WOLAITA SODO UNIVERSITY

College of Agriculture

Department of Horticulture

Review on effect of NPSB Fertilizer Rates on Growth of Tomato (*Lycopersicon esculentum Mill.*)

at wolaita sodo, Ethiopia

By:Wale Adimasu

Id:Ugr/71046/14

Advisor:Taye.B

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1.INTRODUCTION

1.1 BACK GROUND AND JUSTIFICATION

Tomato (*Lycopersicon esculentum Mill.*) belongs to the *Solanacea* Family and self-crossing annual crop. This family also includes other well known species such as potato, tobacco, hot pepper and egg plant (aborigine). The center of origin of the world tomato is considered to be Andean Zone, whereas it is considered that the tomato was domesticated in Mexico (Ara, et al., 2007)

Presently the tomato is one of the vegetables with the highest production in the world and its production is increasing all over the world, primarily, in Asia. The production area in Europe, North and Latin America, tends to stop increasing of yield per hectare, probably yielding varieties.

Tomato is the third most important vegetable in the world next to potato and sweet potato [FAO, 2005]. In 2009 the world' total cultivated area under tomato was 4.89 million ha, with a production quantity of 141.14 million tons [FAOSTAT, 2011]. Chinas the world leading tomato producer with a production of 34.12 million tons followed by the United States and Turkey [FAOSTAT, 2011]. China is not only the world's largest fresh tomato producer, but also the world largest tomato paste producer, followed to Europe and United States. In 2008, the export quantity reached 818,512 tones a sharp increase from106,667ton in the previous year [Zhang *et al.*, 2010].

In the tropics, tomato is mostly produced by transplanting. Good quality of seedling usually leads to better growth, higher yields and earlier maturity tomato is among the most important vegetable crops in Ethiopia. Both fresh and processed tomato varieties are popular and economically important vegetable crops produced in the country [Geleta *et al.,* 1995]. [Lemma *et al*., 2003] indicated that the total production of tomato in the country has shown as a marked increase since it become the most profitable crop providing higher in come to small scale farmers' compared to other vegetable crops. However the production and productivity of the crop in the country is influenced by different factors among which improper plant spacing is the notable reasons of the low productivity of this crop.

The national average of tomato yield under farmer's condition is very low as compared to demonstration and experimental research plot. Increasing production of the crop has a great role to strengthen the growing vegetable industries in the country. Plant spacing greatly influences growth and yield of tomato.

Typically,farmers produce tomato on the method of broadcasting and inter closing in which this type of sowing method has many problems such as high plant population d ue to high seed rate, difficult to management, increasing competition to water and nutrient, harbor to disease and pest, low quality and small size fruits and reduce the yield of tomato. Thus it is crucial to set optimum spacing for better growth and yield of tomato.

1.2 OBJECTIVE

The General Objective Of this paper to Review the Effect Of Different Fertilizer On Vegetative Growth Of Tomato

2. LITERATURE REVIEW

Crops are essential for food security,income generation,and economic growth.They provide nutrition for humans and animals,raw materials for industries and employment for millions,especially in rural areas.In countries like Ethiopia,improving crop cultivation also contributes to environmental protection and resilience against climate change.

2.1 Description of the crop

Tomato (*Lycopersicon esculentum* Mill.) belongs to the*Solanacea*Family and self-crossing annual crop. This family also includes other well-known species such as potato, tobacco, hot pepper and eggplant (aubergine). Tomato is the third most important vegetable in the world next to potato and sweet potato. In 2009 the world's total cultivated area under tomato was 4.89 million ha, with a production quantity of 141.14 million tons.FAOSTAT (2011).

2.2 Origin of Tomato

The centre of origin of the genus *Solanum* section *Lycopersicum* (formerly genus*Lycopersicon*) is the Andean region that includes parts of Colombia, Ecuador, Peru,Bolivia and Chile. All tomato wild relatives are native to this area. Until the arrival of the Spanish explorers to America, the tomato was cultivated in the small vegetable or chards of the Mesoamerican area and was of little economic importance.

It was one more of the weeds of the “milpas”(smallfamilyorchards).The European chroniclersmadeeferencestoit,and sometimesm is interpreted certain quotes that contain the word *tomato* as referencing the tomato, when they were really referring to another species. This may have produced an overestimation of the real importance of the tomato in pre-Columbian times. The word *tomatoe*,introduced into the Spanish language in 1532 (Corominas, 1990), comes from the Nahuatl word *tomatl* and, according to Fray Bernardino of Sahagún (1577) in hisbook “Historia general de lascosas de la NuevaEspaña”(written between 1548 and1578, Sahagún, 1988), it was applied in a general manner to plants bearing spherical.

2.3 Effect of different fertilizer on vegetative growth of tomato

Different fertilizer have varying effects on tomatato vegitative growth

2.3.1 The Effect of Nitrogen Fertilizer on Tomato Growth

Nitrogen-application rate also affects plant growth, nitrogen utilization efficiency, nitrogen metabolism, yield and fruit quality . Nitrogen is an essential nutrient for tomato growth and development. The leaf area and dry matter accumulation of tomatoes increased exponentially with nitrogen application, whereas nitrogen use efficiency, yield and nitrogen fertilizer contribution rate increased first and then decreased with nitrogen application. This suggests that only an appropriate amount of nitrogen can promote the growth of tomato plants, while excessive or small amounts of nitrogen can limit the growth and development of tomato plants . The greenhouse vegetable industry represents 20% of the total vegetable production area in China yet produces 35% of output and 60% of economic value. However, the nitrogen (N) fertilizer input is estimated to exceed crop requirements by a factor of five to six. The nutrient use efficiency (NUE), including apparent recovery efficiency (ARE) and partial factor productivity (PFP) under conventional practices, ranged from 2.6% to 5.7% and 48.3–84.7 $kg\cdot kg^{-1}$. Nitrogen metabolism is an important physiological metabolic process that plants must carry out during growth and development . Nitrogen levels affect the nitrogen metabolism of tomato plants by affecting the activities of major nitrogen metabolizing enzymes, thereby affecting their ability to assimilate amino acids . Under constant light conditions, increasing nitrogen fertilizer could promote the ability of tomato plants to absorb nitrogen .

Adequate nitrogen application is the basis and guarantee for a high yield of tomato plants. However, excessive nitrogen application will cause waste of resources, environmental pollution and many other adverse consequences. Therefore, the timely and effective monitoring of the nitrogen nutrition status in tomato plants and reasonable fertilization based on such monitoring can not only balance the supply and demand of nitrogen in each growth stage of the plant but also reduce the production cost and degree of environmental pollution .

Therefore, in this research, artificial control experiments were performed in an experimental facility considering two factors, high temperature and nitrogen level. Through these experiments, tomato plant growth characteristics under different high-temperature and nitrogen conditions were examined. These data were used to determine the optimal amount of nitrogen to be applied under different high-temperature conditions, providing a basis for tomato nitrogen nutrient diagnosis and utilization efficiency evaluation.

2.3.2 The Effect of Phosphorus Fertilizer on Tomato Growth

Phosphorus (P) is a critical macro-nutrient for tomato plants, influencing various physiological and developmental processes. Here's a structured overview of its effects:

1. Roles of Phosphorus in Tomato Growth

Root Development: Essential for robust root formation, particularly in seedlings and early growth stages.

Energy Transfer & Photosynthesis: Facilitates ATP formation, aiding energy storage and utilization.

Flowering & Fruiting: Promotes flower initiation, fruit set, and seed development, directly impacting yield.

Stress Resistance: Enhances resilience to environmental stresses (e.g., drought, disease).

2. Deficiency Symptoms

Visual Signs: Purple or reddish discoloration in older leaves, stunted growth, delayed maturity, and reduced fruit yield.

Causes: Low soil P, cold soils (reducing uptake), or high pH (>7.5) locking P in insoluble forms.

3. Optimal Application

Soil Testing: Crucial to determine existing P levels and pH (ideal: 6.0–6.8 for availability).

Timing: Apply pre-planting (incorporated into soil) and during flowering/fruiting stages.

Forms: Use water-soluble fertilizers (e.g., super-phosphate) for quick uptake or organic options (e.g., bone meal) for slow release.

N-P-K Ratios: Balanced fertilizers (e.g., 5-10-5) during fruiting to prioritize P and K.

4. Risks of Excess Phosphorus

Nutrient Imbalance: Inhibits uptake of micro-nutrients (e.g., zinc, iron), causing deficiencies.

Environmental Impact: Runoff contributes to eutrophication in water systems.

Plant Toxicity: Rare but may manifest as unnaturally dark green leaves or reduced growth.

5. Environmental and Practical Considerations

Sustainable Practices: Avoid over-application; use soil tests to guide rates.

Cold Climates: Warm soil (via mulching) to improve P uptake in early seasons.

2.3.3 The Effect of Sulfur Fertilizer on Tomato Growth

Sulfur (S) is an essential secondary macro-nutrient for tomatoes, playing a critical role in plant metabolism, protein synthesis, and stress resistance. Here's a detailed overview of its effects:

1. Roles of Sulfur in Tomato Growth

Protein Synthesis: Sulfur is a key component of amino acids (cysteine, methionine) and enzymes, vital for plant growth and fruit development.

Chlorophyll Production: Supports photosynthesis by aiding chlorophyll formation.

Disease Resistance: Strengthens plant immunity against fungal and bacterial pathogens.

Nutrient Uptake: Enhances nitrogen (N) efficiency and vitamin synthesis (e.g., vitamin C in fruits).

Flavor & Aroma: Contributes to the synthesis of flavor compounds (e.g., lycopene, glucosinolates).

2. Deficiency Symptoms

Leaf Symptoms: Yellowing of younger leaves (unlike nitrogen deficiency, which affects older leaves first), stunted growth, and thin stems.

Fruit Issues: Reduced fruit size, uneven ripening, and bland flavor.

Delayed Maturity: Prolonged vegetative growth with poor flowering/fruiting.

3. Optimal Application

Soil Testing: Check soil sulfur levels and pH. Sulfur availability decreases in alkaline soils (pH > 7.0).

Timing: Apply pre-planting and during early growth stages; tomatoes require consistent sulfur throughout their lifecycle.

Forms of Fertilizer:

Inorganic: Ammonium sulfate (21-0-0-24S), gypsum (calcium sulfate), or potassium sulfate.

Organic: Compost, manure, or elemental sulfur (slow-release, requires microbial activity to convert to sulfate).

N-P-K-S Ratios: Use balanced fertilizers (e.g., 10-10-10 with added S) or tailor blends based on soil needs.

4. Risks of Excess Sulfur

Soil Acidification: Overuse of elemental sulfur lowers soil pH, which may harm tomatoes (ideal pH: 6.0–6.8).

Nutrient Imbalance: Excess S can inhibit uptake of molybdenum (Mo) and other micro-nutrients.

Salt Buildup: High sulfate fertilizers (e.g., ammonium sulfate) may increase soil salinity in arid regions.

5. Environmental and Practical Considerations

Sustainable Practices: Use organic matter (compost) to replenish sulfur naturally.

Synergy with Nitrogen: Sulfur enhances nitrogen use efficiency; pair S with N fertilizers for balanced growth.

Drought Resilience: Sulfur improves water-use efficiency, critical in dry climates.

2.3.4 The Effect of Boron Fertilizer on Tomato Growth

Boron (B) is a critical micro-nutrient for tomatoes, required in small but essential amounts for physiological processes like cell wall formation, pollen germination, and sugar transport. Here's a detailed breakdown of its effects:

1. Roles of Boron in Tomato Growth

Cell Wall Development: Strengthens cell walls, improving structural integrity and disease resistance.

Reproductive Success: Vital for pollen tube growth, flower development, and fruit set.

Nutrient Transport: Facilitates calcium (Ca) uptake and sugar translocation, enhancing fruit quality.

Hormone Regulation: Supports auxin synthesis, influencing root and shoot growth.

2. Deficiency Symptoms

Leaf Symptoms: Thick, brittle, or curled young leaves; yellowing between veins.

Fruit Issues: Poor fruit set, hollow or corky fruit interiors, and cracking/blossom-end rot (due to impaired calcium mobility).

Root & Stem Problems: Stunted roots, brittle stems, and delayed maturity.

3. Optimal Application

Soil Testing: Critical for boron levels, as the range between deficiency and toxicity is narrow. Ideal soil B: 0.5–2.0 ppm.

pH Sensitivity: Boron availability drops in alkaline soils (pH > 7.0) or sandy, low-organic-matter soils.

Timing: Apply pre-planting and during flowering/fruiting stages.

Forms of Fertilizer:

Inorganic: Borax (11% B), Solubor (20% B), or B-enriched NPK blends.

Organic: Compost, seaweed extracts, or manure (low but steady B supply).

Foliar Sprays: Use 0.25–0.5% borax solution during flowering for quick correction.

4. Risks of Excess Boron

Toxicity Symptoms: Leaf tip burn, yellowing, and premature leaf drop (older leaves first).

Soil Damage: Over-application can render soil unusable for sensitive crops.

Nutrient Interference: Inhibits uptake of potassium (K) and phosphorus (P).

5. Environmental and Practical Considerations

Precision is Key: Apply boron sparingly (1–2 lbs/acre for soil; 0.5–1 lb/acre for foliar).

Synergy with Calcium: Ensure adequate calcium levels to maximize boron’s benefits (e.g., prevent blossom-end rot).

Organic Management: Use compost or cover crops (e.g., clover) to maintain natural boron levels.

3 SUMMARY AND CONCLUSION

Nitrogen is vital for robust tomato growth, particularly during early vegetative stages, but requires precise management to avoid trade-offs with fruiting and soil health. Deficiency stunts growth, while excess nitrogen leads to imbalanced plants and environmental harm. By tailoring applications to growth stages, using organic amendments, and prioritizing soil testing, growers can harness nitrogen's benefits while minimizing risks. A balanced approach ensures healthy plants, flavorful fruits, and sustainable yields.

Phosphorus is vital for maximizing tomato yield and quality, particularly in root and fruit development. Balanced application, informed by soil testing and growth stage needs, ensures optimal results while mitigating environmental risks. Deficiency and excess both pose challenges, underscoring the importance of mindful nutrient management.

Sulfur is vital for robust tomato growth, influencing everything from protein synthesis to fruit quality. Deficiency leads to poor yields and flavor, while excess risks soil acidification and nutrient imbalances. Tailored application—guided by soil tests and balanced with other nutrients—ensures optimal plant health and productivity. Sulfur's role in enhancing nitrogen efficiency and stress tolerance makes it a key player in sustainable tomato cultivation.

Boron is indispensable for tomato yield and quality, particularly in reproductive stages. Deficiency causes poor fruit development, while excess leads to toxicity. Careful, science-based application—supported by soil testing and balanced with calcium—ensures optimal growth. Boron's role in calcium mobility and sugar transport makes it a silent yet vital player in achieving healthy, marketable tomatoes.

Tomatoes thrive on balanced, stage-specific nutrition. While each nutrient has unique functions, their synergy determines overall plant health and yield. Regular soil testing, pH management, and moderation in application are key to avoiding deficiencies or toxicity. By integrating these practices, growers can achieve robust plants, flavorful fruits, and sustainable productivity.

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