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