Journal of Biology, Agriculture and Healthcare
ISSN 2224-3208 (Paper) ISSN 2225-093X (Online)
Vol.5, No.10, 2015

Evaluating the Effect of Integrated Use of Farm Yard Manure and Urea on the Yield &Yield components Tomato (Lycopersicon esculentum Mill) in the Low Land Irrigated Areas of North western Tigray, Ethiopia

Gebremedhn Gebrtsadkan* Dereje Assefa
1.Shire-Maitsebri Agricultural Research Center, Shire, Ethiopia
2.Department of Natural Resource Economics & Management, Mekelle University, Mekelle, Ethiopia
E-mail:gebrsh04@gmail.com

Abstract
The prevailing higher prices of inorganic fertilizer along with low nutrient value and shortage of organic nutrient sources like Farm Yard Manure (FYM) has become a main problem in managing soil fertility problems, especially for resource poor farmers. So, integrated use of organic and inorganic plant nutrient sources help to overcome problems with the sole application and have more rewarding on stability in production and in maintaining soil fertility. Based on this, a field experiment was conducted to study the effect of integrated use of organic (FYM) and inorganic (Urea) plant nutrient sources on yield and yield components of irrigated tomato(Lycopersicon esculentum Mill),in Tselemti wereda, May ani site during the 2012/13 off season time. Organic (FYM) and inorganic (Urea) nutrient sources was integrated in different proportions to supply 60Kgha^{-1} of Nitrogen (N) from both sources at different ratios. The treatment combinations are T1 (control or with no fertilizer), T2 (100%IF), T3 (25% FYM+75%IF), T4 (50%FYM+50IF), T5 (75%FYM+25%IF) & T6 (100%FYM).Phosphorus was applied at a recommended rate in the form of TSP, adjusted on the basis of phosphorus present in the soil and FYM. The experiment was arranged in RCB Design with four replications. Tomato (variety; Roma VF) was used. Top soil (0-30cm) was sampled before transplanting& after harvest and analyzed for selected soil properties and FYM also analyzed for its chemical composition prior to its application. The results revealed that there was a significant difference in tomato marketable yield and fruit parameters recorded among the treatments. Integrated use of FYM and Urea N sources in 25:75 ratios produced the maximum marketable yield (375.4Qlha-^{1}), fruit yield/plant (2.37Kg),& fruit number/plant (32) and fruit diameter (4.67cm) of tomato followed by plots fertilized with 50:50 ratios.. From this study, it can be concluded that, combined application of FYM with Urea at (25:75&50:50 ratios) significantly increased the tomato yield than other combinations. Therefore, it is recommended to use these combinations for tomato producers of Tselemti wereda for better tomato yield and sustainable soil fertility.
Keywords: FYM, Inorganic, Integrated, Organic, Soil fertility, Tomato, Urea, Yield, Sole application

INTRODUCTION

Recent agricultural trends indicated that yield for many crops are not rising as quickly as they did because of declining soil fertility and mismanagement of plant nutrients. So the challenge for agriculture for the future generations will be to meet the world's increasing demand for food while, maintaining and improving soil and environmental quality in a sustainable way (Peter *et al.,* 2006; Reeves, 1997).

According to Balesh (2006), Soil fertility degradation is described as the most important constraint to food security in Africa in general and SSA in particular. Nutrient status is widely constrained by the imbalances caused due to nutrient input and outputs, resulting to negative nutrient balances. The problem with nutrient imbalance is attributed to insufficient use of mineral and organic nutrient sources as inputs relative to nutrient loss as exports.

Similarly, soil fertility status of Ethiopia is not much different from the situation of SSA region, except higher rates of nutrient depletion and land degradation than most of SSA countries, due to lack of adequate mineral fertilizer input, limited return of organic residues and manure, high biomass removal, erosion, leaching and its dominant high land topography. So, there is an urgent need to improve nutrient management (Habtegebrial and Haile, 2009).

Use of chemical fertilizers is an essential component of conventional agriculture. This approach emphasized the use of external inputs and expensive technologies and often disregarded farmers' knowledge and the resources at their disposal (Ndufa *et al.,* 2005).But ever increasing cost of energy has been an important constraint for increased use of inorganic fertilizer particularly for resource poor farmers (Lay *et al.,* 2002).

It is not possible to obtain a higher crop yield by using organic manure alone due to their unavailability in excess amount and they contain a comparatively low quantity of nutrients compared to inorganic fertilizers (Sarker *et al.,* 2011). Therefore, an urgent need to develop a technology which emphasis on the reduced use of purchased chemical fertilizers, the significant saving of scarce cash resources for small farmers, ensures the conservation and efficient use of native soil nutrients and recycling of organic nutrient flows (Vlaming et al.,1997). Hence, integrating the two forms (Organic and inorganic nutrient sources) and using simultaneously has been suggested as the most effective and alternative method of replenishing and maintaining soil fertility in order to achieve better crop yield. In this regard Farm Yard Manure (FYM) integrated with inorganic fertilizers (Urea), is one of the promising techniques for improving soil fertility and increasing tomato productivity (Sedaf and Qasimkhan, 2010).

Numerous trials have compared the yields from a given amount of inorganic fertilizer (A), organic material (B) and their combination (A+B), in many situations (A+B) have produced higher yields than A or B alone (Muhammad *et al.,* 2003).

The judicious integrated use of both nutrient sources provides an ideal environmental conditions for the crop, as the organic source improves soil properties and enhance the activity of soil biota, immobilize nutrients and slowly releases them, while the inorganic sources made available nutrients immediately, avoiding nutrient depression periods and hastens the decomposition of organic material (Habtegebrial and Haile, 2009). It has been acknowledged that organic and inorganic fertilizer inputs cannot be substituted entirely by one another and are both required for better and sustainable crop production (Anderson *et al.,* 2002; Place *et al.,* 2003).

Tomato (*Lycopersicon esculentum mill*) is a nutritious and popular product all over the world. At present tomatoes ranks third, next to potatoes and sweet potatoes, in terms of global vegetable production. In Ethiopia tomato is also among the most popular and widely grown vegetable crops. Its production has shown a marked increase since it became the most profitable crop providing a higher income to small scale farmers, compared to other vegetable crops (Lemma Dessalegne *et al*., 1992). However, the national average tomato yield in Ethiopia is quite low as compared to the potential productivity of the crop and other African countries like Kenya.

As compared to the potential productivity of the crop, the majority of tomato growers in the study area Tselemti '*woreda* 'were not getting as much yield as expected, because of the low soil fertility and lack of improved & site specific agronomic management practices.(Tesfaye Balem, 2008). To mitigate the problem farmers commonly use a blanket recommendation of inorganic fertilizers (100Kg urea/ha) without considering the potential of the soil and alternative nutrient options such as FYM. But currently most farmers are not applying inorganic fertilizers at recommended rates, because of the high price of inorganic fertilizers. Hence, use of FYM would be un avoidable, particularly for resource poor farmers. However FYM alone may not be enough to meet the nutrient requirements of high yielding tomato varieties. However, no study has been done on the use of integrated fertilization on the production of tomato so far in the study area. Therefore, the aim of this research was to study the impact of combined use of FYM and urea nutrient sources on the yield and yield attributes of off season tomato on Tselemti woreda, Northern Ethiopia.

MATERIALS AND METHODS

The field experiment was conducted at North Western Zone of Tigray,Tselemti woreda May ani '*kebele'* on farmer fields during the off season of 2012/2013.The experimental site is located 10Km north of May tsebri (administrative center of the Woreda) and lies at $13^0$40'N and $38^0$09'E and at an elevation of 1370 meters above sea level (masl). The mean temperature ranges from a minimum of 15.8 ^oC (December) to an average maximum of 35.6^oC (May). It is a low altitude area with average 6 years annual rainfall of 1279.75 mm. The average relative humidity, wind speed and daily sun shine hours of the area are 46.2%, 101.7 km day^{-1} and 8.61hrs respectively. Generally the agro-ecological zone of the '*woreda*' is hot to warm-moist lowlands (M1-7) and Tepid to cool-moist mid highlands (M2-5).

The dominant soil types in the study area are Cambisols, Fluvisols, Nitosols and Vertisols. The result of the experimental site soil analysis shows that the textural class of the soil was clay with a particle size distribution of 37% sand, 19% silt and 44% clay and a pH of 5.98. In addition, the soil was slightly acidic with low total nitrogen, low organic carbon and available phosphorus. This type of soil dominates in all irrigation areas of the study '*Woreda*' (MyARC, 2010).

Surface soil samples from the depths of (0-30cm) were randomly collected from different points with in the entire experimental field using an auger before planting to form composite samples. The samples were analyzed at Tigray Agricultural Research Institute (TARI) soil laboratory center and Mekelle University to determine the soil chemical and physical properties such as: texture, soil pH, total nitrogen, available phosphorus, available potassium, CEC, and organic carbon. Standard laboratory procedures for analyzing physical and chemical parameters were carried out for the composite surface soil samples. Soil texture was determined by the hydrometric method (Day, 1965; Gee and Bauder, 1986). Organic matter was determined based on the oxidation of organic carbon with acid dichromate medium following the Walkley and Black method as described by Dawis and Freitas (1970). Total nitrogen was analyzed using the Kjeldahl method (Dewis and Freitas, 1970). The available soil phosphorus was determined according to the methods of Olsen and Dean (1965); available potassium using the Morgan method (Morgan, 1941); CEC using the ammonium acetate method and Soil pH was determined in 1:2.5 soils: water ratio using a digital pH meter (Sahelemedhin and Taye, 2000). Composite soil samples of 1kg from three angular points within the plot (0-30 cm) were collected from all the 24 plots after harvest. The same procedure was followed like that of pre planting to analyze the same chemical properties of the soil to determine the effect of applied different treatments in the soil.

Well decomposed and one year old of FYM was used as a source of organic nutrient. The same method as the soil was used for preparation and analysis of the major chemical parameters of the FYM.

The field experiment was laid out in Randomized Complete Block Design (RCBD) with six treatments and four replications. Accordingly, treatments were assigned randomly to the experimental plot within a block. A plot size of 3.75 x 4 m (15 m^2) was used. The blocks were separate by 1.5m, whereas plots within a block were 1m apart from each other. Each plot consists of 5 rows of 4m length, with a spacing of 75cm between rows, 30 cm between plants and has a total population of 65 plants. The total experimental area was 29m by 19.5m i.e. 565.5m^2.

The field experiment consisted of 6 treatments involving FYM and Urea as a nutrient sources which are intended to supply 60Kgha^{-1} N in different ratios except the control treatment. i.e

Table- Treatment details used in the experiment

Treatments	% N from FYM	% N from Urea	Treatment details	Nutrient equivalency from both sources
T_1	0	0	Control	Control
T_2	0	100	No FYM +130Kg/ha Urea	60 Kg N from IF only
T_3	25	75	4.5t/ha FYM+97.5Kg/ha Urea	15Kg N from (FYM)+45Kg N from IF
T_4	50	50	9t/ha FYM +65Kg Urea	30Kg N from (FYM)+30Kg N from IF
T_5	75	25	13.5t/ha FYM +32.5 Kg/ha Urea	45Kg N from (FYM)+15Kg N from IF
T_6	100	0	18t/ha FYM +No IF	60 Kg N from FYM only

T_1: Without any fertilizer (0:0)
T_2: Fertilization with 100% IF (0:100)
T_3: Fertilization with 25% FYM + 75%IF (25:75)
T_4: Fertilization with 50% FYM + 50% IF (50:50)
T_5: Fertilization with 75% FYM + 25%IF (75:25)
T_6: Fertilization with 100% FYM (100:0)

Tomato is a heavy feeder of plant nutrients especially nitrogen. The nitrogen demand of tomato is depending mainly on the fertility status of the soil, cultivar and the target yields expected. According to Shankara *et al.,* (2005), for 40t/ha of tomato production (bench mark yield planned by BoARD), 120Kg N/ha is required. In order to add the required amount and proper integration of organic and inorganic fertilizers for tomato production, soil test and calibration of nutrients based on soils laboratory result is very important. The following procedures were used for the proper calibration and integration of fertilizers.

A pre- transplanting composite soil (0-30cm) sample was characterized in the laboratory for nitrogen, phosphorus, bulk density and other parameters. Based on the soil laboratory results of nitrogen and bulk density, the total amount of nitrogen/ha in the 0-30cm depth was calculated.

Accordingly, from the total nitrogen present in the soil about half is always be available (dynamic reserve) and the other half does not easily release (inert reserve),similarly only about 4% of the dynamic reserve is directly available for crop production. Through this information the total nitrogen present in the soil is calculated then subtracted from the required amount and identified the gap. In order to fill the gap and supply the recommended amount of nitrogen from both inorganic & FYM sources, laboratory analysis of FYM was also carried out. According to Gordon *et al.,* (2000), the amounts of organic N converted to plant-available forms during the first cropping year after application vary according to both livestock species and manure handling systems, but in general, about 50% of the organic N may become available the year of application and nearly all of the phosphorus in manure is available for plant use the yea of application. Phosphorus was also applied at a recommended rate in the form of superphosphate and adjusted on the basis of phosphorus present in the soil and FYM.

Based on the above procedure there was about 60kg/ha of nitrogen present in the soil. So, only 60Kg N is applied to calibrate the nutrient requirement of the tomato crop. To supply this amount of nitrogen for tomato from the sole application of FYM and Urea 18t and 130Kg is required respectively. The treatments were arranged based on this principle.

Improved tomato variety 'Roma VF' was used as planting material.

Full dose of organic and half of Urea was applied at the time of transplanting, and the remaining half of Urea was top dressed three weeks after transplanting and at the time of flower initiation. All management practices (ploughing, cultivation, watering, nursery and transplanting method, weeding and others) were applied uniformly to all plots as per standard recommendations for the crop. Seed was sown in nursery on 5 October, 2012 and transplanted after five weeks on 11 November, 2012. The experimental area was kept weed free by hand pulling four times throughout the cropping season.

All data relating to yield and yield components were collected from the central three rows with a net area of 9.75m^2 excluding plants from either end of the rows by 0.75m. For the purpose of crop data collection two plants per row or six plants per plot were tagged randomly and observations on growth, yield and yield components of tomato such as plant height, fruit number, days to physiological maturity, days to 50% flowering, average fruit weight, Marketable fruit yield/plant, fruit diameter, fruit length, marketable and unmarketable fruit yield/plot were recorded periodically.

All crop collected data in this study were subjected to one way statistical analysis of variance (ANOVA) following a procedure appropriate to a randomized complete block design as suggested by (Gomez and Gomez, 1984) and was computed using Gen-Stat 13th edition statistical software. Whenever the treatment was significant, least significance differences (LSD) by Dunken's multiple range comparison was used for mean separation at p=0.05 &p=0.001.The statistical model used for analysis of the data collected from the experimental field is given by:

$\mathbf{Y_{ijk} = \mu + A_i + B_j + \varepsilon_{ijk}}$

Where:

$\mathbf{Y_{ijk}}$ = the response variable

μ = Overall mean.

$\mathbf{A_i}$ = Effect of factor A (organic fertilizer),

$\mathbf{B_j}$= Effect of factor B (inorganic fertilizer),

$\boldsymbol{\varepsilon_{ijk}}$ = Treatment error of factor A (organic fertilizer) and factor B (inorganic fertilizer) and replication as block K.

RESULTS AND DISCUSSION

Fruit Diameter

Fruit diameter of tomato was significantly (P<0.01) longer from plots fertilized with integration of organic and inorganic N sources over the control and sole application of inorganic (Urea) and FYM sources. The highest fruit diameter (4.67cm) was recorded in 50:50 (T4) fertilized treatments, followed by plots fertilized with 25% N from FYM and 75% N from Urea, whereas the lowest fruit diameter from the fertilized plots was recorded in sole FYM treated plots. Mixed fertilization of irrigated tomato by an equal amount of N from FYM and inorganic sources in 50:50 combinations (T4), resulted in 58.3%, 49% and 33.8% increase in fruit mean diameter of tomato as compared to the control (T1), sole FYM (T6) and sole Urea fertilized plots (T2) respectively.

These results suggested that integrated use of FYM and urea performed better than the use of FYM or urea alone, in terms of improving the fruit diameter despite the fact that the level of applied N was same i.e. 60 kg N ha^{-1} either alone or combinations of both sources. This shows the synergetic effect between the organic and inorganic fertilizers. The combined application of urea and FYM at 50:50 or 75:25 ratio based on net N contribution produced excellent results.

Fruit Length

Fruit length is another important yield component of tomato. Results on fruit length showed variable response to the different fertilizer treatments. Treatments (3, 4 and 5) produced significantly (P<0.05) greater fruit length compared with the control (T1). No significant difference (p<0.05) in fruit length was observed between the 100% Urea (T2) and 100% FYM (T6) fertilized plots as compared with the control (non-fertilized) plots, which recorded 5.78cm and 5.71cm respectively. It was noted that the highest fruit length (6.94cm) was found in (T3) fertilized with 25% N from FYM and 75% N from inorganic sources followed by (T_4) receiving 50%N from FYM and 50% N from inorganic sources.

The ANOVA result also indicates that all plots fertilized from both nutrient sources shows significant difference in fruit length as compared with the sole FYM, but only T_3 (25% FYM: 75%Urea) fertilized plots showed a significant difference with sloe Urea received plots. The experimental results on fruit length showed that fertilization with FYM and Urea at (25:75) combinations helped to produce a longer fruit length of tomato. A Similar study (Roy, 1986), found that the integrated use of organic manures and inorganic fertilizers resulted in higher yield attributes of tomato.

Average Fruit Weight

The treatment effect of integrated use of organic and inorganic nitrogen sources on the average fruit weight of tomato was significantly heavier compared with the control, but all the fertilized treatments were not significantly different (P<0.05) to each other. The control treatment recorded the lowest average fruit weight (0.037Kg), which was significantly lower than all other treatments. Application of 50%N from FYM and 50%N from inorganic sources (T4) resulted in the highest (0.073Kg) average fruit weight. Although there was a general increase of average fruit weight with the increasing ratio of FYM from 25% (T3) to 75% (T5) it was not statically different

Table-1: Yield Components of Tomato as Affected by Integrated use of Fertilizers

T#	Trt. Combination		FD(cm)	FL(cm)	AFW(kg)
	% N f FYM	%N IF			
T1	0	0	2.95^{e}	5.59^{c}	0.037^{b}
T2	0	100	3.49^{c}	5.78b^{c}	0.06^{a}
T3	25	75	3.89^{b}	6.94^{a}	0.07^{a}
T4	50	50	4.67^{a}	6.04^{b}	0.073^{a}
T5	75	25	3.23^{d}	6.03^{b}	0.069^{a}
T6	100	0	3.13^{de}	5.71^{bc}	0.067^{a}
SEM(±)			0.071	0.112	0.0045
LSD(0.05)			0.214	0.337	0.014
CV(%)			4	3.7	14.3

Means with in the same column followed by the same alphabets do not differ significantly at the 5 % level of significance: FYM=Farm Yard Manure ; IF=Inorganic fertilizer; FD=Fruit diameter; FL=Fruit length; AFW=Average fruit weight;Kg=kilogram;cm=centi meter

According to the present findings plots, fertilized with N from any sources (organic or inorganic) increase average fruit weight over control treatments but were not significantly different among each other. The increase in average fruit weight of tomato in N fertilized treatments might be due the nitrogen being the constituent of chlorophyll, promoted cell division and cell elongation functional life of plants and production of good fruits.

Number of fruits per plant (NFPP)

As regard to the number of fruits per plant, all the treatments produced significantly higher fruit number per plant than the control treatments, but no significant difference was observed among all fertilization treatments except treatment T_6 differ from T_3 and $_{T4}$.No significance response to NFPP was observed as fertilized with sole Urea compared with sole FYM and combined application of both nutrient sources, but plots that fertilize with mixed FYM and Urea at ratio of 25:75 (T3) and 50:50 (T4) produces significantly a higher NFPP over the sole FYM fertilized plots. Maximum numbers of fruits per plant (32.5) were obtained in plots where 25%N applied from FYM and 75% N from inorganic (Urea) sources (T3), followed by treatment fertilized with 50%N from FYM and 50% N from Urea with a fruit number of (32).

Comparing the fertilized treatments only T_6 was significantly different from the rest treatments and recorded the lowest number of fruits (24.8) per plant of tomato, followed by treatments fertilized with 75%N from FYM and 25% N from in organic (T5). As the amount of FYM increased from 25% (T3) to 75% (T5) in the combination treatments, number of fruits per plant was not significantly increased. The increase in the number of average fruit number per plant with the combined use of organic and inorganic N sources might be due to the mineral fertilizer and mineralization of organic manures throughout the growing period did not put the plants in nutrient stress at any stage resulted in maximum fruit number per plant production.Similar results also reported (Roy, 1986) who indicated that, the integrated use of organic manures and inorganic fertilizers resulted in higher yield attributes in tomato. Similarly Arif et al. (2006) also reported that a marked increase in the number of grain per ear of wheat by applying organic manures and mineral fertilization in combination.

Fruit Yield per Plant

The differential effect of applied N on fruit yield per plant improved significantly ($P<0.05$) over the control treatment. Statistically, only treatment 25:75(T3) was significantly different from all other mixed and sole fertilized treatments except with 50:50 (T4). The results showed that fruit yield per plant were significantly greater in combined N fertilized treatments than the control. The fruit yield per plant varied from 0.91kg/ plant (control) to 2.37kg/plant in treatments receiving 25%N from FYM and 75% N from urea (T3). Generally, the results showed that every fertilizer treatment produced more fruit yield per plant than the control. The highest fruit yield 2.37 was observed in treatment four i.e. 25% N from FYM combined with 75% N from Urea (T3), and the lowest fruit yield from the fertilized treatments was (1.5Kg) in 100% FYM fertilized treatments (T6). For better fruit yield per plant of tomato N requirements could not be met by solely from FYM or inorganic sources. The results of the experimental data on fruit yield per plant revealed that a combined application of N from both sources, i.e , FYM and Urea in 1:3 ratio improves yield

The results are supported by Sedaf and Qasimkhan, (2010) who reported that Integrated Nutrient Management (INM) improves tomato fruit yield and yield quality.

Table-2: Yield Components of Tomato as Affected by Integrated use of Fertilizers

Trts	Trt. Combination		NFPP	FYPP(Kg)
	% N FYM	%N IF		
T1	0	0	15.95[c]	0.91[c]
T2	0	100	26.40[ab]	1.83[b]
T3	25	75	32.25[a]	2.37[a]
T4	50	50	32.00[a]	1.95[ab]
T5	75	25	26.30[ab]	1.58[b]
T6	100	0	24.88[b]	1.54[b]
SEM(±)			1.95	0.150
LSD(0.05)			5.87	0.452
CV(%)			14.8	17.7

Means with in the same column followed by the same alphabets do not differ significantly at the 5 % level of significance: FYM=Farm Yard Manure ; IF=Inorganic fertilizer; NFPP=Number of fruits per plant; FYPP=Fruityield/plant;kilogram.

Marketable Yield

The ANOVA results showed that all fertilizer treatments highly and significantly (P< 0.01).increased marketable yield of tomato compared with the control. The maximum marketable yield 375.4 Qlha^{-1} of tomato was obtained from the combined application of N from FYM and urea in (T3)

25:75ratio, followed by those plots receiving FYM and Urea in the ratio of the 50:50 (T4), 0:100 (T2), and 75:25 (T5), respectively. The marketable yield was minimum (212Qtha^{-1}) in the control treatments. Plots that fertilize with 100 % N from in organic (Urea) had a significantly lower yield compared to those receiving N from FYM and urea in 25:75 (T3) or 50:50 (T4) ratios. The marketable yield was further reduced significantly when N from FYM and urea were added in 75:25 ratio. Plots that fertilize with 100 % N from FYM showed a significantly lower yield compared with all other fertilizer treatments.

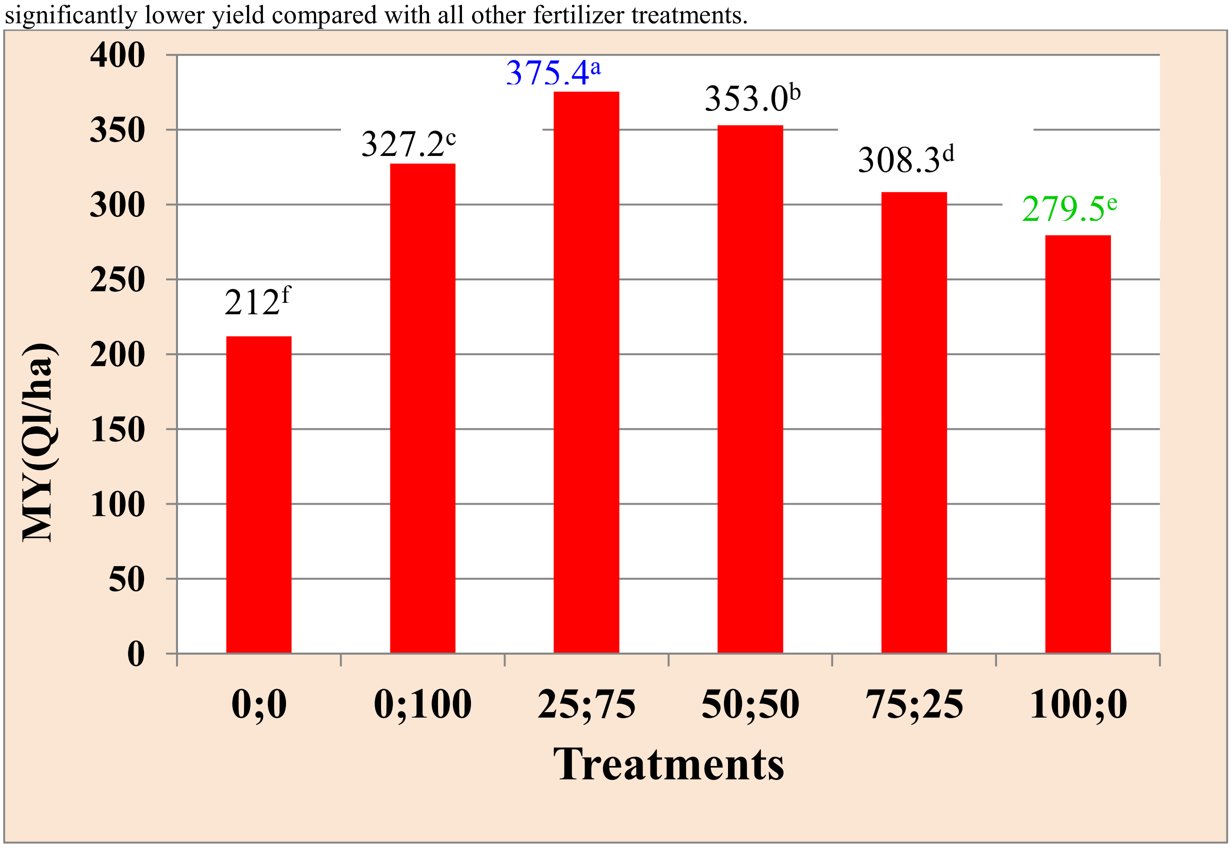

Fig: Marketable tomato yield as affected by integrating use of FYM and Urea

Un Marketable Yield

Application of both organic and inorganic N sources in combination or sole application
Had no significant effect (P<0.05) on unmarketable yield. The results in this investigation showed that even though the treatments receiving 25%N from FYM and 75%N from Urea produced the highest amount of unmarketable yield numerically they are not significantly different with other fertilized and control treatments. From the fertilized treatments T4 which receive 1:1 ratio of FYM and inorganic fertilizer produced the lowest unmarketable yield of tomato (19.58Qtha^{-1}).

Plant Height

Plant height is an important growth character directly linked with productive potential of the plants in terms of fodder and grain yield. The analysis of variance of plant height showed that all the treatments increased plant height significantly (P<0.05) over the control. Taller plants were observed in treatment that combines 25% N from FYM and 75% N Urea (T3).This may be due to the synergist effect of both nutrient sources i.e. N&P mineralization rate respond more at lower FYM and the better availability of inorganic N and enhancing effect of N on vegetative growth.

Plots received 50% N from FYM and 50% N from urea record a higher plant height next to 25:75 combination treatments. As the amount (ratio) of FYM increased from 25% (T3) to 100% (T6) plant height of tomato decreased in the experiment. As compared to the control treatment, the increment in plant height in the fertilized treatments ranged from 9.62cm to 21.8cm. Fertilize with only inorganic fertilizers (Urea) showed significantly higher plant height as compared to only organic (FYM) and 50:50 fertilize treatments. Plant height increased from 72.67 to 81.75cm as the N source from inorganic fertilizer increased from 25% (T3) to 75% (T5).

The probable reason for the decrease in plant height as the ratio of organic manure increase may be due to the slow nature of nutrient release by the organic manure. The result of the experiment confirms with the findings of Iqbal *et al*.,(2002),who reported that application of mineral nitrogen alone or with organic N increased plant height significantly due to stronger role of N cell division, cell expansion and enlargement which ultimately affect the vegetative growth of plant particularly height. Generally it was observed that treatments that received more N from inorganic sources and low N from FYM produced plants with more height as compared to other fertilized and control plots.

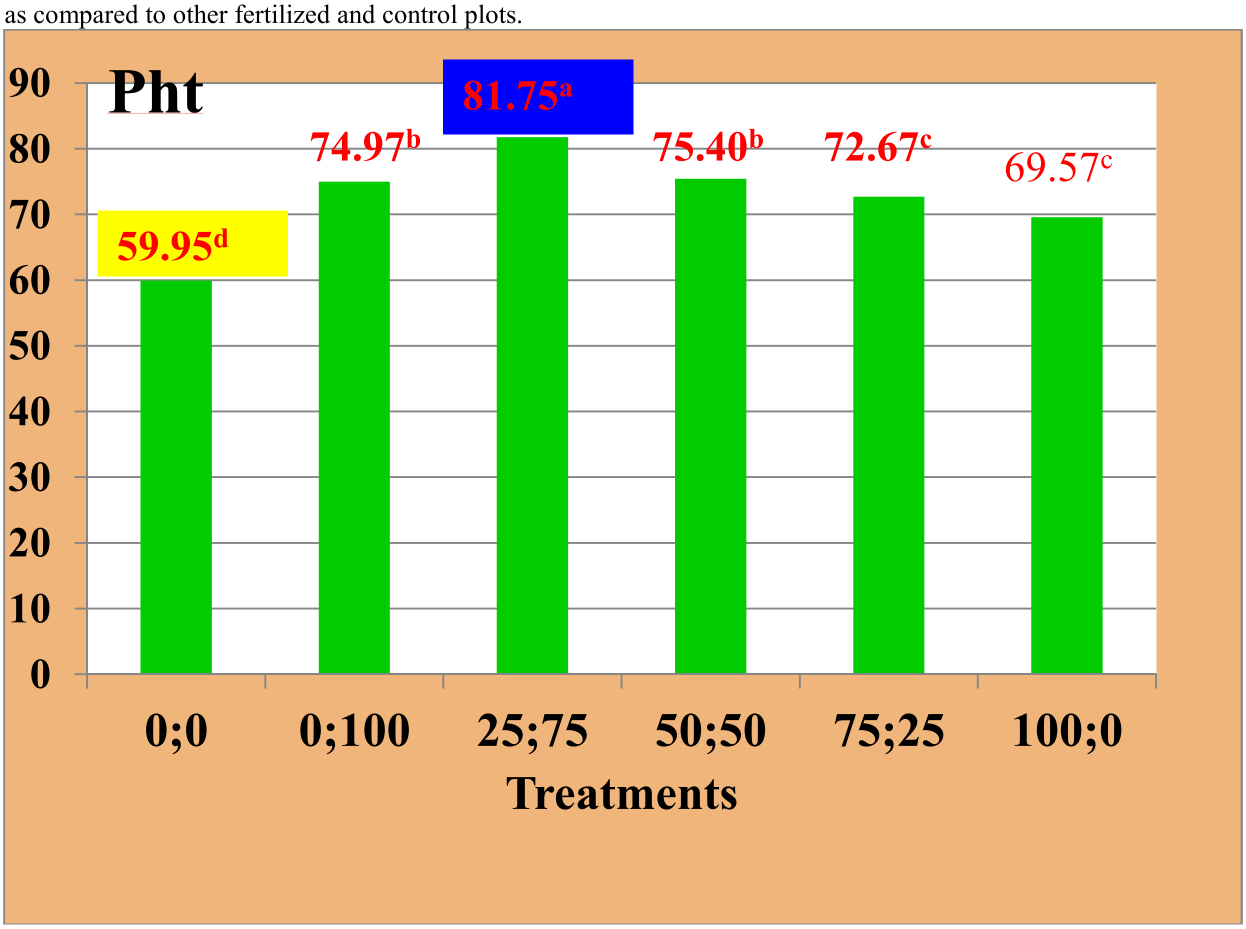

Fig-2: *Plant height as affected by integrating use of FYM and Urea*

Days to Maturity

Integrated use of organic and inorganic fertilizers significantly ($P<0.05$) prolonged the days required for physiological maturity in irrigated tomato. The results showed that physiological maturity of tomato was significantly greater in nitrogen fertilizer treatments than the control and the impact was pronounced at higher level of nitrogen level from FYM.

The shorter days to maturity were recorded from the control plots (T1). Fertilization of irrigated tomato by 100% N from FYM (T6) delayed maturity by 20.5 days compared to non- fertilized (control) treatments. The greater number of days (109.5days) to physiological maturity was recorded in plots receiving 100% N from Farm Yard Manure (FYM). Difference to physiological maturity between the plots that fertilized with 0:100 (T2), 25:75 (T3) and 50:50 (T4)

Combinations were not significant at ($P<0.05$). Increasing the ratio of FYM from25% (T_3) to 100% (at T_6) prolonged days to maturity by 10.75 days. Plots receiving nitrogen from both (FYM and Urea) sources were not significantly different with each other except in 75:25(T5) combinations. Plots that fertilize from only inorganic sources mature earlier next to the control. This agrees with the findings of Koch *et al.,* (1988), who reported that application of commercial fertilizers resulted in increased yields and earlier maturity of maize and N deficient plants are known to have higher specific leaf weights, shortened vegetative growth stages and often a tendency to mature earlier, and compared with well-nourished plants.

Table-3: Physiological maturity of Tomato as Affected by integrated use of Organic & inorganic Nitrogen sources

Trts	Trt combinations		DM
	%N FYM	%N Urea	
T1	0	0	89.0[d]
T2	0	100	97.2[c]
T3	25	75	98.8[c]
T4	50	50	99.8[c]
T5	75	25	104.0[b]
T6	100	0	109.5[a]
SEM(±)			1.18
LSD (0.05)			3.56
CV (%)			2.4

Conclusion

Integrated use of organic (FYM) along with inorganic (Urea) fertilizers performed better than the use of FYM or Urea alone in terms of yield and yield components of tomato, despite that the level of applied nitrogen (N) was same either from alone or combination of both. The statistical result of this investigation showed that the combined use of FYM and inorganic fertilizers significantly affect (increase) all most all the agronomic parameters (marketable yield and other yield attributes), compared with control (non-fertilized) treatments which gave low fruit yield, indicated that soil fertility of the research area is very low and requires soil improvement practices, and among the different combinations of FYM and Urea nutrient sources, tomato respond well to the application of FYM and Urea at a ratio of 25:75, i.e. This combination increased marketable yield by 14.7% from the sole application of Urea and 34% from FYM applied alone. Similarly, yield attributes: taller plants (81.75cm), maximum fruit length (6.94cm), average fruit weight (0.0070Kg) and maximum number of fruits per plant (32.5) were recorded in this treatment. This might be due to the positive and synergy effect of inorganic and organic manure owing to the balanced nutrition, which helped, in increased growth and attributes. So, to get better yield and higher economic benefit from irrigated tomato productions farmers are suggested to use the integration of FYM at (25%) and inorganic fertilizers (75%) rates.

Conflict of Interest

The author(s) have not declared any conflict of interests.

AKNOWLEDGEMENTS

This research was conducted in partial fulfillment of the *M.Sc* degree at Mekelle University by the first author. Funding was provided by the SIDA project.

REFERENCES

Anderson J., Blackie M., Eilitta M., Fernandes E., Sanginga N., Smaling E., and Spencer D.(2002). A consultative review of the Rockefeller foundation's activities to improve and sustain soil fertility in East and Southern Africa. New York.

Arif M.,Ali S.,Khan A.,Jan T.,and Akbar M. (2006).Influence of Farm Yard Manure application on various wheat cultivars Sarhad J. Agric.22(1)22-29.

Balesh Tulema (2006). Integrated plant nutrient management in crop production in the central Ethiopian highlands. Norwegian University of Life Sciences, Norway.

Dawis and Frietas.(1970). Physical and Chemical methods of soil analysis. FAO Bulletin No. 10, Rome, Italy, p 275.

Gee G.W., and Bauder J.W. (1986).Particle-size analysis. p. 383–411

Habtegebrial K. and Hail M. (2009).Introduction to plant nutrition and soil fertility management. Mekele University,Tigray, Ethiopia.

Iqbal A.S., Abbasi M.K.,and Rossl G.(2002).Integrated Plant Nutrition System(IPNS) in Wheat under rain fed condition of Rawalkot Azad Jammu and Kashmir Pak.Jsoil.scie.20:77-80.

Lay G.G., Baltissen W., Veilcamp W., Nyaki A., and Schrader T. (2002). To wards integrated soil fertility management in Tanzania. Developing farmers options and responsive policies in the context of prevailing agro-ecological, socio-economics and institutional conditions. Amsterdam, Netherlands.

Lemma Dessalegne, Yayeh Zewdie and Herath, E. (1992). Agronomic studies in tomato. Horticulture research and development in Ethiopia: Proceedings of the Second National Horticultural Workshops of Ethiopia. Addis Ababa, Ethiopia.

Manual, Maitsebri, Tigray, Ethiopia.

Morgan M. F, (1941). Chemical diagnosis by the Universal Soil Tests System. New Haven, Bull. 450.

Muhammad U., Ehsan U., Ejaz A., and Amir L. (2003). Effect of Organic and in organic Manures on growth and yield of Rice Variety "Basmati–2000".

MyARC (2010). Maitsebri Agricultural Research Center: Rice Production Techniques

Ndufa J. K., Cadisch, G., Poulton,C., Noordin Q. and Vanlauwe, B. (2005)Integrated Soil Fertility Management and Poverty Traps in Western Kenya.

Negi, S. C., and Mahajan G. (2000). Effect of FYM, planting methods and fertilizer levels on rain fed wheat. Crop Res. Hisar. 20 (3) 534-536.

Olsen S.R., Cole C.V., Watnable F.S., and Dean L.A. (1954). Estimation of Available Phosphorous in Soils by Extraction with Sodium Bicarbonate. USDA.

Peter G., Francesco G., and Montague Y. (2006).Integrated nutrient management, soil fertility, and sustainable agriculture. Current issues and future challenges

Place F., Christopher B., Barrett B., Freeman A., Bernard D. and Vanlauwe, D. (2003). Prospects for integrated soil fertility management using organic and inorganic inputs: Evidence from smallholder African agricultural systems. Food Policy 8(2003): 365-378

Reeves D. (1997).The role of soil organic matter in maintaining soil quality in continuous cropping systems. Soil tillage research 43:131-167.

Roy R. N. (1986). FAO,fertilizer program me with special reference to integrated plant nutrition system.Fertilizer in Agricultural Development. New Delhi, India:

Sadaf Javaria and Qasim khan M. (2010).Impact of integrated nutrient management on tomato yield, quality and soil environment.Journal of plant nutrition 34(1)140-149. Pakistsn.

Sahelemedhin Sertsu and Taye Bekele (2000).Procedures for Soil and Plant Analysis.Technical paper No.74. National Soil Research Center, Ethiopia Agricultural Research Organization, Addis Ababa, Ethiopia.

Sarker M. M., Matin, M. A., Hossain, M. G. and Ahmed M. (2011). Effect of tillage intensity, Fertilizer and manure on Physical Properties of Soil and crop yield. J. Expt. Biosci. 2(2):61-66.

Shankara N., Joep van Lidt de J, Marja de G., Martin H. (2005).Cultivation of tomato production, processing and marketing.4thedition,Wageningen, Netherlands.

Tesfaye Balem (2008). Response of tomato cultivars differing in growth habit to nitrogen and phosphorus fertilizers and spacing on vertisol in Ethiopia.

Vlaming J., Gitari J. N., and van Wijk M. S. (1997). Farmers and researchers on their way to integrated nutrient management