EFFECT OF [illegible] FERTILIZER ON GROWTH, FLOWERING, FRUITING AND POSTHARVEST QUALITY OF TOMATO IN IMPROVED BRIS SOIL

SITI NOR AZURIN BINTI JAMALUDDIN

FAKULTI AGROTEKNOLOGI DAN SAINS MAKANAN
UNIVERSITI MALAYSIA TERENGGANU

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EFFECT OF FOLIAR FERTILIZER ON GROWTH, FLOWERING, FRUITING AND POSTHARVEST QUALITY OF TOMATO ON IMPROVED BRIS SOIL

By
Siti Nor Azurin Binti Jamaluddin

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ENDORSEMENT

The project report entitled **Effect of Foliar Fertilizer on Growth, Flowering, Fruiting and Post Harvest Quality of Tomato on Improved Bris Soil** by **Siti Nor Azurin binti Jamaluddin**, Matric No. **UK 16013** has been received and corrections have been made according to the recommendations by examiners. This report is submitted to the Department of Agrotechnology in partial fulfillment of the requirement of the degree of Science in Agrotechnology (Post Harvest Technology), Faculty of Agrotechnology and Food Science, Universiti Malaysia Terengganu.

....

(Prof. Madya Hj. Abdullah Mohd Zain)
Main supervisor

PROF. MADYA ABDULLAH MD. ZAIN
Pensyarah
Jabatan Agroteknologi
Fakulti Agroteknologi dan Sains Makanan
Universiti Malaysia Terengganu.

Date: 22 APRIL 2010

............(signed)............
(NAME)
Co supervisor

Date:

DECLARATION

I hereby declare that the work in thin thesis is my own except for quotations and summaries which have been duly acknowledged.

Signature : ....

Name : SITI NOR AZURIN BINTI JAMALUDDIN

Matric No. : UK 16013

Date : 22 APRIL 2010

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ABSTRACT

Tomato is a climacteric fruit with have a very short life span. Tomato is suitable for planting at highland (above 100m). Nevertheless, some tomato cultivars can be planted in lowland. Rate of fertilization of tomato are different depends on soil type. Bris soil has lower in fertility or less suitable planting tomato and it needs higher fertilizer rate compared with mineral soil. Foliar fertilizers are widely used in vegetable and fruit crops, that contain various macro and micronutrients, which are essential for the proper growth and yield. This study was conducted to determine the effect of foliar fertilizer (Nutri Multi Liquid and Vita Grow Plus) on growth, flowering, fruiting and post harvest quality of tomato on improved bris soil. Physical characteristics were determined by quantitative measurements of plant height, stem diameter, number of flower and number of fruit. Chemical evaluation involved TSS and pH. The results obtained from these studies indicated that there were significant differences ($P<0.05$) in TSS between the application of foliar fertilizer and inorganic fertilizer (NPK Green and NPK Blue). Generally, plant height and stem diameter increased during plant growth but decreased during flowering and fruiting. Foliar fertilizers were found to improve the overall plant growth. However, inorganic fertilizer (NPK Blue) application affected the flowering, fruiting, TSS and fruit pH.

ABSTRAK

Tomato merupakan buah klimakterik yang mempunyai jangka hayat yang singkat. Tomato lebih sesuai ditanam di tanah tinggi (lebih 1000m). Walapun begitu, terdapat juga kultivar-kultivar tomato yang boleh ditanam di tanah rendah. Kadar pembajaan tomato berbeza mengikut jenis tanah. Tanah pasir yang kuraang subur atau sederhana sesuai untuk tanaman tomato dan memerlukan kadar baja yang lebih tinggi berbanding tanah mineral. Baja foliar banyak digunakan untuk sayuran dan buahan yang mengandungi pelbagai makro dan mikronutrien yang diperlukan untuk pertumbuhan dan hasil yang baik. Kajian ini dijalankan untuk menentukan kesan baja foliar (Nutri Multi Liquid dan Vita Grow Plus) ke atas pertumbuhan, pembungaan, pembuahan dan kualiti lepas tuai tomato pada tanah bris yang telah dibaiki. Ciri-ciri fizikal ditentukan melalui ukuran kuantitatif tinggi pokok, diameter stem, bilangan bunga dan bilangan hasil. Penilaian kimia pula melibatkan jumlah pepejal terlarut (TSS) dan pH. Keputusan yang diperolehi dari kajian ini menunjukkan perbezaan yang bererti ($P<0.05$) pada TSS di antara penggunaan baja foliar dan baja tak organik. Secara umumnya, pertumbuhan tinggi dan diameter meningkat sepanjang pertumbuhan tetapi kemerosotan sepanjang pembungaan dan pembuahan. Baja foliar dikenalpasti membantu dalam keseluruhan pertumbuhan. Walaubagaimanapun, baja tak organik (NPK Blue) yang diaplikasi berkesan untuk pembungaan dan pembuahan, TSS dan pH buah.

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LIST OF ABBREVIATIONS

^{o}C	Degree celcius
g	Gram
<	Less than
>	More than
±	Plus-minus
cm	Centimeter
^{o}F	Degree Fahrenheit
%	Percentage
N	Nitrogen
P	Pottasium
K	Kalium
T	Tan
ha	Hectare
l	Liter
ml	Milliliter

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CHAPTER 1

INTRODUCTION

1.1 Background of study

Tomato (*Lycopersicon esculentum* Mill.) is one of the most popular of garden vegetables. Tomato is a fruit vegetables categorized as a neutral crop come from South America. Tomato is commonly planted in Malaysia especially in highlands (Cameron Highland and low land). Three major processed products are on processed tomato preserves (whole peeled tomatoes, tomato juice, tomato pulp, tomato puree, tomato paste, pickled tomatoes), dried tomatoes (tomato powder, tomato flakes, dried tomato fruits) and tomato-based foods (tomato soup, tomato sauce, ketchup). Tomato is commonly used as a model crop for diverse physiological, cellular, biochemical, molecular and genetic studies because it is easily grown, has a short life cycle and is easy to manipulate (by grafting and cutting).

The morphology of the tomato includes the root, leave, stem, flower and seed. The height of the crop is 2-3 meters. The stem is green; branches and coating have fine fur. Shape of the stem is round and soft (young plant) but it will change to become woody and hard (old plant). The root is strong with many fibrous roots and is able to penetrate inside the soil until 30-70cm. The leaf is green and fur also have varies in shape and size. The flower is yellow and may produce 5-10 bud at the branches or stick. Fruit colour is green when young and red or yellowish red when mature.

Tomatoes have significant nutritional value. In recent years, they have become known as an important source of lycopene, which is a powerful antioxidant that acts as an anticarcinogen. They also provide vitamins and minerals. One medium ripe tomato can provide up to 40 percent of Vitamin C and 20 percent of Vitamin A. They also contribute B vitamins, potassium, iron and calcium to the diet. There are two types of tomatoes commonly grown. Most commercial varieties are determinate. Determinate refers to a plant that reaches a mature height and stops there. These "bushy" types have a defined period of flowering and fruit development. Most heirloom garden varieties and greenhouse tomatoes are indeterminate, which means they produce flowers and fruit throughout the life of the plant. Indeterminate plants never cease growing, and will continue climbing or sprawling until pruned, or the fall frost ends the season (Kelly et al., 2006).

Tomato is considered a tender warm season crop but is actually a perennial plant, although it is cultivated as an annual. It is sensitive to frost and will not grow perpetually outdoors in most parts of the country. Most cultivated tomatoes require around 75 days from transplanting to first harvest and can be harvested for several weeks before production declines. Ideal temperatures for tomato growth are 70-85 °F during the day and 65-70 °F at night. Significantly higher or lower temperatures can have negative effects on fruit set and quality. The tomato is a self-pollinating plant and, outdoors, can be effectively pollinated by wind currents (Kelly et al., 2006).

Foliar fertilizers are widely used in vegetable and fruit crops, that contain various macro and micronutrients, which are essential for the proper growth and yield. Foliar fertilizer technology came into use early in this century, but did not become more common practice. After 1980s, the application of foliar fertilizers is the quickest way to deliver nutrients to the tissues and organs of the crop, and is proved that application of these micronutrients is beneficial to correct certain nutrient deficiencies (Anonymous, 2001). Foliar feeding is the practice of applying liquid fertilizers to plant leaves. The leaves are green factories where the complex chemical processes of photosynthesis produce the compounds, plants needed for growth. Foliar fertilizers are absorbed right at the site where they are used as quite fast acting, whereas, much of the soil fertilizers may never get used by plants. For instance, 80% of the phosphorus applied through conventional fertilizers may get fixed up in the soil, but, up to 80% of foliar-added phosphorus directly absorbed by the plants (Donelon, 2005).

Tomato quality at harvest is primarily based on uniform size and freedom from growth or handling defects. Appearance is a very important quality factor. Tomatoes should have a waxy gloss; small blossom-end and stem-end scars that are smooth; presence of a brown corky tissue at the stem scar; uniform color and minimum size for the variety; and an absence of growth cracks, cat facing, zippering, sunscald, insert injury, hail damage, mechanical injury or bruising. Size is not typically a factor of grade quality, but it may strongly influence commercial buyers' expectations. Good harvesting management is needed to pick high quality tomatoes (Kelly et al., 2006).

1.2 Problem statement

The main problem of grow of the tomato plant is depends on factor that influence the plant cannot grow well such as of the characteristics of the soil which have low water holding capacity, very low fertility. So, the Bris soil should be improved to produce quality of yield. The use of chicken dung as a basal and complete fertilizer (NPK Green) applied for all crop is one of the method of improving Bris soil. If used only foliar fertilizer to the plant, it cannot support the plant growth because foliar fertilizer is one of the liquid fertilizer to supply supplemental doses of minor and major nutrients, plant hormones, stimulants and other beneficial substance.

1.3 Significance of Study

Foliar fertilizer is the most effective way to apply micro nutrients or trace elements, and supplement the major elements at active growth stages. The readily-available nutrients are more easily utilized, NPK lead absorptions. Foliar fertilization improves the nutrient use efficiency. Foliar-applied N can be up to seven times more efficient than soil-applied N. Other benefits of foliar-applied N include lower application rates (higher efficiency), plus the relative ease of obtaining timely, uniform applications. A combination of soil-applied and foliar applied N is the best management practice to reduce the potential for nitrates in groundwater. Foliar fertilization will optimize by using fertilizer and reduce the cost application, increasing in quality of yield and easy to apply.

1.4 Objective of Study

The objective of this experiment is to study the effect of foliar fertilizer on growth, fruiting and post harvest quality of tomato.

CHAPTER 2

LITERATURE REVIEW

2.1 Improved Bris Soil

Chilli and tomato are potential crops that can be grown on Bris sandy soil. However, appropriate crop management techniques should be employed to overcome inherent soil problems. The requirements of organic (chicken dung) and inorganic fertilizers ($N:P_25:K_2O:MgO$ = 12:12:17:2) were 10 and 2 t/ha, respectively. The best mulching materials was paddy straw at the rate of 6 t/ha which was applied immediately after planting. Sprinkler irrigation was the most suitable irrigation system on Bris soil. Yield of 25 and 40 t/ha were obtained for chilli and tomato, respectively. However, the yields were dependent on the cropping season. Crops planted in dry season (January and February) gave the highest yield (Zaharah et al., 1992).

Bris soil which is not only has a low water holding capacity, but also has low fertility level. The use of micro irrigation on Bris soil gives the opportunity for the fertilizer to be applied through irrigation system, known as fertigation (Wan Zaki, 2006).

2.2 Organic fertilizer for soil fertility

Natural and organic fertilizers differ from chemicals in that they feed your plants while building the soil. Soils with lots of organic material remain loose and airy, hold more moisture and nutrients, foster growth of soil organisms, and promote healthier plant root development. If only chemicals are added the soil gradually loses its organic matter and macrobiotic activity. As this material is used up, the soil structure deteriorates, becoming compact, lifeless and less able to hold water and nutrients. This result in increased amounts of fertilizer needed to feed plants (Jennifer, 2009).

The quantity of soil organic matter in the soil has been found to depend on the quantity of organic material which can be introduced into the soil either by natural returns through roots, stubble, slough off roots nodules and root exudates or by artificial application in the form of organic manures which can otherwise be called organic fertilizers (Ayoola and Adeniyan, 2006).

2.3 Complete fertilizer

Fertilizer is important to add the element of nutrient that soil needed. Uniform fertilizer is giving on the suitable time which is faster on crop growth and produce high fruit yield. Fertilizer solutions or starter solutions are prepared by dissolving the fertilizer salts in water. The mainly contain mixed fertilizer having N, P_2O_5, K_2O in the ratio of 1:2:1 and 1:1:2 and are replied to young vegetables plants at the time of transplanting. It is used in place of watering which helps in rapid establishment and quick early growth of plants. Only a small amount of fertilizer is applied as a starter solution. This solution provided the nutrients which reach to the plant roots immediately. The solution is sufficiently diluted so that it does not inhibit growth (Peet, 2005).

The use of inorganic fertilizers alone has not been helpful under intensive agriculture because it aggravates soil degradation. The need to use renewable forms of energy has revived the use of organic fertilizers worldwide. Nutrients contained in organic manures are released more slowly and are stored for a longer time in the soil, thereby ensuring a long residual effect (Sharma and Mittra, 1991).

One of the major essential elements for growth of plants is nitrogen. Nitrogen is required in large quantities for plants to grow, since it is the basic constituent of proteins and nucleic acids. Nitrogen is provided in the form of synthetic chemical fertilizer. Such chemical fertilizers dose a health hazard and microbial population problem in soil besides beings quite expensive and making the cost of production high. In such situation the bio-fertilizers play a major role (Tiwary et al., 1998).

The solanaceous vegetable crops (tomato, eggplant, chilli and bell peppers [Capsicum spp.]) generally take up large amounts of nutrients. Eggplant is very effective in making use of plant nutrients already available in the soil, whereas tomato and chilli and bell peppers, are not. Potassium is the most prominent inorganic plant solute and is the only mineral nutrient that is not a constituent of organic structures. Its function is mainly in osmoregulation, the maintenance of electrochemical equilibrium in cells and its compartments and the regulation of enzyme activities. Potassium has a crucial role in the energy status of the plant, translocation and storage of assimilates and maintenance of tissue water relation. K plays a key role of crop quality. It improves size of fruit and stimulates root growth. It is necessary for the translocation of sugars and formation of carbohydrates. K also provides resistance against pest and diseases and drought as well as frost stresses (Fawzy et al., 2007).

2.4 Foliar Fertilizer

Plant nutrients are also absorbed through the leaves of plants and this absorption is remarkably rapid and complete for certain nutrients. In this method spraying of leaves of growing plants with suitable fertilizer solutions is done. The solutions may be prepared in a low concentration to supply any one plant nutrient or a combination of nutrients. The demerits o foliar application of nutrients are : (i) marginal leaf burn or scorching when strong solutions are used, (ii) several applications are needed for moderate to high fertilizer rates, and (iii) foliar spraying of fertilizers is costly compared to soil application if not combined with any other spraying (pesticides, insecticides or hormone spraying) (Heuvelink, 2005).

In the other ideas say that foliar sprays should be avoided because of the potential for damage to the foliage from spraying in hot or bright weather and because leaves do not absorb nutrients well but they are sometimes used under emergency conditions while the situation in the root zone is being corrected. Foliar sprays of urea dissolved in water at 2.5 g/l can be applied to correct a severe nitrogen deficiency. For phosphorus deficiency, foliar sprays with potassium or ammonium phosphate are possible but are not recommended as they can cause serious leaf damage. For potassium deficiency, the crop may be spared with a solution of 20 g potassium sulphate/l. To correct calcium deficiency quickly, plants can be sprayed with a solution of 2-7 g calcium nitrate/l or a 0.3% calcium chloride solution. Magnesium deficiencies can also be corrected with sprays of salts (Adams, 1999).

Foliar-applied nutrients have the benefit of being 4 to 30 times more efficient and there is no risk of groundwater contamination. Studies using labeled phosphorus (P) on apple, cherry, corn, and tomato, potato, and bean crops have shown that as much as 12 to 14 percent of the total P can be supplied by multiple foliar sprays.

Since P can be very immobile in the soil, foliar applications can be up to 20 times more effective than soil applications. The benefits of foliar N sprays compared to soil applications include lower application rates and the ease of obtaining timely, uniform applications. With attention to best use guidelines, the efficiency of foliar applied N may be optimized at nearly 95 to 100 percent. Based on the foregoing information, if the recovery of soil-applied N ranges from 15 to 62 percent, it can be concluded by the method of estimation that foliar-applied N has an efficiency of 1.3 to 1.6 times soil applied N at the low end and 7 at the upper end. Compared to soil applied N, on a pound-for-pound basis, foliar-applied N can be up to 7 times more efficient (Dixon, 2007).

Foliar feeding is the practice of applying liquid fertilizers to plant leaves. The leaves are green factories where the complex chemical processes of photosynthesis produce the compounds, plants needed for growth. Foliar fertilizers are absorbed right at the site where they are used as quite fast acting, whereas, much of the soil fertilizers may never get used by plants. For instance, 80% of the phosphorus applied through conventional fertilizers may get fixed up in the soil, but, up to 80% of foliar-added phosphorus directly absorbed by the plants (Donelon, 2005). Silberbush (2002) stated that foliar fertilization is widely used practice to correct nutritional deficiencies in plants caused by improper supply of nutrients to roots. Ca and B which are immobile in the plant should be applied in small amounts at high frequency rather than in one application for correcting temporary deficiencies in vegetables (Maynard and Hochmuth, 1996).

Foliar feeding is an effective method for correcting soil deficiencies and overcoming the soils inability to transfer nutrients to the plant. Tests have shown foliar feeding can be 8 to 10 times more effective than soil feeding and up to 90 percent of a foliar fed nutrient can be found in the smallest root of a plant within 60 minutes of application. Foliar fertilizers have been used on many crops for at least 40 years. In recent years, foliar application of essential nutrients has increased and has been used to improve the quality and increase yields of muskmelon, maize, soybean and peanuts. The ability of a crop variety to absorb large amount of nutrients and convert them into plant biomass on highly enriched soils, where less efficient cultivars reach a yield plateau, has been described as the 'effectual response' to fertilizer application. In this approach to plant nutrition, the emphasis is placed solely on plant uptake from the soil. One of the most immediate, obvious effects of applying mineral nutrients, especially nitrogen, to the soil is an increase in leaf area (Akanbi, 2007).

2.5 Growth of Tomato

Growth is defined as the increase in biomass and dimensions of a plant or organ (quantitative aspects). The process that determine crop growth and yield mentioned with the emphasis on the influence of environmental factors such as light, carbon dioxide, temperature, humidity and cultural practices. Crop growth shows a delayed response to climatic factors (essentially with respect to leaf area growth) in addition to the intermediate response via crop photosynthesis.

2.6 Fertilization for fruit set

The limitation of tomato yield was investigated in a number of cultivars with contrasting fruiting habits. Unless light is limiting, yield is mainly restricted by the number or the size of the fruit (i.e. the sink strength rather than the supply of assimilate (i.e. the source strength). Fruit size is determined by both cell number and cell size. The rate of fruit expansion is affected by assimilate supply, temperature and water relations in the plant. The size or the growth rate of a tomato fruit is regulated by the import of assimilate and water. The sink strength for assimilate of a tomato fruit measured by the rate of assimilate import may be related to the routes of sugar transport into the sink cells during fruit development. Enzymes regulation of the hydrolysis of the sucrose by sucrose synthase and the accumulation of starch by pyrophosphorylase may determine the rate of assimilate import in the young fruit. Vacuolar inverts activity may determine the sugar composition of a mature fruit, but may not affect the overall dry matter accumulation of a tomato fruit. While yield is determined by the balance between sources and sink strengths of the plant, quality is determined by the transport and metabolism of sugars within the fruit (Marianne, 2000).

Poor pollination reduced seed number and actual fruit mass. Fruit pruning increases fruit size, without influencing seed number and fruit with many seeds may stay small when grown on plants with a high fruit/leaf ratio. This indicates the influence of assimilate availability on fruit size. Fruit size is investigated the link between genetic and developmental controls of fruit (Bertin et al., 2003).

2.7 Fertilization for Post harvest Quality

Fruit quality may also suffer, as insufficient photosynthates and nutrients are available for normal development of all fruit. The fruiting habit of tomato plants is also variable. Tomatoes are harvested at different stages of ripeness for different purposes. Processing tomatoes are mechanically harvested red-ripe and immediately transported to a processing plant. Quality characteristics of fresh market fruit are similar to those of processing tomatoes but characteristics that are readily apparent to the consumer (colour, size, shape, firmness and aroma) dominate the others. Fruit quality is strongly affected by temperature (Dorais et al., 2001).

Temperature directly influences metabolism and indirectly, cellular structure and other components that determine fruit quality such as colour, texture, size and organoleptic properties. An air temperature of 23°C improved the taste of tomatoes, increased fruit dry matter and K:Ca ratio. And reduced the proportion of softer and meanly fruit as compared with fruit grown at 17°C. Growth at 17°C produced softer and less juicy and aromatic fruits. Such fruit have a less resistant cuticle, despite a higher content of reducing sugars and a lower content of titrable acids (Janse and Schols, 1992).

High quality red-ripe tomatoes contain around 93% water and 5-8% dry matter. The carbohydrate concentration (mainly as equal amounts of glucose and fructose) increases progressively through maturation and ripening and can account for 50% of the dry matter. Ripe fruit are a good source of vitamins A and C and potassium. A steroid glycoside, tomatine, decreases during ripening from 0.08% in mature green fruit to 0.00% in the ripe fruit. Tomatine is toxic to mammals and has a bitter taste (Saltveit, 2005).

2.8 Soluble Solid (SS) and titratable Acids (TA)

Soluble solid (SS) and titratable acids (TA) are important components of flavour. Fruit high in both acids and sugars have excellent flavour, while tart fruit have low sugar content and bland fruit have low acidity (kader et al., 1978). Soluble solids are usually measured with a refractometer calibrated in °Brix. There is large variation among tomato genotypes for pH and titratable acidity. A ripe tomato is acidic and its pH values range from 4.1 to 4.8. Titratable acids are composed primarily of the organic acids citric acid (~9% dry weight) and malic acids (~4% dry weight). While organic acids citric acids only constitute 0.4% of the fresh fruit. Variation in acids content has a much greater impact on flavour than the limited variation in sugar content that exists among cultivars (Salveit, 2005).

2.9 Vitamin C

Ripe tomatoes are good sources of many vitamins including vitamin A and C. The vitamin A content of a tomato is determined by its carotene content. In general, cultivars with better colour (deeper red, uniform colour throughout the fruit) have higher vitamin A activity. Cultivars containing high β-carotene levels have been developed but it often have an orange hue that detracts from consumer acceptance. Vitamin C content of tomatoes increases as they ripen. Mature green and breaker fruit that were ripened with ethylene lost less vitamin C by the time they reached the red ripe stage than did fruit allowed to ripen without added ethylene. However, both were lower than fruit ripened on the tomato plant (Salveit, 2005).

CHAPTER 3

MATERIALS AND METHODS

3.1 Materials

Tomato seed variety F1 hybrid 303 and Nutri Multi liquid fertilizer was obtained at greenhouse UMT. Foliar fertilizer Vita Grow Plus was purchased from Pertubuhan Peladang (Wisma Peladang Kuala Terengganu).

3.2 Methods

3.2.1 Raising seedling

Tomato seed was treated with fungicide (Thiram) to protect the seed from fungi infection. The seed was sowed in tray containing peat moss as a sowing medium. The seedlings were later transferred to polystyrene cup with soil (Japanese soil). The seedling was transferred to a shade until ready for transplanting. At 4-5 leaves stage, the seedlings were, transferred from polystyrene to the field. Only the seedlings that ware healthy, free from insect and disease infections were selected for planting.

3.2.2 Preparation planting area

The experiment area was prepared by ploughing. The area was improved by adding POME. Planting of beds measuring 60cm by 270cm was constructed. The plantings beds were covered with polyethylene film for controlling weeds and for conserving water. Watering was done by manually pipe water.

3.2.3 Transplanting

Hardening process was given to protect the seedling from transplanting shock. The plants were transplanted at 4-5 leaves stage. Only the healthy plant was transplanted in the evening to avoid the seedling from water stress. The spacing between plants is 30cm. Tomato plants were watered twice daily manually and observing was making intervals. Inorganic complete fertilizer (NPK Green) was given at each growth stage to support plant growth and development.

3.2.4 Staking

Tomato crop must have staking because it has soft stem. Besides, staking is important to ensure the crop grow vertically, to protect the crop when blow with wind, easy to receive the energy from sunlight, pruning and fertilizing. Staking system that used is single system which is more effective and practical because crop expose to the sunlight. About a month after transplanting, the plants were staked with bamboo or wood branch to prevent lodging.

3.2.5 Application of Fertilizer

Inorganic complete fertilizer (NPK Green) was applied as a basal application for each crop growth. Foliar fertilization was applied after transplanting before flowering. The layer of fertilizer rate was calculated following :

Inorganic Complete fertilizer (NPK Green) = 15 : 15 : 15

Area of planting bed = 270 cm x 60 cm

= 16200 cm^2

Rate of fertilizer used for plant :

1 ha = 1.5 tan

1 x 108 cm = 1.5 x 106 g

16200 cm2 = X g

X g = (1.5 x 106 g) x (16200 cm2) / 1 x 108 cm

= 238 g (total of fertilizer used in one beds)

= 238g / 4 (number of plant per beds)

= 59.5 g (total fertilizer used in one plant)

Foliar Fertilizer :

1. Nutri Multi liquid fertilizer (500 ml) – RM 18

   The content inside this fertilizer is N, P, K + TE (15 : 25 : 35)

   It is sprayed once in two weeks.

   Other content is Aloe Vera, humid acids and amino acids.

2. Vita-Grow Plus (1 liter) – RM 30

The content is this fertilizer is N : P : K (20 : 10 : 40)

Once sprayed on 10-14 days.

Basic application: 90ml/18 liter water

Table 3.1 : Experimental design of the study

Treatment	Stage 1	Stage 2
Treatment 1 (Control)	Bris soil	Bris soil + NPK Green
Treatment 2	Bris soil + NPK Green	Bris soil + NPK Green + NPK Blue
Treatment 3	Bris soil + NPK	Bris soil + NPK + Foliar fertilizer (Nutri Multi liquid)
Treatment 4	Bris soil + NPK	Bris soil + NPK + Foliar fertilizer (Vita Grow Plus)

3.2.6 Crop care

3.2.6.1 Pest and diseases management

The disease infected parts plants were removed to avoid the disease from spreading to other plants. Pesticides such as cypermethrin, malathion and furadan were also used.

3.2.6.2 Weed control

Weed on the beds also was controlled manually by hand without using herbicides.

3.2.7 Harvesting

Tomato fruits were harvested around 8-9 weeks after transplanting (±30 days after flowering). Fruit in yellowish-green color (90% green color and 10% yellow) was harvested for analysis. Fruit was harvest manually by hand to ensure the fruit skin remains uninjured.

3.3 Data analysis

3.3.1 Physical analyses

3.3.1.1 Growth measurement

Growth measurement was collected the height, diameter of stem of the tomato plant.

3.3.1.2 Flowering measurement

Flowering measurement was observed and collected by count the flower every week.

3.3.1.3 Fruiting measurement

Fruiting measurement of the tomato crop was determined on their size, shape, colour and texture of the tomatoes.

Table 3.2 : Fruiting measurement observation

Measurement	Size	Diameter (cm)
Fruit	Large	> 6 cm
	Medium	5 – 6 cm
	Small	< 5 cm
Shape	Round	
Colour	90% green and 10%yellow	
Texture	Soft and have air cavity when dissect the fruit	

3.3.2 Chemical analysis

3.3.2.1 Total Soluble Solid (TSS)

TSS of the fruit samples was determined by using Refractometer (Atago Hand Refractometer, Model 11, 0-50% Brixs). Results expressed as degrees of Brix. Fruit was cut into small pieces and put in a muslin cloth and then squeeze to get the juice. One to two drops of juice was enough to put on the refractometer prism (the refractometer prism was first cleaned well with distilled water and wiped dry) and the reading (Brix) were recorded. The refractometer was pointed towards a light source and the percentage of total soluble concentration was read. The refractometer prism cleaned before measuring the next sample. Three readings were taken and these values were averaged to represent the sugar content.

Juice is expressed from excised tissue with a garlic press or from homogenized tissue and a few drops are put on the prism of the refractometer. While readings influenced by the amount sugars in the sample, the other water-soluble constituents (organic acids and soluble pectins) in the sample may also contribute significantly to the reading.

3.3.2.2 pH evaluation

The pH value was measured by using pH meter. 5g of each sample was punch using mortar. 5ml distilled water was added into the sample that was punched. The reading was taken until the pH value on the pH meter become stable.

3.3.3 Statistical analysis

Data analysis was done to determine the effects of different treatments. The means were compared by analysis of variance, ANOVA One-Way using SPSS 16.0 statistic software. When differences were detected ($P<0.05$), Tukey test was used to compare the means between four treatments.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Physical changes

The interpretation of crop responses to environmental factors was facilitated by making a distinction between growth and development. Developmental processes such as inflorescence formation, flower development, fruit set and fruit ripening all have a strong impact on tomato yield which is determined by both the number and mass of individual fruits. These processes include germination, leaf, stem and root development (Heuvelink, 2005).

4.1.1 Height

Figure 4.1 and appendix F, showed the average effect of different fertilizer treatments on height of tomato plants. Weekly growth in height was normal in all treatments and not significantly different (P>0.05) from the control. On the average, the addition of NPK Blue and foliar fertilizers gave better plant growth even after 2^{nd} week of planting. However, the applications of foliar fertilizers (T3 and T4) have resulted in even better plant growth after the 6^{th} weeks of planting. The result of the study indicated some additional benefits of foliar fertilizers especially towards the later part of plant growth. Compared to soil applied N, on a pound for pound basis, applied N can be up to 7 times more efficient (Dixon, 2007).

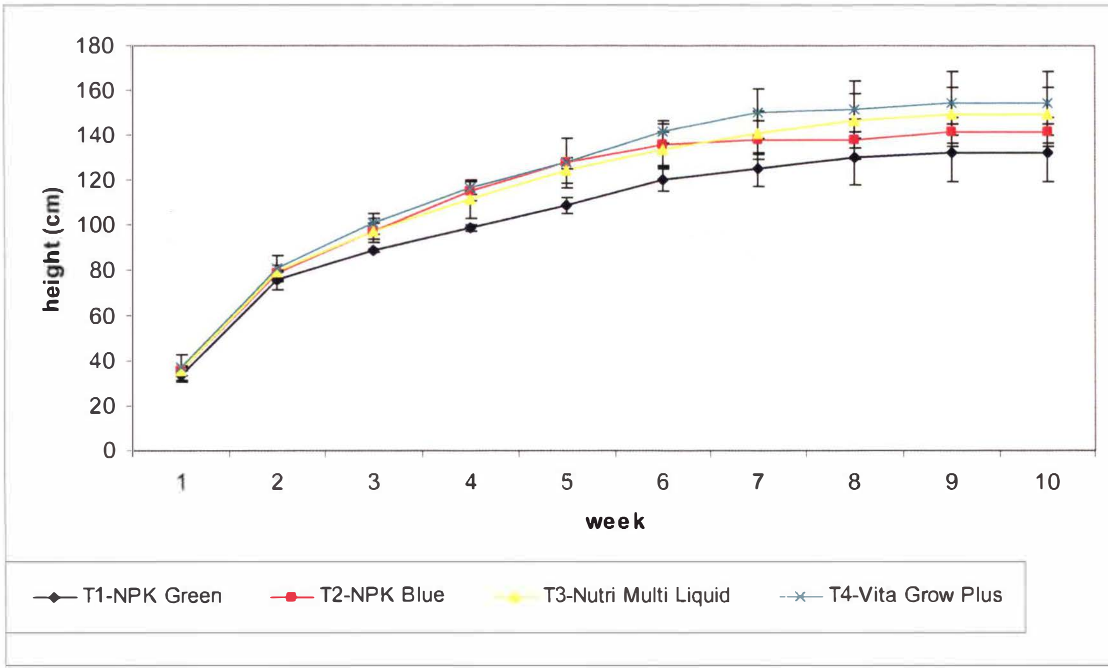

Figure 4.1: Effect of different fertilizer on height of tomato plants.

4.1.2 Diameter

Figure 4.2 and appendix G, showed the average effects of different fertilizers on plant diameter. Similar to plant height, fertilizer treatments have no significant (P>0.05) effect on plant diameter as compared to the control (T1). However, the growth in plant diameter was better in plants which were applied with foliar fertilizer (T4) after the 7th weeks of planting. The application of foliar fertilizer has added extra nutrient (micronutrient) as a supplement for plant growth. In terms of nutrient absorption, foliar fertilization can be from 8 to 20 times as efficient as ground application (George, 2003).

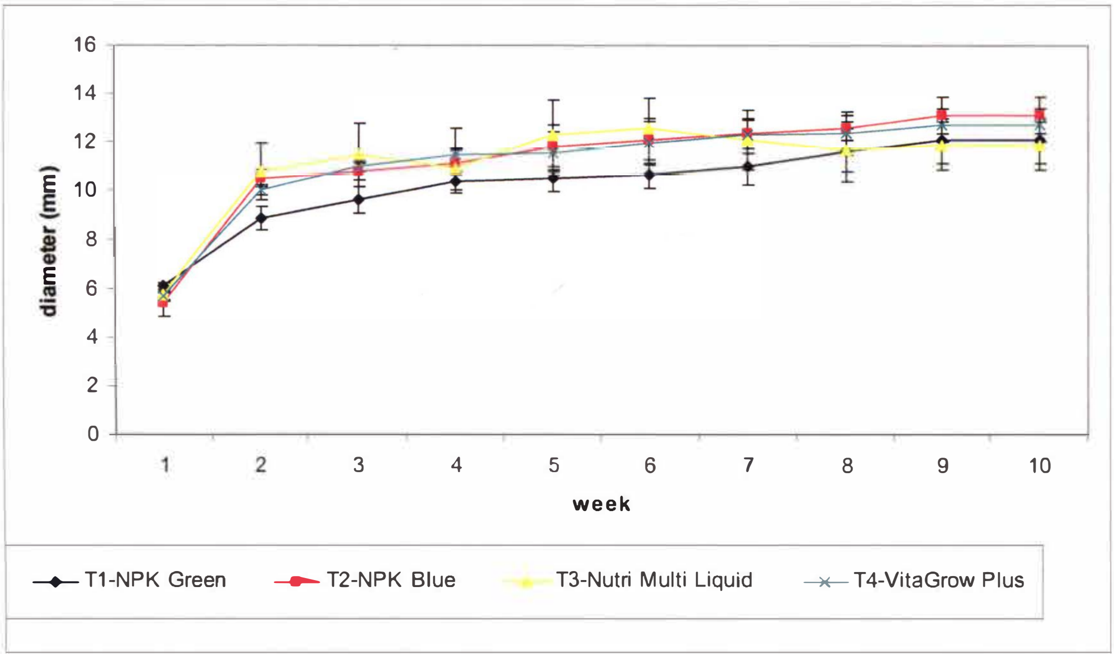

Figure 4.2: Effect of different fertilizer on diameter of tomato plants.

4.1.3 Number of Flower

Environmental factors such as light, temperature, carbon dioxide, nutrition, moisture and growth regulator directly or indirectly influence flower initiation. Tomato flowering is complex. Factor that increase the total amount of assimilates in the plant as well as those increasing the competitive potential of the apex decrease the number of leaves preceding the first inflorescence (Heuvelink, 2005).

Figure 4.3 and appendix H, showed the average effects of different fertilizer treatments on number of flowers. Weekly appearance of flower after 4th week decreased in all treatments, similar to plant height and plant diameter there have no significantly different ($P>0.05$). On the average, the additional of foliar fertilizers gave better number of flower on 4th week. Soil applied fertilizer was better than foliar fertilizer applied even on 5th week. However, the number of flower was better in plants applied with NPK Green (T1) compared to foliar applied application. Soil applied showed better to support plant growth because plant was taken the nutrient from the soil. Foliar application is not suitable applied during rainy day and excessive wind that caused the flower dropped and less pollination occurred. According to George (2003), foliar fertilizers spray when wind is minimal. This is especially important with finely atomized sprays because they drift readily.

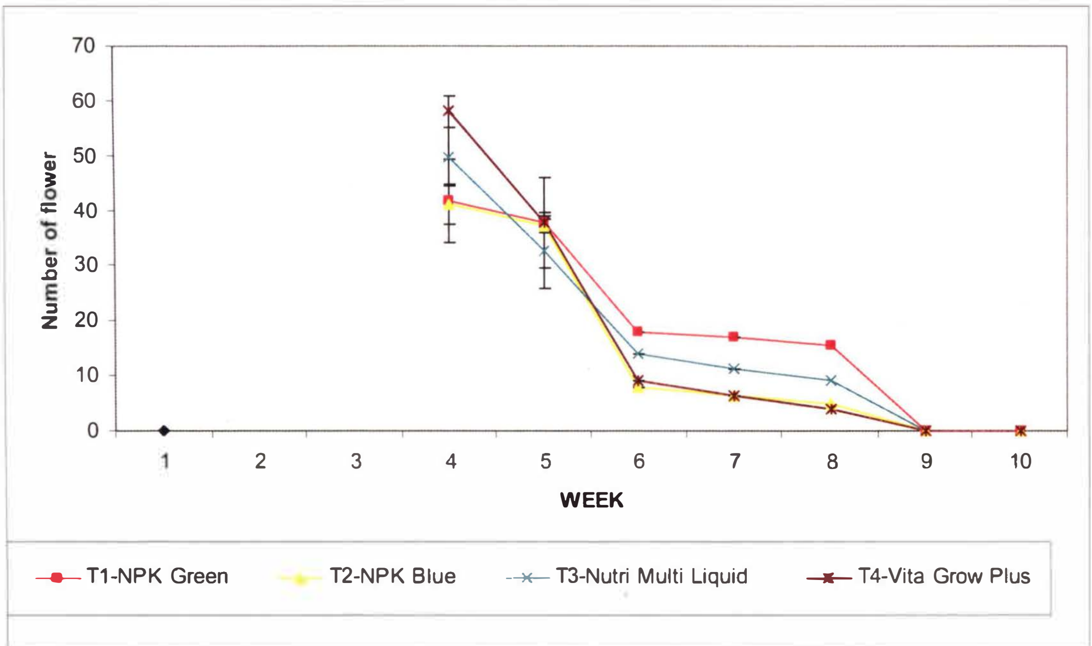

Figure 4.3: Effect of different fertilizer on number of flower.

4.1.4 Number of Fruit

Fruit set defined as proportion of open flowers that subsequently set fruit of a marketable size, may fail for many reasons. Flower and fruit abortion is defined as the proportion of flowers that fail to yield fruit of marketable size and hence fruit set is one minus abortion. Tomato flower abortion occurs frequently, whereas tomato fruit abortion is uncommon, although sometimes distal fruits stop growing at a small size and never ripen. Failure of pollen production (amount and viability of pollen) or pollination, pollen germination, pollen tube growth, ovule production, fertilization or fruit swelling may all result in poor fruit set. However, poor fruit set in low light conditions is most frequently caused by failure of pollen production or pollination (Heuvelink, 2005).

Figure 4.4 and appendix I, showed the average effect of different fertilizer on number of tomato fruit. Weekly, number of fruit showed fluctuation in all treatments but not significantly different (P>0.05) from control (T1). On the average, the addition of NPK Blue and foliar fertilizer gave better number of fruit even after 3 weeks planting. However, the control treatment (T1) has resulted in ever better number of fruit on 9th week because the actions of NPK Green absorption is very slowly uptake where only at the end especially during the last plant growth contribute NPK Green. In this experiment, it seemed that soil applied is better than foliar fertilizer application because plant absorb the nutrient from improved bris soil during rainy day and excess wind.

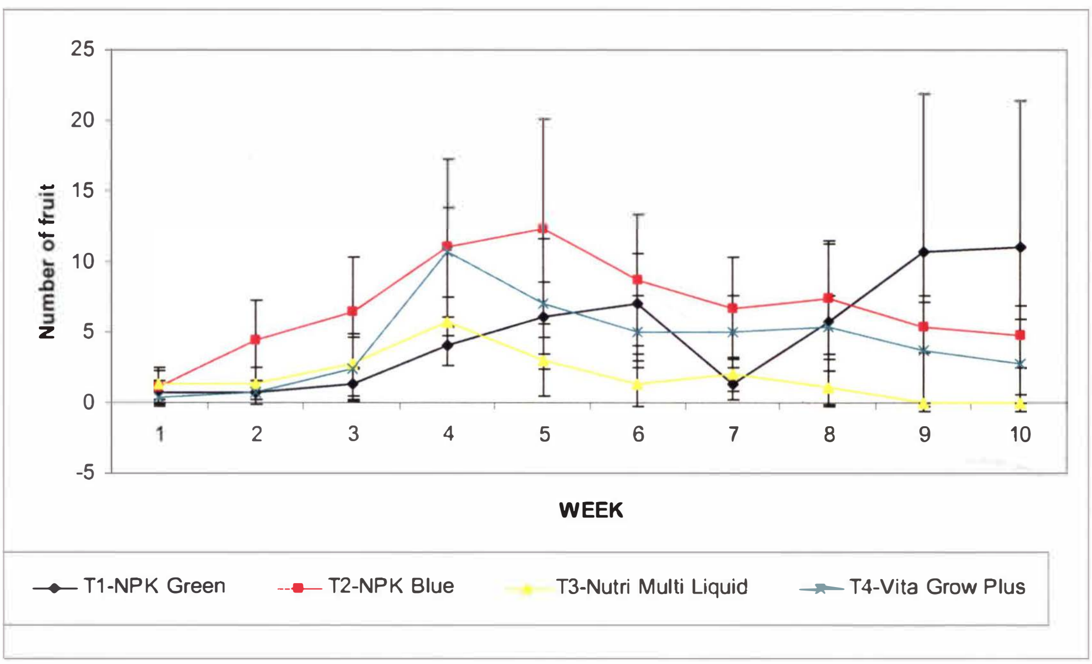

Figure 4.4: Effect of different fertilizer on number of tomato fruit.

4.2 Chemical changes

4.2.1 Total Soluble Solid

Soluble solid and titratable acidity are important component of flower. Fruit length in both acids and sugars have excellent flavour, while tart fruit have low sugar content and bland fruit have low acidity. Sugars accumulate through their importation from photosynthesizing leaves and after harvest from the hydrolysis of stored starch. Stage of harvested fruit at elevated temperature hastens not only ripening but also respiratory loss of stored carbohydrate (Salveit, 2005).

Based on the figure 4.5 and appendix J, showed the average on effect of different fertilizer on total soluble solid. Total soluble solid showed most significant difference ($P<0.05$) for all treatments. On the average, soil applied fertilizer (T1 and T2) gave better chemical changes on TSS compared with foliar fertilizer application (T3 and T4). However, the addition of NPK blue give better TSS than the control (NPK Green) because NPK Blue contribute to fruit set and help to make the sweet flavour on tomato fruit.

The effectiveness of applying macronutrients such as nitrogen, phosphorus and potassium to plant leaves is questionable. It is virtually impossible for tomato plants to absorb enough N, P or K through the leaves to fulfill their nutritional requirements; furthermore, it is unlikely that they could absorb sufficient amounts of macronutrients to correct major deficiencies. Although nitrogen may be absorbed within 24 hours after application, up to 4 days are required for potassium uptake, and 7 to 15 days are required for phosphorus to be absorbed from foliar application (Kelly and George, 2006).

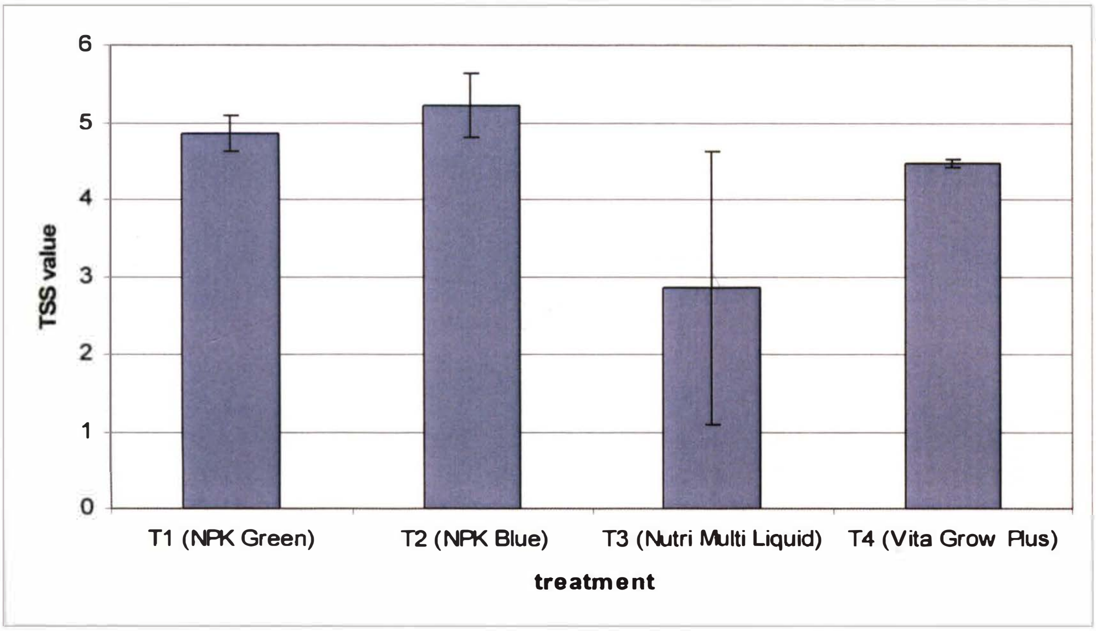

Figure 4.5: Effect of different fertilizer on total soluble solid of tomato fruit.

4.2.2 pH value

A ripe tomato is acidic and it pH value range from 4.1 to 4.8 (Salveit, 2005). Figure 4.6 and appendix K, showed the average on effect of different fertilizer on pH value of tomato fruit. pH value showed no significant different (P>0.05) for all treatment. On the average, similar to TSS value, soil applied fertilizer (T1 and T2) is better than foliar fertilizer (T3 and T4). It was because tomato plant did not absorb enough the foliar applied fertilizer for fruit quality. The fruits were harvested earlier to avoid fruit damage (cracking) during monsoon season.

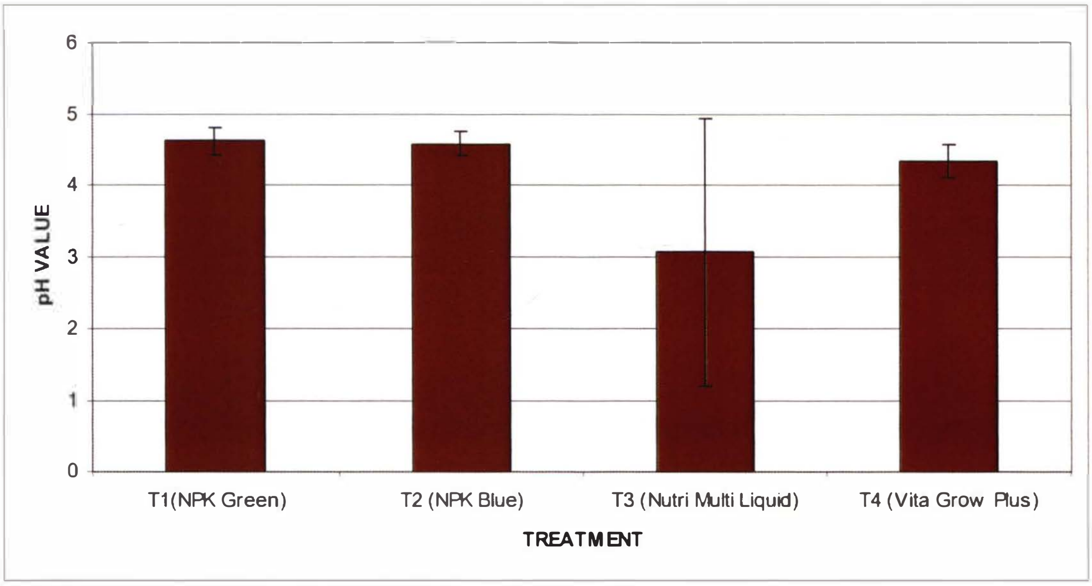

Figure 4.6: Effect of different fertilizer on pH of tomato fruit.

CHAPTER 5

CONCLUSION

5.1 Conclusion

In conclusion, results obtained from physico-chemical studies indicated that there were significant differences between different types of fertilizer treatments for some parameters (plant height, plant diameter, number of flower, number of fruit, TSS and pH). However, among all the fertilizer treatments, the addition of NPK Blue in treatment 2 was better. Only for height and diameter parameter foliar fertilizer application was better than soil applied fertilizer. In addition of NPK Green, foliar fertilizer was used to give the supplement for plant growth. During monsoon season, the application of foliar fertilizer was not suitable due to heavy down pour. Nevertheless, foliar fertilizer has given benefit to increase the yield. In this experiment, combination between NPK Green and NPK Blue are better in number of flower and number of fruit because plant absorbed the nutrients from the improved bris soil. Fruit that was applied with inorganic complete fertilizer showed the highest total soluble solid and pH.

5.2 Recommendation for further study

For the further study of effect of foliar fertilizer on growth, flowering, fruiting and post harvest quality of tomato on improved bris soil, should be carried out indoors (under shelter) to prevent from wind and rain. For indoor plants, apply once a month. For flowers and vegetables outside, apply every two weeks, preferably in the morning.

This study can also be done using different concentration of foliar fertilizers especially with respect to conduction of foliar fertilizer and fertilizer supplement. The addition, for operation seeking to farm more sustainably, this include some combination of compost, livestock manure, green manure, cover crops, soil-applied rock minerals and well-planned crop rotations that include legumes.

For further application technology, there have two technologies that appear especially applicable to foliar fertilization deserve to be mentioned. The first is use of electrostatic sprayers, which impart a charge to the spray particles and cause them to adhere more readily to plants. The second technology, known as Sonic Bloom, uses sound to increase the leaves absorption of nutrients (George, 2003).

REFERENCES

Adams, P. 1999. Plant nutrition demystified. *Journal of Acta Horticulture* 481:341-344.

Akanbi W.B., Adebayo T.A., Togun O.A., Adeyeye A.S. and. Olaniran O.A. 2007. The Use of Compost Extract as Foliar Spray Nutrient Source and Botanical Insecticide in ***Telfairia occidentalis.*** *World Journal of Agricultural Sciences* 3 (5): 642-652.

Ayoola, O. T. and Adeniyan O. N. 2006. Influence of poultry manure and NPK fertilizer on yield and yield components of crops under different cropping systems in south west Nigeria. *African Journal of Biotechnology* Vol. 5 (15), pp. 1386-1392.

Bernardinus, T. Wahyu, W. 2007. *Penanaman Tomato*. Synergy Media Books. Kuala Lumpur.

Bertin, N., Causse, M., Tricon, D. and etc. 2009. Identification of growth processes involved in QTL for tomato fruit size and composition. *Journal of Experimental Botany* 60:237-248.

Bettiol, W., Ghini, R. 2004. Organic and Conventional Tomato cropping Systems. *Journal of Science Agriculture* 61:253-259.

Dixon, R.C. 2007. Foliar Fertilization Improves Nutrient Use Efficiency. *Buletin of Ferilizer Technology (Nutra-flo's online resource for agricultural fertilizers)* 40P22-23.

Dr. Christopher, J.K. How to use foliar fertilizers. [online]. Available from: http//:www.ehow.com/how_2128658_use-foliar-fertilizer.html [Accessed 15 October 2009].

Dr. Mary, P. 2001. Tomato. [online]. Available from: http://www.ncsu.edu/sustainable/profiles/bot_tom.html [Accessed 12 July 2009].

Fawzy, Z.F., El-Nemr, M.A. and Saleh, S.A. 2007. Influence of Levels and Methods of Potassium Fertilizer Application on Growth and Yield of Eggplant. *Journal of Applied Sciences Research* 3(1): 42-49.

Garden Web. 2006. How do I start tomatoes from seed?. [online]. Available from: http://faq.gardenweb.com/faq/lists/tomato/2005151350204l3.html [Accessed 12 July 2009].

George, K. 2003. Foliar Fertilization. [online]. Available from: http//www.attra.org/attar-pub/foliar.html [Accessed 15 October 2009].

Heuvelink, E. 2005. *Tomatoes*. Wageningan University. CABI Publishing. UK.

Ho, L. 1996. The mechanism of assimilate portioning and carbohydrate compartmentation in fruit in relation totle quality and yield of tomato. *Journal of Experimental Botany* 47:1239-1243.

Iannoti, M. 2008. Growing Great Tomatoes. [online]. Available from: http://gardening.about.com/od/growingtips/tp/Tomato_Tips.htm [Accessed 11 July 2009].

Jabatan Pertanian Semenanjung Malaysia. 1997. *Pakej Teknologi tanaman Tomato.* Majucetak sdn. Bhd.

Janse, J. and Schols, M. 1992. *Specific temperature and transpiration effects on the flavour of tomatoes.* In: Annual Report. Glasshouse crops Research Station, Naaldwijk, The Netherlands. Pp. 39-40.

Jennifer, B. 2009. Organic fertilizer. [online]. Available from: http://www.planetnatural.com/site/xdpy/kb/n-p-k-organic-fertilizers.html [Accessed 20 July 2009].

Kader, A.A, Moris, L.L, Stevens, M.A and Albright-Holton, M. 1978. Composition and flavour quality of fresh market tomatoes as influenced by some postharvest handling procedures. *Journal of the American Society for Horticultural Science* 103:6-13.

Kelly, W.T., Boyhan, G. 2006. Commercial Tomato Production Handbook. *University of Georgia. Buletin of Extension Horticulturies* 1312.

Kinet, J.M. and Peet, M.M. 1997. *Tomato.* In: Wien, H.C. (ed). The Physiology of Vegetables Crops. CAB International, Wallingford. UK, pp. 207-258.

Padem, H.A. Ocal, A.S. 2009. Effects of foliar Fertilizer on Yield and Some Characteristics of Processing Tomato. *Journal of ISHS Acta Horticulture* 487. [online]. Available from: http://www.actahort.org/books/487/index.htm [Accessed 4 November 2009].

Riofrio, M. 2000. *Tomato.* Ohio State University Extension. [online]. Available from: http://www.uri.edu/ce/factsheets/sheets/tomato.html [Accessed 12 July 2009].

Salveit, M.E. 2005. Fruit ripening and fruit quality. In: Heuvelink, E., *Tomatoes.* Wageningan University. CABI Publishing. UK. p 156-159.

Sharma, A.R. and B.N. Mittra, 1991. Effect of different rates of application of organic and nitrogen fertilizers in a rice-based cropping system. Journal *of Agricultural Science (Cambridge),* 117: 313-318.

Straumietis, M. 2008. Advantages of Using a Foliar Fertilizer. [online]. Available from: http://ezinearticles.com/?Advantages-of-Using-a-Foliar-Fertilizer&id=1230662 [Accessed 11 July 2009].

Thegardeners Network. 2009. How to Grow Tomatoes. [online]. Available from: http://www.gardenersnet.com/vegetable/tomato.htm [Accessed 12 July 2009].

Tiwary, D.K. D.M. Abuhasan and Chattopadhyay, 1998. Studies on the effect of inoculation with *Azotobacter* and *Azosprillum* on growth yield and quality of Banana. *Indian Journal of Agriculture*, 42: 235-240.

Wan Zaki, W. M., Mohammud, C. H. 2006. Micro Irrigation For Open Field Planting: Effect Of Surface Drip Fertigation On Growth And Yield Of Flue-Cured Tobacco Grown On Two Soil Types. 7th International Micro Irrigation Congress. [online]. Available from: www.irncid.org/DWNLoad.aspx?FN=889947616927284890.pdf [Accessed 24 August 2009]

Zaharah, A., Engku Ismail, E. A., Virmala, P. 1992. Management of Bris Sandy Soil (Rudua Series) for Chili and Tomato Production in Peninsular Malaysia. [online]. Available from: http://www.actahort.org/members/showpdf?booknramr=369_25 [Accessed 24 August 2009]

Zotarelli, L., Dukes, M.D., Scholberg, J.M.S., Mun˜oz-Carpena, R. and Icerman, J. 2009. Tomato nitrogen accumulation and fertilizer use efficiency on a sandy soil, as affected by nitrogen rate and irrigation scheduling. *Journal of Agricultural Water Management* 96, 1247–1258.

APPENDICES

APPENDIX A : Data on the average plant height of tomato on improved bris soil

Treatment	Height (Week)									
	1	2	3	4	5	6	7	8	9	10
T1	33.383	75.667	88.333	98.5	108.667	120	124.833	129.667	132	132
T2	35.46	78.917	97.083	115.333	127.75	135.5	138.083	138.083	141.667	141.667
T3	35.683	79.5	97.5	111.167	124.5	133.833	141	146.333	149	149
T4	36.917	80.917	100.417	116.333	127.583	141.5	149.75	151.417	154.167	154.167

APPENDIX B : Data on the average plant diameter of tomato on improved bris soil

Treatment	Diameter (Week)									
	1	2	3	4	5	6	7	8	9	10
T1	6.107	8.847	9.595	10.355	10.485	10.625	11.003	11.578	12.052	12.052
T2	5.435	10.53	10.806	11.156	11.793	12.066	12.335	12.590	13.123	13.123
T3	5.743	10.763	11.485	10.892	12.268	12.542	12.087	11.662	11.872	11.872
T4	5.688	10.015	10.972	11.463	11.537	11.947	12.273	12.343	12.682	12.682

T1-NPK Green   T2-NPK Blue   T3-Nutri Multi Liquid   T4-Vita Grow Plus

APPENDIX C : Data on the average number of flower of tomato on improved bris soil

Treatment	Number of flower (Week)									
	1	2	3	4	5	6	7	8	9	10
T1				42	38	18	17	16	0	0
T2				41	37	8	6	5	0	0
T3				50	33	14	11	9	0	0
T4				58	38	9	6	4	0	0

APPENDIX D : Data on the average number of fruit of tomato on improved bris soil

Treatment	Number of fruit (Week)									
	1	2	3	4	5	6	7	8	9	10
T1	1	1	1	4	6	7	1	6	11	11
T2	1	4	6	11	12	9	7	7	5	4
T3	1	1	3	6	3	1	2	1	0	0
T4	0	1	2	11	7	5	5	5	4	3

T1-NPK Green T2-NPK Blue T3-Nutri Multi Liquid T4-Vita Grow Plus

APPENDIX E : Data on the average TSS value and pH value of tomato on improved bris soil

Treatments	TSS	pH
T1	4.9	4.61
T2	5.2	4.58
T3	2.9	3.07
T4	4.5	4.34

T1-NPK Green T2-NPK Blue T3-Nutri Multi Liquid T4-Vita Grow Plus

APPENDIX F : Effectof foliar fertilizer on plant height of tomato on improved bris soil.

Treatments	Height (Weeks)				
	1	2	3	4	5
T1	33.383 ± 1.996^a	75.667 ± 4.320^a	88.333 ± 0.736^a	98.500 ± 1.275^a	108.667 ± 3.488^a
T2	35.460 ± 1.877^a	78.916 ± 3.043^a	97.083 ± 3.776^a	115.333 ± 4.601^a	127.750 ± 10.999^a
T3	35.683 ± 2.016^a	79.500 ± 0.354^a	97.500 ± 5.690^a	111.167 ± 8.488^a	124.500 ± 5.842^a
T4	36.917 ± 5.901^a	80.917 ± 5.658^a	100.422 ± 4.651^a	116.333 ± 2.944^a	127.583 ± 2.439^a

Treatments	Height (Weeks)				
	6	7	8	9	10
T1	120.000 ± 4.950^a	124.833 ± 7.602^a	129.667 ± 11.754^a	132.000 ± 12.728^a	132.000 ± 12.728^a
T2	135.500 ± 9.546^a	138.083 ± 8.588^a	138.083 ± 8.868^a	141.667 ± 6.542^a	141.667 ± 6.542^a
T3	133.833 ± 7.368^a	141.000 ± 9.823^a	146.333 ± 11.918^a	149.000 ± 12.505^a	149.000 ± 12.505^a
T4	141.500 ± 4.861^a	149.750 ± 11.179^a	151.417 ± 12.962^a	154.167 ± 14.306^a	154.167 ± 14.306^a

Means within columns with same letters are not significantly different ($P>0.05$)
Means within columns with different letters are significantly different ($P<0.05$)

T1-NPK Green T2-NPK Blue T3-Nutri Multi Liquid T4-Vita Grow Plus

APPENDIX G: Effect of foliar fertilizer on plant diameter of tomato on improved bris soil.

Treatments	Diameter (Weeks)				
	1	2	3	4	5
T1	6.107 ± 0.174^{a}	8.847 ± 0.466^{a}	9.595 ± 0.561^{a}	10.355 ± 0.453^{a}	10.485 ± 0.506^{a}
T2	5.435 ± 0.534^{a}	10.530 ± 0.343^{a}	10.806 ± 0.398^{a}	11.156 ± 0.514^{a}	11.793 ± 0.943^{a}
T3	5.743 ± 0.152^{a}	10.763 ± 1.153^{a}	11.485 ± 1.302^{a}	10.892 ± 0.874^{a}	12.268 ± 1.464^{a}
T4	5.688 ± 0.166^{a}	10.015 ± 0.202^{a}	10.972 ± 0.1618^{a}	11.463 ± 1.101^{a}	11.537 ± 0.886^{a}

Treatments	Diameter (Weeks)				
	6	7	8	9	10
T1	10.625 ± 0.509^{a}	11.003 ± 0.764^{a}	11.578 ± 1.238^{a}	12.052 ± 0.945^{a}	12.052 ± 0.945^{a}
T2	12.066 ± 0.932^{a}	12.335 ± 0.574^{a}	12.589 ± 0.522^{a}	13.123 ± 0.778^{a}	13.123 ± 0.778^{a}
T3	12.542 ± 1.273^{a}	12.087 ± 1.218^{a}	11.662 ± 0.895^{a}	11.872 ± 0.992^{a}	11.872 ± 0.992^{a}
T4	11.947 ± 0.894^{a}	12.273 ± 0.710^{a}	12.343 ± 0.884^{a}	12.682 ± 0.680^{a}	12.682 ± 0.680^{a}

Means within columns with same letters are not significantly different ($P>0.05$)
Means within columns with different letters are significantly different ($P<0.05$)

T1-NPK Green T2-NPK Blue T3-Nutri Multi Liquid T4-Vita Grow Plus

APPENDIX H: Effect of foliar fertilizer on number of flower of tomato on improved bris soil.

Treatments	Number of Flower (Weeks)				
	1	2	3	4	5
T1	0.00±0.00	0.00±0.00	0.00±0.00	41.67±10.157^a	37.67±7.118^a
T2	0.00±0.00	0.00±0.00	0.00±0.00	41.00±14.300^a	37.00±24.658^a
T3	0.00±0.00	0.00±0.00	0.00±0.00	49.67±8.287^a	32.67±8.165^a
T4	0.00±0.00	0.00±0.00	0.00±0.00	58.00±24.166^a	37.67±26.118^a

Treatments	Number of Flower (Weeks)				
	6	7	8	9	10
T1	18.00±6.964^a	17.00±7.649^a	15.67±8.256^a	0.00±0.00	0.00±0.00
T2	8.00±6.481^a	6.33±3.629^a	5.00±1.225^a	0.00±0.00	0.00±0.00
T3	14.00±4.243^a	11.33±5.354^a	9.00±6.819^a	0.00±0.00	0.00±0.00
T4	9.00±4.950^a	6.33±2.858^a	4.00±1.414^a	0.00±0.00	0.00±0.00

Means within columns with same letters are not significantly different ($P>0.05$)
Means within columns with different letters are significantly different ($P<0.05$)

T1-NPK Green T2-NPK Blue T3-Nutri Multi Liquid T4-Vita Grow Plus

APPENDIX I: Effect of foliar fertilizer on number of fruit of tomato on improved bris soil.

Treatments	Number of Fruit (Weeks)				
	1	2	3	4	5
T1	0.67 ± 0.816^a	0.67 ± 0.816^a	1.33 ± 1.080^a	4.00 ± 1.141^a	6.00 ± 2.550^a
T2	1.00 ± 1.225^a	8.67 ± 2.858^a	6.33 ± 4.021^a	11.00 ± 6.285^a	12.33 ± 7.757^a
T3	1.33 ± 1.080^a	1.33 ± 1.080^a	2.67 ± 2.160^a	5.67 ± 0.408^a	3.00 ± 2.550^a
T4	0.33 ± 0.408^a	0.67 ± 0.816^a	2.33 ± 2.273^a	10.67 ± 3.189^a	7.00 ± 4.637^a

Treatments	Number of Fruit (Weeks)				
	6	7	8	9	10
T1	7.00 ± 3.536^a	1.33 ± 1.080^a	5.67 ± 5.760^a	10.67 ± 11.232^a	11.00 ± 10.464^a
T2	8.67 ± 4.708^a	6.67 ± 3.629^a	7.33 ± 3.894^a	5.33 ± 1.780^a	4.67 ± 2.160^a
T3	1.33 ± 1.633^a	2.00 ± 1.225^a	1.00 ± 1.225^a	0.00 ± 0.000^a	0.00 ± 0.000^a
T4	5.00 ± 2.550^a	5.00 ± 2.550^a	5.33 ± 2.273^a	3.67 ± 3.894^a	2.67 ± 3.266^a

Means within columns with same letters are not significantly different ($P>0.05$)
Means within columns with different letters are significantly different ($P<0.05$)

T1-NPK Green T2-NPK Blue T3-Nutri Multi Liquid T4-Vita Grow Plus

APPENDIX J: Effect of foliar fertilizer on TSS of tomato on improved bris soil.

Treatments	TSS
T1	0.0426 ± 0.2354^{ab}
T2	0.0378 ± 0.4098^{a}
T3	0.0555 ± 1.7682^{b}
T4	0.0501 ± 0.0408^{ab}

Means within columns with same letters are not significantly different ($P>0.05$)
Means within columns with different letters are significantly different ($P<0.05$)

APPENDIX K: Effect of foliar fertilizer on pH value of tomato on improved bris soil.

Treatments	pH
T1	4.613 ± 0.185^{a}
T2	4.583 ± 0.166^{a}
T3	4.653 ± 1.878^{a}
T4	4.337 ± 0.245^{a}

Means within columns with same letters are not significantly different ($P>0.05$)
Means within columns with different letters are significantly different ($P<0.05$)

T1-NPK Green T2-NPK Blue T3-Nutri Multi Liquid T4-Vita Grow Plus

CURRICULUM VITAE

Name	: Siti Nor Azurin binti Jamaluddin
Permanent Address	: 1/79 Rumah Kakitangan, Felda Air Tawar 5, 81903 Kota Tinggi, Johor.
Telephone Number	: 017-7558550
E-mail	: sakura_ixora@hotmail.com
Date of Birth	: 14 June 1984
Place of Birth	: Negeri Sembilan
Nationality	: Malaysia
Race	: Melayu
Gender	: Perempuan
Religion	: Islam
Educational Background	:

2007 – 2010	Universiti Malaysia Terengganu (UMT)
2004 – 2007	Kolej Universiti Sains dan Teknologi Malaysia (KUSTEM)
1997 – 2003	Sekolah Menengah Kebangsaan Tun Habab, Kota Tinggi, Johor
1991 – 1996	Sekolah Kebangsaan Bukit Mahkota, Felda Bukit Aping Timur, Kota Tinggi, Johor

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