

Effects of Nitrogen and Phosphorus Fertilization Rates on Tomato Yield and Partial Factor Productivity Under Irrigation Condition in Southern, Ethiopia.

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Abstract: *Moringa (Moringa oleifera)* the most important plant which gained much importance in the recent days due to its multiple uses and benefits that includes as food, medicinal uses, water purification, biopesticide and production of biodiesel to agriculture and industry. To overcome nutritional problems like, anaemia and vitamin A deficiency. *Moringa oleifera* flower contains adequate amount of calcium, iron, vitamin C and fiber for the women, children and old age people. *Moringa oleifera* is an interesting plant for its contribution in bioactive compounds. In particular, leaves, the most used part of the plant, are rich in vitamins, carotenoids, polyphenol, phenolic acids, flavonoids, alkaloids, glucosinolates, isothiocyanates, tannins and saponins. The high contribution in bioactive compounds may explain the pharmacological properties ascribed to *Moringa oleifera* confirmed numerous pharmacological properties such as prevention or treatment of diabetes, cardiovascular disease, dyslipidemia, cancer and infective diseases and ensuring safety on human health consequently to a chronic or long-term disease related problems. The focus of this review is exploring the potential of *moringa* for multipurpose as medicinal, as biopesticide, as nutritional sources and industrial inputs. All the part of the plant such as leaves, fruits, pods, stem barks and roots which contains an excellent source of vitamins, beta-carotene, calcium, iron, riboflavin and phenolic acid used to cure different diseases which make the plant as a gift of nature. Therefore, there is an affirmative action that the plant has vast traditional industrial applications that contributes a lot in human livelihood.

Keywords: Gift of nature, *moringa oleifera* tree.

1. INTRODUCTION

Moringa is a perennial softwood tree composed of various species (*Moringa Oleifera*, *Moringa Pterygosperma*, *Moringa drouhardii*, *Moringa Stenopetala*, *Moringa Peregina*, *Moringa Cocanensis*). It is an important tree in various parts of the world such as distributed in India, Thailand, Singapore north eastern and south western Africa Mexico, Philippines and Arabia (Fahey, 2005). Findings by Livestrong, (2012) indicated that *moringa* has been used for many human race ranging from consumption to domestic usage, animal forage, plant manure, bio pesticides and as ornamental plants. This makes a plant as tree that is long consumed by man and given the nicknames of *Moringa* as “never die” due to its incredible ability to survive harsh weather and even drought (Paliwal *et al.*, 2011).

The plant possesses many valuable properties which make it of great scientific interest. It is a drought tolerant, fast growing, multi purpose and one of most useful tree due to its medicinal and nutritional properties in world and therefore described as a ‘miracle tree’ (Amaglo., 2006).

Apart from its food and feed supplement and staple food, function of different parts of the tree includes as spices, raw material for soaps, cosmetic oils, and has various medicinal and therapeutic applications due to its composition of proteins, vitamins, oils, fatty acids, micro macro minerals elements and various phenolic compounds. Different studies reported that the extracts of different parts of the plant provides a therapeutic properties such as anti-inflammatory, antimicrobial, anti-oxidant, anti-cancer, cardiovascular, hepatoprotective, anti-ulcer, diuretic, anti-urolithiatic, and anti-helminthic effects (Nouman *et al.*, 2014). *Moringa oleifera* is referred to as a “miracle tree” or a “wonder tree” of significant s

ocio economic importance because of its several nutritional, pharmacological and industrial applications (Fuglie, 2001).

Similarly, almost every part of this plant (leaves, roots, seed, bark, fruit, flowers and immature pods holds products useful for humans as wound healing, antipyretic, anti diabetic, antihypertensive, lipid lowering, anti fertility and anti-tumor properties etc. Its wide availability and easy cultivation offers immense opportunities as a commercially viable medicinal and nutritional supplement even in developed countries. The above idea was supported by Mughal *et al.*, (1999) that nearly every part of this plant, including root, bark, gum, leaf, fruit (pods), flowers, seed, and seed oil have been used for various ailments in the indigenous medicine.

According to Singh *et al.*, (2012) for centuries in many cultures around the world, the medicinal usage of the *Moringa* has been used to treat problems such as skin infection, anemia anxiety asthma, blackheads, blood impurities, bronchitis, catarrh, chest congestion, cholera and many other illnesses. *Moringa oleifera* shows great promise as a tool to help most severe problems in the developing world such as malnutrition, medicinal applications poverty alleviation and water purification. That is why *Moringa* is truly a miracle plant, and a divine gift for the nourishing and healing of man.

Despite the different efforts and methods to use *moringa oleifera*, important actions should be undertaken to significantly drop the rate of malnutrition in developing countries. Among other solutions in the fight against malnutrition, increasing the availability and consumption of highly nutritious foods is the other alternatives. Since usage of indigenous wild food species with high nutritional of *moringa* in different forms or integrated as a food supplements in one or the other way significantly contributes a lot in a poverty reduction. Understanding and improving the role and function of different parts of the plant gives an opportunity to utilize the indigenous plants with rich nutritional and medicinal values.

2. MEDICINAL USES OF MORINGA OLEIFERA

The *Moringa Oleifera* tree has been used medicinally for long time. It is used in preventative medicine, for liver, kidney, stomach and thyroid problems. In addition to its medicinal value, it has been used as a complete food, with more Vitamin A than carrots, more Vitamin C than oranges, more calcium than milk and more iron than spinach. Reports also show that it has strong antioxidant properties due to the presence of major bioactive compounds of phenolics, such as quercetin and kaempferol which are responsible for antioxidant activity (Chumark *et al.*, 2008). The extracts also guard against skin cancer, prostrate and cysts growth, prevent the growth of tumors and glands. According to native medicine's wisdom, *moringa oleifera* can be used for cancer treatment since it contains particularly potent inhibitors of activation of lymphoblastoid cells. Similarly, some scientific evidence showed its antibiotic activity due to a compound called pterygospermin and used to control diabetes, anemia and high blood pressure.

2.1. Anti-inflammatory and Immuno-modulatory Properties of *Moringa oleifera*

Inflammation is a protective immune vascular response that involves immune cells, blood vessels, and molecular mediators to eliminate the initial cause of cell injury, clear out necrotic cells and tissues damaged from the original insult and the inflammatory process, and to initiate tissue repair (Coppin, *et al.*, 2013).

2.1.1 Anti-cancer Properties

Moringa oleifera leaves have a capacity to protect organism and cell from oxidative DNA damage associated with cancer and degenerative diseases. Anticancer properties of extracts of *moringa oleifera* leaves on different types of tumor cells found that the aqueous extract of *moringa oleifera* leaves exhibited an inhibitive effect on cell proliferation of KB human tumor (KB) cells line. This anti-proliferative effect was also associated with an induction of apoptosis, morphological changes and DNA fragmentation (Sikder *et al.*, 2013).

As it was reported by Nair *et al.*, (2005) the Reactiveoxygenspecies (ROS) production by moringa is specific and targets only cancer cells which making it an ideal anti-cancer agent that displayed and increased the appearance of glutathione S-transferase, which inhibits and attack the expression of antioxidants and antioxidant enzymes. However, Moringa leaf extracts are antioxidants and anticancer agents that induce

ROS due to glucosinolates, niazimicin, and benzyl isothiocyanate compounds in leaves that are held responsible for the anticancer activities (Liou, and Storz., 2010; Leelawat *et al.*, 2014).

2.1.2. Antipyretic Property:

Moringa have antipyretic property due to the presence of ethanol and ethyl acetate extract of its seeds and an herbal formulation called JU-RU-01 which served as antipyretic agent (Chandra *et al.* 2010

Similar findings suggested by (Venkateshwara *et al* 1999; Bhattacharya *et al* 2014) that leaf extract, ethanol and ethyl acetate extracts of seeds showed significant antipyretic activity.

2.1.3. Skin & Hair Care

The medicinal role of *moringa* seed oil for hair care has been appreciated since ancient times. It is highly beneficial in protecting the hair from environmental damage, including ultraviolet radiation and it serves as a valuable conditioner for the scalp, strengthens the roots, and stimulates hair growth too. (Stussi *et al.*, 2002).

2.1.4. Treats Neurodegenerative Diseases

The effectiveness of *moringa* has been very valuable in the treatment of neurodegenerative diseases. Studies have shown that treatment with its extracts has the potential to alter brain monoamines like nor epinephrine, serotonin, and dopamine, and it extends its protection against monoaminergic deficiencies related to Alzheimer's disease. *Moringa*

with its antioxidants can reduce the reactive oxygen species, thereby protecting the brain (Kirisattayakul *et al.*, 2013)

2.1.5. Protects Against Kidney Problems

Moringa extracts act as a protective effect against nephrotoxicity, which refers to the kidney problems caused as a consequence of exposure to certain drugs or toxins. Studies have revealed that the nephroprotective effect of *moringa* helps in attenuating renal injuries due to its high antioxidant content and it serves as an effective bio-absorbent and helps in the removal of heavy metals and harmful toxins. (Adeyemi *et al.*, 2014).

2.1.6. Acts as Antibacterial Agent

It possesses antibacterial, antifungal, and antimicrobial properties, and effective against the growth of disease causing microbes since *moringa* extracts exert a wide spectrum of protective activity against food borne microorganisms such as *Salmonella*, *Rhizopus* species, *E. Coli*, *Enterobacter aerogenes*, *Pseudomonas aeruginosa* and *Staphylococcus aureus* and the plant possess antifungal qualities which in general helps in preventing the growth of diseases causing contaminants (Saadabi and Abu Zaid, 2011).

2.1.7 Treats Stomach Disorders

The isothiocyanates present in *moringa* are effective in the treatment of abdominal disorders such as constipation, gastritis, and ulcerative colitis due to its extracts and can be considered as an effective herbal alternative to antacids and antihistamines. It is also capable of controlling parasitic worms, their anthelmintic activities (Rastogi *et al.*, 2009).

3. THE ROLE OF DIFFERENT PARTS OF MORINGA OLEIFERA

3.1. Moringa Oleifera leaves

Moringa oleifera leaves significantly decrease blood glucose concentration and the extract from *moringa* leaf is effective in lowering blood sugar levels after ingestion (Mittal *et al.*, 2007; Ndong *et al.*, 2007). It also acts as an anti-inflammatory property, by reducing body pains, effective against arthritis, rheumatism, joint pain, migraine and other headaches (Odebiyi and Sofowora., 1999).

The leaves of *Moringa oleifera* plant also contain a profile of important trace elements, a good source of proteins, vitamins, beta-carotene, amino acids and various phenolic compounds (Anwar, 2007). Different reports suggested that *moringa* leaves are rich source of β -carotene, protein, vitamin C, Calcium, potassium and act as a good source of natural antioxidants such as ascorbic acid, flavonoids, phenolics and carotenoids (Dillard and German, 2000; Siddhuraju and Becker, 2000).

Alvarez *et al.*, (2014) also reported the availability of sufficient amount of vitamin A for its key role in many physiological processes such as vision and reproduction. Similar findings were reported by Fe

reira *et al* (2008) that its potentials in embryonic growth and development, immune competence, cell differentiation, cell proliferation and apoptosis, maintenance of epithelial tissue, and brain function.

Powder of leaves of *Moringa oleifera* has also been used to treat malnutrition in children, pregnant women, and nursing mothers because of its nutrient composition (more iron than spinach, more calcium than milk, more potassium than banana, and more vitamin C than oranges and the protein quality rivals the egg and milk protein (Fahey., 2005).

Fresh leaves of *Moringa oleifera* are also a good source of carotenoids with pro-vitamin A carotene which intervenes in the synthesis and metabolism of many compounds, like tyrosine, folic acid and tryptophan, hydroxylation of glycine, proline, lysine carnitine and catecholamine. The β -carotene in *moringa oleifera* leaves facilitates the conversion of cholesterol into bile acids and hence lowers blood cholesterol levels and increases the absorption of iron in the gut by reducing ferric to ferrous state and protecting the body from various deleterious effects of free radicals, pollutants and toxins (Chambial, *et al.*, 2013).

Moringa leaves provide Calcium which helps to prevent anemia, osteoporosis bone weakness (muscle and nerve damage (Dena McDowell, 2006). provides abundant preventive action on, Edema a collection of fluid under the skin (which most commonly affects the legs, feet, and ankles), weight loss, ridges (deep lines in finger and toe nails, thinning or brittle hair), reduced pigmentation in the hair, skin rashes, dryness, flakiness, general weakness and lethargy, muscle soreness, skin ulcers, difficulty sleeping, headache, nausea and stomach pain, fainting, severe depression and lack of energy (Grosvenor, 2010). Thus, *moringa oleifera* is variably labeled as miracle tree, tree of life, mother's best friend, God's gift to man, savior of the poor. In many regions of Africa, it is widely consumed for self-medication by patients affected by diabetes, hypertension, or HIV/AIDS (Monera and Maponga, 2010).

According to the study reported by Pilotos *et al.*, (2020), consumption of *moringa* leaves may enhance CD4+ T cell activation as well as increased T cell numbers, which are important for helper function and parasite clearance by the host's immune system even at lower dose (0.1 $\mu\text{g/mL}$) and stimulate both cellular and humoral immune responses (Gupat *et al.*, 2010).

3.2. *Moringa Oleifera* flowers

Moringa Oleifera flowers are known to improve the quality and flow of mothers' milk during breastfeeding. Different research findings also suggested its key role in solving urinary problems since flower juice encourages urination and a powerful cold remedy as a tea. Medicinal role of *moringa oleifera* flowers is that it serves as a stimulant, aphrodisiac, abortifacient and cholagogue was well documented.

It also used to cure inflammations, muscle diseases, hysteria, tumors' and enlargements of the spleen and lowering the serum cholesterol as well (Sikder *et al.*, 2013).

According to the study conducted by Anwar *et al.*, (2007) *moringa* flower contain nine amino acids, sucrose, D-glucose, traces of alkaloid, wax, and is rich in potassium and calcium. Other studies reported that *moringa flower* contain pterogosperrin, an antibiotic that is highly effective in the treatment of cholera and a significant hepatoprotective effects. It has also curative ability over inflammations, muscle diseases, tumours, the ability to reduce serum cholesterol, which make it useful for regulation of cholesterol to phospholipid ratio.

3.3. *Moringa Oleifera* pods

Moringa Oleifera pods are used as de-wormer, to treat liver spleen problems and potent for diarrhea.

Moringa pods treat tooth ache from tooth decay, expel worms, treat problems of the liver and spleen, and relieve joint pain. Studies conducted by indicated that *moringa* pods/drum sticks have been used to combat malnutrition, especially among infants and nursing mothers for enhancing milk production and also regulate thyroid hormone imbalance (Thurber and Fahey., 2009).

3.4. *Moringa Oleifera* roots

Moringa roots are used as a laxative and to treat spasms of the colon, treat circulation problems, high blood pressure, kidney dysfunctions and low back pain; for gout, asthma and hiccoughs. *Moringa* root extracts commonly applied to cure inflammatory swellings and an antibiotic effect that is effective in the treatment of cholera (Rollof *et al.*, 2009). *Moringa Root* also stimulant in paralytic afflictions, used as a laxative, in treating rheumatism, articular pains, lower back or Kidney pain and

constipation. Besides the above factors, *moringa* roots have antibacterial and antimicrobial effects (Rao *et al.*, 2001).

3.5. *Moringa Oleifera* seeds.

Moringa Oleifera seeds are used to treat arthritis, rheumatism and cramp, when roasted and pounded seeds are mixed with coconut oil and applied to the problem area. The seed oils of moringa are effective against skin infecting bacteria, because it contains pterygospermin (antibiotic and fungicides). The seed extract if taken orally very effective in decreasing liver lipid peroxides, antihypertensive. The seeds are antipyretic, acrid, bitter and antimicrobial activity (Anwar, 2005).

Moringa Oleifera seed powder is particularly effective in purifying water. This is important in many societies, where the only drinking water available may come from a dirty river or lake. It removes dirt by joining with the particles and sinking to the bottom. It also is extremely effective in removing harmful bacteria from bodies of water and potential substitute for aluminum sulphate to remove solids in drinking water thus, it is much more economical and safer than aluminum sulfate and other chemicals traditionally used in water purification.

The antioxidant content in *moringa* seeds are able to limit the oxidative stress that can lead to heart disease, heart failure and high blood pressure. Similarly the oleic acids in moringa seeds are responsible for its anti-hypertensive effect and ability to reduce heart diseases, stimulate sleep by inducing hormones. As it is a rich source of amino acid tryptophan it prevents insomnia and helpful in neurotransmitter function helps to fight fatigue and insomnia.

3.6. *Moringa* steam bark.

According to Adeyemi, *et al.*, (2014) steam bark acts as a cardiac stimulant, anti-ulcer and anti-inflammatory agents Alkaloids like morphine, moriginine, minerals like calcium, magnesium and sodium. The alkaloid helps the bark to be antiulcer, a cardiac stimulant and helps to relax the muscles. *Moringa* steam bark also used to cure eye diseases, prevent enlargement of the spleen, formation of tuberculosis glands of the neck, and destroy tumors and to heal ulcers. The juice from the root bark also important in ears to relieve earaches, as a pain killer in a tooth cavity. (Siddhuraju and Becker, 2003).

Findings reported by Adeyemi and Elebiyo, (2014) that *moringa oleifera* root bark acts as an anti-ulcer, anti-inflammatory and cardiac stimulant agent. It has higher nutrient quantities than seeds and leaves. The roots barks are taken by women as permanent contraception due to its inactivation or suppression effect on the reproductive system.

The roots aqueous extract and dry root powder has been used against antilithic, hepatoprotective, carminative, antifertility, anti-inflammatory, stimulant in paralytic condition and effective for cardiac/circulatory stimulant, lower back pains or in renal pains (Khare, 1997). The role of *moringa oleifera* root bark juice as suggested by Hsu, (2006) effective to treat illnesses like asthma, circulatory/ endocrine, digestive, nervous, skin disorders, gastritis inflammation, rheumatism and reproductive health.

3.7. Socio-economic importance *M. oleifera*

Moringa oleifera is one of the most useful tropical trees which propagates easily through sexual and asexual means and its low demand for water and soil nutrients makes its production and management easy. According to Foidl *et al.*, (2001) introduction *m. oleifera* into a farm has biodiverse environmental effects both on the farm and the surrounding eco-system.

According to Verma *etal.* (1976) because of its fast growing *M. oleifera* planted on large scale as a potential source of wood for the paper industry, wrapping, textiles and cellophane used for blue dye in different country.

4. CONCLUSIONS AND RECOMMENDATION

Properties of *moringa oleifera* are multidimensional and thus, have varied economic application. Its easy cultivation within unfavorable environmental condition and wide availability makes it an excellent potential for growth in economy and health & nutrition sector in a developing countries. Furthermore, the *moringa* tree is an extremely rich source of antioxidants such as quercetin and chlorogenic acid. For people who deal with diabetes and high blood sugar, regular consumption of *moringa* leaves, roots and seeds can also help to significantly lower your blood sugar levels. Certain studies have also shown that *moringa* leaves and seed pods can help to regulate

hormonal imbalances and help to slow the aging process. While the health benefits of *moringa* go on and the majority of these health benefits come from the fact that it packs an enormous amount of nutrition into one small, little leaf. The high protein content along with the high concentration of essential vitamins and minerals has made the *moringa* tree effective in helping to combat malnutrition of children and mothers in developing countries. At the same time, *moringa* can be consumed as a natural medicine supplement for everything from reducing swelling to boosting the immune system and to increase breast milk production in lactating mothers.

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