"THE FERTILIZING POTENTIAL OF *TITHONIA DIVERSIFOLIA* (Hemsl.) A. Gray: A GREEN ALTERNATIVE FOR SUSTAINABLE AGRICULTURE"

DISSERTATION

SUBMITTED IN PARTIAL FULFILLMENT OF

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BY

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CERTIFICATE

This is to certify that the dissertation work entitled "The Fertilizing Potential of *Tithonia diversifolia* (Hemsl.) A. Gray: A Green Alternative for Sustainable Agriculture", submitted in partial fulfillment of the requirements for the award of the Degree of Bachelor of Science in Botany is an authentic work carried out by Jisna Mary James (Reg No: AB22BOT010) under the supervision and guidance of Miss. Rishika P.S.

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DECLARATION

I hereby declare that the dissertion entitled "The Fertilizing Potential of *Tithonia diversifolia* (Hemsl.) A. Gray: A Green Alternative for Sustainable Agriculture" submitted to Mahatma Gandhi University in partial fulfillment of requirements for the award of the Degree of Bachelor of Science in Botany is a record of original research work done by me under the guidance of Miss Rishika P.S, Deparment of Botany, St. Teresa's College, Ernakulam

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Place: Ernakulam

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Jisna Mary James

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Abstract

Tithonia diversifolia, a shrub in the family Asteraceae, is widely distributed in the humid and subhumid tropical regions. The availability of nutrients greatly affects the growth and yield of plants. During this time excessive and continuous use of inorganic fertilizers can lead to a decrease in soil fertility rates. Utilization of mexican sunflower as a supplier of organic materials can be done easily and efficiently because mexican sunflower plants are very easy to get and grown widely. Green fertilizer of *T. diversifolia* has been recognized as an effective source of nutrients for vegetables, rice and maize. This paper reviews the potential of *T.diversifolia* green fertilizer for soil fertility improvement and as a supplier of organic materials to increase growth and yield. Treatment using mexican sunflower dose (D) consists of: D1= 1 kg leaves, D2= 500g with 500g cow dung, D3= 750g leaves with 250g cow dung. The results of the study obtained mexican sunflower with a dose of fertilization can produce growth and yield. Green leaf biomass of *T. diversifolia* is high in nutrients, averaging about 3.5% N, 0.37% P and 4.1% K on a dry matter basis. *T. diversifolia* biomass decomposes rapidly after application to soil, and incorporated biomass can be an effective source of N, P and K for crops. In some cases, vegetables yields were even higher with incorporation of *T. diversifolia* biomass than with commercial mineral fertilizer at equivalent rates of N, P and K. In addition to providing nutrients, *T. diversifolia* increase soil microbial biomass. While using *T. diversifolia* as a fertilizer, reduce the cost of other fertilizer. Mexican sunflower as an organic fertilizer can improve soil fertility and be able to provide nutrients to plants.

CHAPTER 1

INTRODUCTION

Organic fertilizer are natural substance that provide essential nutrients to plant improving soil health and fertility. An organic fertilizer is a fertilizer that is derived from organic sources, including organic compost, manure, green manure, worm castings, cow dung, fish emulsion, bone meal, alfalfa meal. Organic fertilizer enhance the natural soil processes, which have long term effect on soil fertility. It improving soil's water holding capacity and aeration and also release nutrients slowly, providing a steady supply to plants. It promote beneficial microorganisms, fungi, bacteria, and organic fertilizer help to decrease plant disease. Generally it is considered safe and non toxic when used properly, but like any fertilizer, excessive application can lead to problems like nutrient toxicity or soil imbalances. Organic fertilizers are environmental friendly and minimizing environmental pollution. Many organic fertilizer, such as compost etc. can be made at home it reducing costs. Comfrey tea, nettle tea, alfalfa meal tea, worm wood tea, *T. diversifolia* banana peel, coffee grounds, moringa oleifera, eucalyptus leaves are some examples of organic fertilizers that can be made from plants. Because they are rich in nitrogen, phosphorus, and potassium (NPK). It is crucial for plant growth, providing nutrients for various stages of development, from leaf growth to flowering and fruiting.

The plant's biomass, including leaves and stem, is rich in essential nutrients like nitrogen (N), phosphorus (P), and potassium (K). So the *T. diversifolia* has been used as a green manure and biofertilizer (Hemsley A. Gray).

T. diversifolia is a flowering plant in the tribe heliantheae within the family Asteraceae. It is mainly represented by shrub. *T. diversifolia* commonly known as mexican sun flower. It is originated from mexico. It is now widely distributed the central america, and also including asia, and africa and it is common in indigenous fallow system in southest asia. A plant of the tropics and subtropics, it can also be grown as a summer annual in temperate areas. The plant has escaped from cultivation and become a weed in many areas of the tropics and subtropics.

T. diversifolia is known for its vibrant, daisy like flowers, making it a popular choice for ornamental purposes in gardens and landscapes was probably introduced in to africa as an ornamental. *T. diversifolia* has a woody stem that can grow up to 5, to 6 meters in height. Normally no branches are present in the main stem. The stem is green or brownish green in color. It is smooth and slightly hairy. The leaves are green or dark

green. The leaves can grow up to 30 cm in length and 15 cm in width. The leaves are soft and velvety. The leaves are elliptical in shaped and arranged in clusters at the end of the branches. The flowers are bright orange or yellow in color. It can grow up to 10 cm in diameter. 10-15 Petal are present in the flowers. Tap root system is present in the plant *T. diversifolia*. The roots can grow up to 1 meter in depth. Roots are yellowish brown in colored. The plant has glandular hairs on its leaves and stem. The plant has leafy bracts that resemble small leaves and are found at the base of the flower clusters. Plant produces a fruit that is a dry, brownish- black achene. Mature plants can produce 80,000 to 160,000 seeds annually. The growth and the development of plants are determined by two main factors. The first factor is the genetic (genotype) (Nunes-nesi et al., 2016; pohl et al., 2019), which describes plant characters that are inherited from its parents. The second is an environment factor (carbon dioxide, water, radiation, temperature, and nutrient) (Amoo & Babalola, 2017; He et al., 2019; Zhu et al., 2018).The plant tithonia is commonly used as a fodder (Anette, 1996 :Roothaert and patterson, 1997,Roothaert et al...,1997), poultry feed (Odunsi et al .,1996), fuel ,soil erosion control ,compost , landdemarcation (Nginja et al., 1998) ,ornamental , green manure, biopesticide, living fence (Nginja etal., 1998, Otuma et al.,1998).

T.diversifolia is widely valued in several cultures for it medicinal properties. *T. diversifolia* has a long tradition of use by local people for treating and preventing ailment and diseases. The plant is widely used in several countries such as Democratic Republic of Congo, Mexico, Costa rica, Nigeria, Kenya, Philippines, Sao Tome and Principe, Taiwan, Uganda, and Venezuela to traditionally treat numerous diseases including snake bite, measles, gastric ulcer, menstrual pain, and wounds, liver pain, stomach pain, sore throat, indigestion. And also it has anti- inflammatory, antimicrobial, anticancer, and anti -HIV, antiviral, antispasmodic, antidiarrhoeal, analgesic Properties .The stem and leaf extract are take orally to treat adscesses, hematomas, and muscular cramps (Frei et al.,1998; Jatem-Lasser et al.,1998). *T. diversifolia's* flower can be used to produce a natural dye for textiles. This plant provides a habitat for various wildlife, including birds, bees, and butterflies. And the plant can help sequester carbon from the atmosphere, mitigating climate change. The plant extracts have antioxidant and anti inflammatory properties, making them useful in cosmetics and skincare products. It has a repellent activity on the mosquito anapholes gambiae, and a smaller, but still significant, action on other species of mosquito.

The chemical analyses of the plant is indicate the presence of bioactive substance such as alkaloids, tannins, flavonoids, saponins, terpenoids and phenols in leaves, stem, and root of *T. diversifolia* (Olayinka et al.,2015). Glycosides have been detected from the aqueous and methanolic extracts of shoot of *T. diversifolia* plant (Otusanya and Ilori, 2012) and are known for their potential to lower cholesterol and have antimicrobial

effects. Tannins, Flavonoids, Alkaloids, saponins, terpenoids, glycosides, present in extract is leaves, stem, and root. Steroids present in leaves and root only. Phenolics found in flower extracts. Carbohydrates, anthocyanins, and coumarins are present in root. Volatile oil present in leaves. Extract of the tithoina have medicinal value for treatment of hepatitics (Lin et al., 1993 ; Kuo and Che, 1997) and control of amoebic dysentery (Tona et al.,1998). Extract from *T.diversifolia* plant parts reportedly protect crops from termites (Adoyo et al., 1997) and containing chemicals that inhibit plant growth (Baruah et al., 1994; Tongma et al., 1997) and control insects (Carino and Rejester, 1982; Dutta et al., 1993).

The green biomass of *T.diversifolia* was recognized to be high in nutrients and effective as a nutrient source for lowland rice (Nagarajah and Nizar, 1982) . Studies in the highlands of western kenya identified green biomass of tithonia as an effective source of nutrients for maize (Gachengo, 1996; Niang et al., 1996). Recent work in Malawi (Ganunga et al., 1998) and Zimbabwe (jiri and Waddington, 1998) reported *T.diversifolia* biomass to be an effective nutrient source for maize.

T.diversifolia leaves are rich in nitrogen, phosphorus, potassium. The leaves can be added to compost or used as a mulch to provide nutrients to plant. Its biomass contains an average of about 3.5% nitrogen (N) and 0.37% phosphorous (p), 4.1% potassium (K). *T. diversifolia* decomposes rapidly, releasing these nutrients and improving soil fertility. It's particularly beneficial for crops like maize, vegetables, and lowland rice. Western kenya has proven to be an excellent location to quantify the ability of *T.diversifolia* biomass to improve soil fertility because crop production in wester kenya can be constrained by soil N, P and K deficiencies (Lijzenga, 1998). This plant causes immediate and sustained increase in soil PH and an immediate and sustained decrease in extractable Aluminium in soils. Extract Mexican sunflower (*T. diversifolia*) could be one of the suitable choices as the replacement for organic manure. This kind of plant is found growing in several areas. Due to the limited knowledge, many farmers could not get the benefit from these multifunctional plant. The plant containing nutrients to support plant growth and development.

CHAPTER 2

OBJECTIVES

- Prepare an organic fertilizer using *Tithonia diversifolia* (mexican sunflower) that can be an effective alternative to or complement commercial mineral fertilizers in providing nutrients.
- To compare the effective growth of plant in various concentrations of organic fertilizer

CHAPTER 3

REVIEW OF LITERATURE

Mexican sunflower (*Tithonia diversifolia*) is a valuable source of nutrients and can be used as a green manure or compost component, improving soil fertility and potentially reducing reliance on synthetic fertilizers. *Tithonia diversifolia* (Hemsl.) is commonly known as Mexican sunflower (Brazil), buttercup or mirasol (Colombia), yellow flower or arnica-da-terra (Venezuela) and yellow daisy (Cuba). And it's *Tithonia diversifolia* foliage is rich in protein and comparable to forage legumes in that respect. However, variability is high with protein content ranging from 12% to more than 30% DM, depending on the stage of maturity and on the proportion of stems in the fodder.

Likewise, fibre content is highly variable: ADF content varies from 23% to more than 40%. One study found that nutritive value was highest in the vegetative stage and decreased sharply during flowering (Navarro et al., 1990 cited by Perez et al., 2009), but another study reported very low protein values even at the pre-flowering stage (Gualberto et al., 2011). Stems were found to contain less than 10% DM of protein (Pathoummalangsy et al., 2008). *T. diversifolia* foliage is rich in minerals (10-16% DM), particularly calcium. Biomass is rich in nitrogen (N), phosphorus (P), and potassium (K), making it a good source of nutrients for plants. This biomass often used a soil amendments and an alternative nutrient source (Munir & Swasono, 2012; Ojeniyi et al.,2012; Olabode et al., 2007; Pardono, 2011).

There is evidence that plants *T. diversifolia* they accumulate nitrogen in their leaves much as legumes have high levels of phosphorus and potassium, a large root volume, a special ability to recover the shortage of nutrients from the soil. Furthermore, it is considered a rustic plant, presenting a wide range of adaptation to soil and climate conditions, such as acidity and low soil fertility, high temperatures and drought.

Its use as green manure is recommended for short-cycle improved fallow systems, as it restores soil fertility, increasing the productivity of subsequent crops. This is due to the high foliar concentration of nitrogen, phosphorus and potassium, and the fact that these nutrients are quickly released in forms available to plants during the decomposition process. In Kenya and other parts of Africa, leaf analysis of *T. diversifolia* revealed relatively high concentrations of N, P, K, Ca and Mg, when compared to most legume species used in biomass production.

Mexican sunflower produces a nutrient-rich (N, K and P) biomass and its positive effect on subsequent rice and maize crops has been reported from Africa and Brazil (Devide,

2013; Olabode et al., 2007; Jama et al., 2000). Its abundance and adaptability, coupled with its rapid growth rate and very high vegetative matter turnover, makes it a candidate species for soil rejuvenation and improvement, as a green manure or as a major component of compost manure. Different practices have been reported: Mexican sunflower can be left to decompose on the field, or it can be turned into green manure (Olabode et al., 2007; Bot et al., 2001). In the latter case, leaves and soft twigs should be cut and chopped into small pieces before flowering and the resulting mixture evenly spread on the ground before being incorporated in the soil (Bot et al., 2001).

In Kenya, Mexican sunflower green manure is profitable for high-value crops such as Brassica sp., French beans, tomatoes and Napier grass (Pennisetum purpureum) (Bot et al., 2001). In the Philippines, 1 to 2 tons of freshly chopped Mexican sunflower forage had a positive effect on a sweet potato crop (Pandosen, 1986). From the Philippines, it was also reported that Mexican sunflower could be a potential organic foliar fertilizer for rapeseed (Dela Pena et al., 2013). Mexican sunflower has a positive effect on crop yields when used in intercropping (Orwa et al., 2009). Mexican sunflower was used to control soil erosion in the Usambara mountains of Tanzania, but it was not as effective as Napier grass or Guatemala grass (Tripsacum andersonii) (Mwango et al., 2014). In Brazil, Mexican sunflower was used for soil remediation along roadsides where heavy metals, and particularly lead, accumulate (Olivares, 2003).

Mexican sunflower contains limited amounts of secondary metabolites (tannins, flavonoids, esteroids, alkaloids, saponins, terpenoids and anthocyanidins) that can act as antinutritional factors (Delgado et al., 2010). Though these antinutritional factors are in much lower concentrations that in other tropical forages, such as Leucaena leucocephala, it can be useful to reduce their level through air-drying (Odedire et al., 2011; Delgado et al., 2010). Decreases in white blood cell content have been observed in pigs and poultry fed increasing amounts of dried *T. diversifolia* forage (Olayeni et al., 2006). This could be explained by the presence of terpenoids (sesquiterpene lactones) in the leaves (Dutta et al., 1986).

Combination of Mexican sunflower (MS) compost with NPK fertilizer significantly affected the yield component of sweet corn (N Setyowati et al.). The effectiveness of inorganic fertilizer (NPK) at 100kgN/ha, Cassava Wastes (CW) and Mexican Sunflower (MSW) composts each at 0, 20 and 40t ha were assessed on maize growth in the contaminated field 1 in 2008 and 2009 (SA Adejumo et al., 2011).

To determine the effect of the composition of urea fertilizer and Mexican sunflower compost (MSC) on the production and quality of various basil accessions (Ocimum basilicum L.) (Arifah Rahayu et al., 2021).

The agronomic aspects of Mexican Sunflower (*Tithonia diversifolia*), in spite of its potential for multiple uses. In this study, we evaluated the effects of application rates of biofertilizer and irrigation on yield, growth, and leaf chlorophyll and nutrient content of Mexican Sunflower (Matheus Mendes Reis et al., 2018). Mexican sunflower (*Tithonia diversifolia*) could be suitable for replacing organic manure and rice husk charcoal during the seedling phase (Andre Sparta et al., 2021).

In this study determine the effect of storage temperature on physical-chemical properties of *T.diversifolia* liquid organic fertilizer (Joshua Thambura et al., 2022). These study obtained mexican sunflower with a dose of fertilization 11,273 ton/ha equivalent to 230 kg N/ha (D3) can produce growth and yield of the highest potato crops (F Deru Dewanti et al., 2020). Mexican sunflower leaves (*Tithonia diversifolia*) contain high levels of nitrogen (N) and potassium (K). Combining it with poultry bone meal rich in phosphorus may produce a compost mix containing high N, P, and K (Krisman Sembiring et al., 2024). These study explained that mexican sunflower or paitan in Indonesian (*Tithonia diversifolia* L) is a weed with high biomass production with nutrient quality that potentially use as composting material (Jahra Pelu et al.,2020). Mexican sunflower management in arable crops is becoming increasingly important due to its prevalent growth habit. The field experiments were conducted to compare weed suppressive abilities of two cover crops and two maize herbicides on Mexican sunflower (Josephine Olutayo Amosun et al., 2021).

Tithonia diversifolia contains allelochemicals that inhibit or stimulate growth of agricultural crops. A study was conducted to investigate the allelopathic effects of fresh shoot aqueous extracts of *T. diversifolia* on the germination of seeds and growth of young seedlings of Spiderplant (Cleome gynandra) under laboratory and glasshouse conditions (DM Musyimi et al.). To investigate improvement in soil fertility and performance of tomato using bio-fertilizer obtained from the anaerobic digestate of *Tithonia diversifolia* (Mexican sunflower) shoot (Samuel O Dahunsi et al., 2018). These study explores the effectiveness of *Tithonia diversifolia* as a green manure, analyzing its ability to improve nutrient availability and soil structure in areas with low fertility. The plant's rapid growth, high biomass production, and rich nutrient content, particularly nitrogen and phosphorus, make it a promising organic amendment for degraded soils (Yulita Farni , 2024).

Investigate the effects of the aqueous extract of *Tithonia diversifolia* leaves on semen characteristics and spermatozoa morphology Wistar rats (JO Olukunle et al., 2015). To examine the effects of aqueous leaf extracts of *Tithonia diversifolia* (Ti) and Vernonia amygdalina (Ve), as well as NPK fertilizer (15-15-15) on the germination, growth and development of maize (Kanayo S Chukwuka et al., 2014)

To determine the decomposition and nutrient release patterns of *Tithonia diversifolia*, a rarely used non-traditional species but of research interest in soil fertility improvement practices in Ghana (ST Partey et al., 2011). This paper investigated the effects of application of NPK (Nitrogen, Phosphorus and Potassium) and plant tea (*Tithonia diversifolia*) manure on selected soilless growing media on growth rate of Amaranthus cruentus L (Roseline Chemutai et al., 2019)

Reviews the potential of *T.diversifolia* green biomass for soil fertility improvement based on recent research in western Kenya. Green leaf biomass of *T.diversifolia* is high in nutrients, averaging about 3.5% N, 0.37% P and 4.1% K on a dry matter basis (B Jama et al., 2000). These study explained the allelopathic effects of fresh shoot aqueous extract of *Tithonia diversifolia* (Hemsl.) A. Gray was investigated on the germination of seeds and growth of young seedlings of Zea mays L (RO Oyerinde et al., 2009). Effect bulking agent on composting mexican sunflower (Tithonia diversifolia L) biomass and utilization on pak choi production (Jahra Pelu et al., 2020). Influence of composted Tithonia-biomass and N-Mineral fertilizer on soil physico-chemical properties and performance of Tomato (Lycopersicon lycopersicum) (PA Babajide et al., 2008).

Effect of Compost Mix of Mexican Sunflower (Tithonia diversifolia) Green Manure and Poultry Bone Meal on Productivity and Nutritional Quality of Red Russian (Kale Krisman Sembiring et al., 2024). Production and quality of katuk (Sauropus androgynous (L.) Merr) plants on various composition of urea fertilizer and Mexican sunflower compost (Arifah Rahayu et al., 2021). Influence of water extract of Mexican sunflower (Tithonia diversifolia) on growth of cowpea (Vigna unguiculata) (LB Taiwo et al., 2005).

Comparative study of different rates of composts made from Mexican sunflower (Tithonia diversifolia) and cassava peels on maize growth on lead contaminated soil (Sifau Adenike Adejumo et al., 2013). Mexican Sunflower (Tithonia diversifolia) as a Source of Organic Matter in Potato Cultivation (F Deru Dewanti et al., 2020). Effect of storage temperature on quality parameters of liquid organic fertilizer prepared from Mexican sunflower (Tithonia diversifolia) (Joshua Thambura et al., 2022). 2011SA Adejumo,In-situ remediation of heavy metal contaminated soil using Mexican sunflower (Tithonia diversifolia) and cassava waste composts (SA Adejumo et al., 2011). Effects of Sunn hemp (Crotalaria juncea) and Mexican sunflower (Tithonia diversifolia) soil amendments on yields and quality of two indigenous vegetables grown (Leonard U Amulu et al., 2021). Yield and agronomic efficiency of sunflower in response to nitrogen fertilizer application and sowing season (RafaelDelgado Martínez et al., 2018)

CHAPTER 4

MATERILAS AND METHODS

4.1 Collection of Plant Material

SPECIES NAME : *Tithonia diversifolia*

COMON NAME : Mexican flower

COLLECTED AREA: Njarackal (vypin)

Fig 4.1: *Tithoina diversifolia (*Hemsl) A. Gray - habit

KINGDOM: Plantae

DIVISION : Tracheophyta

CLASS : Magnoliopsida

ORDER : Asterales

FAMILY : Asteraceae

SUB FAMILY : Asteroideae

GENUS : Tithonia

SPECIES : Tithonia diversifolia

In the present study, the first step was to collect the leaves. Collected leaves belong to the Asteraceae family, namely *Tithonia diversifolia,* which were chosen as it is a weed plant. About 8 pots were used for this experiment.

The materials used for making the green fertilizer are as follows:

The following materials were used:

- Leaves (*Tithonia diversifolia*)
- Cow dung
- Water and pots

Three types of fertilizer were made to check the concentration in which condition the growth is more taken. Composition of fertilizers are given below:

Sl.No	Leaves	Cow dung	Water
Fertilizer 1	1000g	_	7L
Fertilizer 2	500g	500g	7L
Fertilizer 3	750g	250g	7L

Table 4.1: Composition of fertilizers

PREPARATION OF FERTILIZER

Collect the specimen (leaves) from the plant *Tithonia diversifolia*. Cut the unwanted stems and flowers of it. Take leaves to prepare organic fertilizer. Weighed the leaves as per the concentration in given above details and also weighed the dry cow dung. Measure the litre of water which is needed for this experiment. Take three buckets to mix the materials in various concentrations, first add weighed leaves, cow dung and then water. Materials should be completely immersed with water. Mix the mixture well. Repeat the process by making the other two fertilizer in the above concentrations. And then, all the combination formulas were fermented in an anaerobe process for 7 to 14 days. Stirre well the fertilizer daily once. After that fertilizer were ready to apply and it is diluted in the ratio 1:3.

Fig 4.2 :Fertilizer 1

Fig 4.3:Fertilizer 2

Fig 4.4:Fertilizer 3

Fig 4.5:Ratio 1:3

Selecting the right chili plant variety is crucial for successful experiments because different varieties exhibit varying traits, such as yield, disease resistance, and growth characteristics, impacting the outcome of your research. So choosing a high-yielding variety is important for experiments focused on maximizing production. well- suited to your local climate, including temperature, rainfall, and sunlight conditions.

Chilly are selected plant to prove *Tithonia diversifolia* as an organic fertilizer. Equal size of seed saplings were choosed to planting. After planting chilly, applied the fertilizer in weekly thrice.

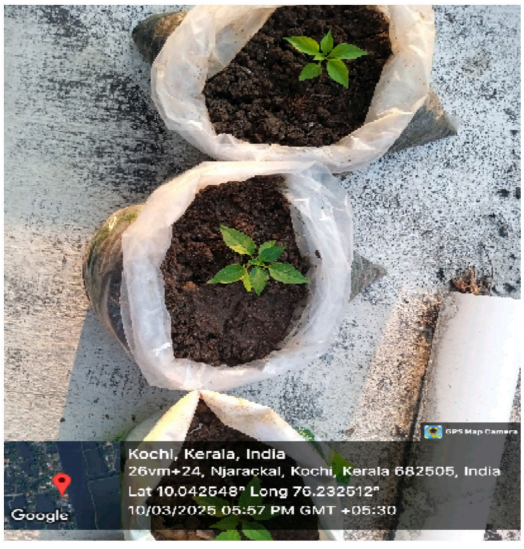

Fig 4.6 : Test on Capsicum annuum L.

CHAPTER 5

OBSERVATION AND RESULTS

Comparative analysis of growth patterns of organic fertilizer (*Tithonia diversifolia)* for seven weeks. After seven weeks experiment was concluded and data was tabulated. The observations are given as below:

Control

Weeks	Length in cm			No. of leaves		
	Fertilizer1	Fertilizer2	Fertilizer3	Fertilizer1	Fertilizer2	Fertilizer3
1st week	4	4.5	4.7	6	6	7
2nd week	5.2	6.4	9.6	7	8	11
3rd week	6.6	7.3	12.1	9	11	14
4th week	8.9	13.1	18.6	12	16	25
5th week	11.1	21.4	32.7	14	23	48
6th week	17.3	25.2	40.6	18	35	62
7th week	21.2	29.4	45.2	23	43	74

Table 5.1: Observation analysis of control

Fertilizer 1

Weeks	Length in cm	No. of leaves
1st week	4.2	6
2nd week	4.8	7
3rd week	5.4	8
4th week	7.1	10

5th week	9.2	14
6th week	13.2	17
7th week	16.8	21

Table 5.2: Observation analysis of fertilizer1

Fertilizer 2

Weeks	Length in cm	No. of leaves
1st week	4.6	7
2nd week	5.4	9
3rd week	7.1	10
4th week	10.5	14
5th week	15.1	18
6th week	22.4	23
7th week	30.1	34

Table 5.3: Observation analysis of fertilizer2

Fertilizer 3

Weeks	Length in cm	No. of leaves
1st week	4.8	7
2nd week	7.9	11
3rd week	11.6	13
4th week	15.9	28

5th week	26.5	49
6th week	35.5	65
7th week	42.7	72

Table 5.4: Observation analysis of fertilizer3

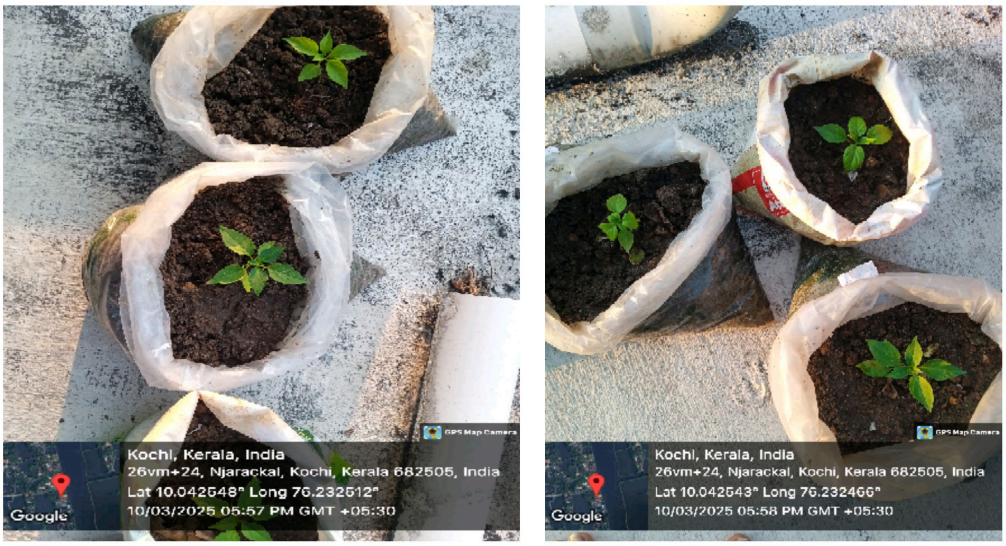

Fig.5.1: Growth of plant in 1st week

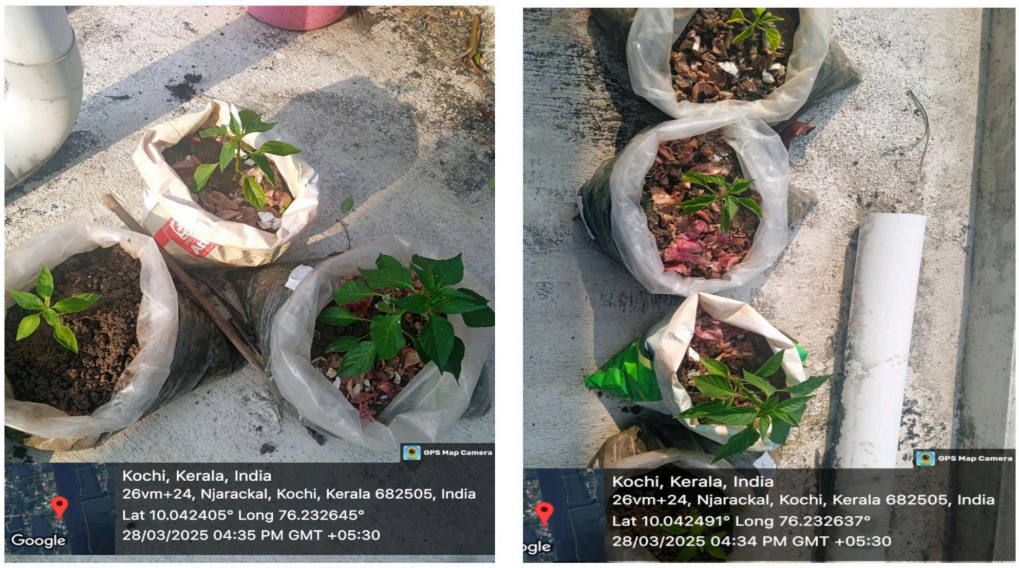

Fig.5.2: Growth of plant in 2nd week

Fig.5.3: Growth of plant in 5th week

Fig.5.4: Growth of plant in 6th week

Fig.5.5: Growth of plants in 7th week

CHAPTER 6

DISCUSSION

Organic fertilizers, derived from natural sources like plant and animal matter, improve soil health and fertility by providing nutrients and organic matter, while promoting a healthy soil ecosystem. They contain essential nutrients like nitrogen, phosphorus, and potassium (NPK), as well as micronutrients, which are vital for plant growth and development. Unlike synthetic fertilizers that release nutrients quickly, organic fertilizers release nutrients gradually, ensuring a sustained supply for plants over time. Using organic fertilizers reduces the risk of pollution and runoff, as they are biodegradable. By improving soil health and fertility, organic fertilizers can reduce the need for synthetic fertilizers and pesticides.

Mexican Sunflower is an impressive member of the sunflower family, Asteraceae. *T. diversifolia* is a shrub-like perennial or annual invasive plant. Regardless of the invasive nature of *T. diverisifolia*, it has also been found useful in folkloric medicinal practices as well as in remediation of heavy metals from the soil. *T. diversifolia* is a successful invader of new habitats through its tolerance to heat and drought, its rapid growth rates and its large production of lightweight seeds which are easily dispersed by wind, water and animals. Dormant seeds also remain viable in the soil for up to four months.

T. diversifolia contained some compounds having functional groups such as alcohols, olefins, six-membered ring lactams, ester, aromatic compound which can also be found in sesquiterpene lactones, an allelochemical implicated in phytotoxicity. The extract promoted seedling and plant growth.

The combination of Mexican sunflower (MS) compost with NPK fertilizer significantly affected the yield component. This finding aids in the development of sustainable agricultural practices that minimize the usage of synthetic fertilizer.

Little is known about the agronomic aspects of Mexican Sunflower (*Tithonia diversifolia*), in spite of its potential for multiple uses.

The plant accumulates nutrients and organic matter, which, when incorporated into the soil, enhances fertility and structure

In our study, it was found that *T. diversifolia* leaf fertilizer revealed the effective growth in chilly plant. Fertilizer 3 showing the better growth in chilly plant compared to other fertilizers in various concentrations. Fertilizer 3 contains 750 g leaves of *T. diversifolia*, 250 g cow dung and also 7L water. The result of this experiment showed that

application of organic fertilizer of *T. diversifolia* into soil was beneficial for chilly growth.

Plant growth proven by checking the highest plant height and number of leaves. Organic fertilizer was applied in weekly thrice. In the 1st week of plant growth was appeared only a slightly changes. Fertilizer 3 resulted that plant height in 4.8 cm and 7 number of leaves. These results showed little difference when compared to other fertilizers.

Positive result for 2nd week were fertilizer 3 with plant height in 7.9cm and 11no.of leaves. Fertilizer 3 were showing the maximum growth of chilly plant.

Positive result for 3rd week were fertilizer 3 with plant height in 11.6cm and 13 number of leaves. Plant grow very healthy compared other 2 plants.

Positive result for 4^{th} week were fertilizer 3 with plant height in 15.9cm and 28 number of leaves. In this week plant start to flowering.

Positive result for 5^{th} week were fertilizer 3 with plant height in 26.5 and 49 number of leaves. Show more flowering and new branches start to develop in this week.

Positive result for 6^{th} week were fertilizer 3 with plant height in 35.5 and 65 number of leaves. Plant start to fruiting and develop several branches.

Positive result for 7^{th} week are fertilizer 3 with plant height in 42.7 and 72 number of leaves. In this week fruit attain its maximum growth.

Result of this experiment showed that application of organic fertilizer *Tithonia diversifolia* into soil was favorable and useful for the growth of chilly plant. This fertilizer promotes plant growth, flowering and fruiting. So, it is considered as organic fertilizer due their advantages characters. Plant have enriching properties that valuable in promoting plant height, number of leaves and other characters.

CHAPTER 7

SUMMARY AND CONCLUSION

Organic fertilizer are natural products used for farming to enhance sustainable crop production. It improve soil health and plant growth by providing nutrients slowly and sustainably enhancing soil structure, water holding capacity and microbial activity. Generally organic fertilizers are more environmental friendly. It can reduce the need for chemical pesticides and herbicides. The selected plant for preparing the organic fertilizer in this experiment was *Tithonia diversifolia* belongs to the family Asteraceae that is commonly known as the Mexican sunflower. It is considered as a weed plant that grows rapidly in an particular location where it is not wanted, often competing with intentionally grown plants for water, nutrients, and light. *Tithonia diversifolia* has a high nutrient content, with an average NPK ratio of approximately 3.5% nitrogen (N), 0.37% phosphorus (P), and 4.1% potassium(K). It is a nutrient rich plant that can be used as an organic fertilizer.

The present study was conducted to understand and compare the effective growth of selected plant while using leaf extract of *T. diversifolia*. The specimen was collected from njarackal (vypin), ernakulam. The preparation of organic fertilizer using *T. diversifolia* were conducted to study the fertilizer properties and effective growth in selected plants. Leaves are used for preparing the organic fertilizer. Unwanted parts of plants are removed. Leaves of *T. diversifolia* was taken in various concentrations. Fertilizer 1 containing only leaves (1000g), water(7L), and fertilizer 2 contains leaves(50Og), cow dung (500g), water(7l) and fertilizer 3 contains leaves(750g), cow dung (250g) and water(7l) and all the combination formulas were fermented in an anaerobe process for 14 days. Fertilizer were ready to apply and it is diluted in the ratio 1:3. We selected chilly plant for this experiment for their better availability, high yielding variety, disease resistance and growth characteristics. Analysis of leaf extract revealed that fertilizer promotes better plant growth, improve soil fertility.

Tithonia diversifolia as an organic fertilizer serves several important nutrients during seedling growth, ie, nitrogen, phosphorus, potassium, calcium, magnesium (Aisueni et al., 2009; Han et al., 2016). The application of organic fertilizer also improves soil fertility, soil pH, and several plant growth parameters (Han et al., 2016). medium improve soil pH in an acid condition, increase nutrient availability and soil porosity, supporting root growth, improve physical and chemical properties of soil, and increase plant productivity. Extract Mexican sunflower (*Tithonia diversifolia)* could be one of the suitable choices as the replacement for synthetic fertilizer. This kind of plant is found

growing in several areas. Due to the limited knowledge, many farmers could not get the benefit from this multifunctional plant. Mexican sunflower contains several beneficial nutrients to support plant growth and development (nitrogen, phosphorus, potassium, calcium, and magnesium)

Hence, the leaf extract of *T. diversifolia* were used as an organic fertilizer. It is considered as an weed plant, it is grow rapidly over an entire area and inhibits the growth of other plant. Instead of cutting them it can use an organic fertilizer. Compared to other weed plants, its NPK value is higher and also containing fertilizer properties.

The result of this experiment showed that application of organic fertilizer of Mexican sunflower into soil was beneficial for the growth of chilly seedling. This fertilizer promotes plant growth (plant height, number of leaves, and leaf area), improve plant biomass, and improve soil chemical properties (pH, organic carbon, and total nitrogen). Application twice a week of Mexican sunflower extract could replace the function of other manure as the nutrient source in chilly seedlings. This treatment resulted in highest plant height, number of leaves, leaf area, and total biomass of plant.

CONCLUSION

1. Application of Mexican sunflower extract into soil media indeed was beneficial for chilly seedling growth.

2. The treatment with two times application of this extract resulted in better plant growth performance compared to more complete media combination.

3. This experiment proved that this fertilizer is potential replacement component which function as the source of nutrient in chilly seedling.

CHAPTER 8

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