Study of some Morphological Characters in Coconut (Cocos nucifera L.) as Effected by Organic and Inorganic Fertilizers Amendments in Sandy Loam Soil of Karachi, Pakistan

Abdul Hameed Solangi¹, M.Z. Iqbal² and Parwiaz Ahmed Baloch³

Abstract

A comparison is made on the effect of organic and inorganic fertilizers on the some morphological characters of coconut. The study demonstrated that the treatments T₁ (Nitrogen, Phosphorus and Muriate of potash (NPK) + Neem seed powder (NSP) + Gliricidia sepium leaves (GSL)) and T₂ (NPK+ GSL) significantly increased most of the morphological characters (stem girth, number of leaves, petiole and leaflets). The study revealed that vegetatively the coconut was grown well on soil amended with organic and inorganic fertilizers. The morphological characters i.e the stem girth (173.77 cm) of coconut at 20 cm height T₁ (NPK + NSP + GSL) treatment produced maximum girth as compared to T₂ to T₈ {T₂ (NPK+ NSP), T₃ (NPK+ GSL), T₄ (NSP + GSL), T₅ (NPK), T₆ (GSL), T₇ (NSP), T₈ (Control)} treatments. The 11 leaf scars length (80.44 cm) was significantly (p<0.05) highest in T₁ as compared to T₂ to T₈ treatments. The present study also revealed that the number of leaves (28.77) were significantly (p<0.05) greater in T₁ as compared to T₅ to T₈ treatments. The petiole length (139.44 cm) and thickness (3.27 cm), were found significantly (p<0.05) highest in T₁ as compared to T₈ treatment. Leaflets length and number of leaflets were significantly high in T₁ and T₂ as compared to T₃ to T₈ treatments while, the leaflets width (5.04 cm) was significantly high in T₁ as compared to other treatments. It is therefore, recommended that treatment T₁ {NPK (1.0:0.5:1.0kg) + NSP (10.0kg) + GSL (20.0kg)}/palm/year was enough to improve the morphological characters to enhance future productivity.

Key words: Coconut, morphological characters, stem, leaf, organic, inorganic, fertilizers

Introduction

Coconut (Cocos nucifera L.) is a perennial cross-pollinated plant that is grown in nearly 92 countries spread along the tropical belt, where it is used for domestic use, as a source of food, oil production and construction materials. 11.9 million hectares of coconut are grown in the world, 8 million hectares, or about 70% is in South East and East Asia (FAOSTAT, 2008; Perera et al. 2015, Carpio et al. 2005 and Harries, 1978). The coconuts are produced 83% in Asia where Indonesia is the largest producer with 3.0 million ha that produce about 18.3 million tons of nuts, followed by Philippines that has an area of 3.5 million ha with production of 15.35 million tons of nuts. India has an area of 2.1 million ha that produce about 11.9 million tons of nuts (FAOSTAT, 2014). The coconut palm is known as “The Tree of Life” because of its range of environmentally sustainable uses (Foale, 2003).

¹Institute of Plant Introduction, SARC, PARC, Karachi, Pakistan.
²Department of Botany, University of Karachi-75270, Pakistan.
³Food Quality and Safety Research Institute, SARC, PARC, Karachi, Pakistan.
Email: drahsolangi@gmail.com
According international criteria (FAO, 1980) only 30 percent of the total fields contained adequate organic matter. Beside many beneficial effects on soil properties and plant growth, soil organic matter is also indicative of N supply status of soils. In soils which are poor in organic matter, the green manuring crops usually grown are cow pea, Sunhemp, Crotalaria juncea and Calopogonium mucunoides (ICAR, 2004). As such, palm spends entire life span of 70-80 years or more rooted in one place. Consequently it removes most of the available nutrients in the soil within a few years. Annually, a palm removes large quantities of nutrients from the soil.

The organic materials (cattle manure, goat manure, broiler and layer poultry manure, farm yard manure, biogas residue, sewage sludge, compost (Gliricidia sepium, Pueraria, Calopogonium and Acacia) have considerable amounts of macro and micro-nutrients and these materials could be used as a source of plant nutrients for coconut to supply the N requirement in full and P, K and Mg requirements in part (Tennakoon and Bandara, 2003). The soils of the rain fed area are particularly less fertile because of low organic matter contents. Its health and sustainability can be enhanced through incorporating different organic fertilizers such as farm yard manure, poultry manure, neem cake, compost green manure (Gupta, 2003). The manure and fertilizer requirements of ridge and sponge gourd grown in interspaces of coconuts, the highest yield of the crop and the benefit cost ratio was recorded in recommended dose of NPK + 50% of farmyard manure (Nair and Nair, 2006). The integrated use of organic and inorganic fertilizers did not only increase mutual efficiency but also help in the substitution of chemical fertilizers (Hussain et al. 1988; Ghosh and Sharma, 1999).

Maheswarappa et al. (1998) noted that among organic manures, farmyard manure and vermicompost applied alone, and a combination of farmyard and NPK treatments promoted growth compared with the other treatments and the control. Tennakoon (1990) observed that applying 20 kg goat manure/palm annually increased soil nutrient content by 45%. It also improved the microbiological activity and water holding capacity. Organic fertilization dates back to the old practice of Chinese farmers who used it to conserve soil fertility and to ease soil cultivation. The soil properties are significantly improved due to organic matters which bettered the soil physical conditions, soil nutrients status, and soil biological properties (Tennakoon, 1988). Agyarko et al. (2006) reported that soil nutritional levels increased with poultry manure and increasing levels of neem leaves.

Marimuthu et al. (2001) reported that application of 50 kg farm yard manure, along with the recommended dose of NPK, recorded the highest N, P and K contents in soil and leaf, with 47% high nut yield compared to the control. Subramanian et al. (2005) investigated that the leaves of Gliricidia sepium decomposed relatively fast, providing nitrogen and potassium and the application also improved the soil moisture availability as compared to application of inorganic fertilizers alone. Solangi and Iqbal (2012) investigated that combined treatment of inorganic and organic {(Nitrogen, Phosphorus and Muriate of potash (NPK) + Neem seed powder (NSP) + Gliricidia sepium leaves (GSL)} significantly increased most of the morphological characters of coconut seedling. Therefore, it is needed that according to Khan et al. (2009) the fertility and productivity of the soil be restored, using organic fertilizers in combination.

Leal et al. (1994) observed that the vegetative growth and disease incidence were evaluated by the number of missing and live leaves, stem girth and the number of stomata in 6 leaflets of leaf 7 in the first year and leaf 10 in the second year. P and K had an effect on vegetative growth. Nath et al. (2003) investigated the significant influence of the main effect of N, P and K on mean number of fully opened leaves in the crown, number of female flowers/palm, nut setting, nut yield/palm/year and cumulative nut yield for eight years. The available soil K increased with increasing levels of K application at all soil depths.
The aim of the present research is to investigate some morphological characters in coconut as affected by organic and inorganic fertilizers amendments in sandy loam soil of Karachi. Therefore, this study was undertaken to find out the suitable and economical dose of fertilizers for the coconut palm. This study also aimed to increase the farm productivity and enhancing farmer’s income.

Material and Methods

Description of Experimental site

The experimental area was at the Plant Introduction Center (PIC), Southern Agricultural Research Center (SARC), Pakistan Agricultural Research Council (PARC), Karachi. Karachi is situated on the coast along the Arabian Sea (Latitude 24° 50’ - 25° 15’ North and Longitude 65° 51’ -67° 40’ East, altitude 26ft above sea level) of Pakistan. The climate of Karachi is subtropical maritime desert (Chaudhry, 1961). The fast urbanization and construction of new industrial units in Karachi are affecting the vegetation growing around these areas (Iqbal et al. 2001). Climatically, it falls under humid type, and forms a part of the coastal area. The sensitivity to temperature not only limits coconut in terms of the latitude (27° N and 27° S) but within these ranges the altitude higher than 600 m above sea level.

Coconut is found to grow well between 20° North and South of the equator. As for the light requirements for coconut crop, the optimum ranges are between 2000 to 2200 hours/ annum (120 hours/month was the minimum) (ICAR, 2004).

Physico-chemical characteristics of soil of coconut palm experimental site, PIC, Karachi were observed i.e. soil texture of the experimental site was sandy loam, pH 8.47, electrical conductivity {EC} (dS/m) 0.48, calcium carbonate {CaCO₃} (%) 34.00, organic matter {OM} (%) 0.34, nitrogen {N} (ppm) 0.012, phosphorus {P} (ppm) 12.72 and potassium {K} (ppm) 79.00 (Solangi, 2013).

Morphological Characteristics

Three coconut palms (Variety: Sri Lanka Tall) were selected randomly from the experimental plots and each treatment was carried out in three replicate for each treatment. Thus, in the whole study 72 adult coconut palms were characterized by the method of IPGRI (1995) and Solangi (2001). The morphological characteristics included girth measurement at 20 cm and 1.5 m above soil level and length of stem with 11 leaf scars, measured starting from the bottom of the first leaf scar to the bottom of the 11th leaf scar. The leaf morphology observed was normally made on leaf number 09. Number of leaves, petiole length, width and thickness, rachis length, leaflet length, leaflet width and leaflets number were recorded. For leaflet characteristics, four leaflets (two on each side) near the middle of the rachis were taken for measurements.

Organic and inorganic amendments

Preparation of test material

The dry neem (Azadirachtaindica A. juss.) fruits were collected under the neem trees from suburb of the experimental site, after collection, the seeds were crushed for use as test material. The leaves of Gliricidia trees (Gliricidia sepium) were also collected from the experimental site as test material.

The inorganic fertilizers additives like urea for nitrogen, di-ammonium phosphate for phosphorus and muriate of potash for potassium having NPK fertilizer doses were applied in the ratio of 1.0:0.5:1.0 kg/palm in two annual (July and December) split applications for four years. There were three replications of eight treatments. The detail of amendments included urea, di-ammonium phosphate and muriate of potash (NPK) in combination with Neem seed powder (NSP) and Gliricidia sepium leaves (GSL) at different levels is given in Table 1.

Statistical Analysis

The experiment was laid out in a Completely Randomized Block Design (CRBD). ANOVA and difference among the treatments means were compared using LSD test at 5%
Table 1. Kinds and fertilizers rates applied

| Treatment | Ingredients used | Applied twice in a year for four years |
|-----------|------------------|---------------------------------------|
| T<sub>1</sub> | Urea (N), di-ammonium phosphate (P), muriate of potash (K), (NPK) + Neem seed powder (NSP) + *Gliricidia sepium* leaves (GSL) | 1.0: 0.5: 1.0 kg + 10.0 kg + 20.0 kg/palm |
| T<sub>2</sub> | NPK + Neem seed powder | 1.0: 0.5: 1.0 kg + 10.0 kg/palm |
| T<sub>3</sub> | NPK + *Gliricidia sepium* leaves | 1.0: 0.5: 1.0 kg + 20.0 kg/palm |
| T<sub>4</sub> | Neem seed powder + *Gliricidia sepium* leaves | 10.0 kg + 20.0 kg/palm |
| T<sub>5</sub> | Neem seed powder | 10.0 kg/palm |
| T<sub>6</sub> | *Gliricidia sepium* leaves | 20.0 kg/palm |
| T<sub>7</sub> | Neem seed powder | 10.0 kg/palm |
| T<sub>8</sub> | Untreated (control) | Nil |

Table 2. Effects of organic and inorganic amendments on stem girth (at 20 cm and 1.5 m height), 11 leaf scar length and number of leaves of coconut (*Cocos nucifera* L.)

| Treatments | Stem girth (cm) at 20 cm | Stem girth (cm) at 1.5 m | 11 Leaf scar length (cm) | Number of leaves |
|------------|--------------------------|--------------------------|--------------------------|------------------|
| T<sub>1</sub>(NPK + NSP + GSL) | *173.77 ± 6.62 a* | 96.33 ± 2.07 a | 80.44 ± 0.78 a | 28.77 ± 0.95 a |
| T<sub>2</sub>(NPK + NSP) | 163.55 ± 4.23 a | 92.33 ± 3.10 ab | 75.22 ± 2.75 ab | 26.88 ± 1.13 ab |
| T<sub>3</sub>(NPK + GSL) | 168.33 ± 6.24 a | 89.11 ± 5.20 ab | 68.88 ± 2.79 bc | 26.55 ± 0.83 ab |
| T<sub>4</sub>(NSP + GSL) | 170.88 ± 4.91 a | 82.11 ± 4.04 b | 61.11 ± 3.12 cd | 26.33 ± 1.05 ab |
| T<sub>5</sub>(NPK) | 166.33 ± 5.53 a | 90.88 ± 4.33 ab | 61.44 ± 4.88 cd | 24.44 ± 0.91 bc |
| T<sub>6</sub>(GSL) | 170.33 ± 6.92 a | 94.55 ± 1.66 a | 56.22 ± 2.73 d | 24.11 ± 0.99 bc |
| T<sub>7</sub>(NSP) | 168.55 ± 8.05 a | 94.44 ± 2.35 a | 59.11 ± 3.90 d | 24.44 ± 1.08 bc |
| T<sub>8</sub>(Control) | 158.11 ± 9.65 a | 81.55 ± 3.32 b | 58.11 ± 3.15 d | 22.00 ± 1.17 c |
| LSD <p><sub>p<0.05</sub></p> | 18.95 | 9.76 | 8.07 | 2.82 |

Statistical significance determined by analysis of variance. Numbers followed by the same letters in the same column are not significantly (p<0.05) different, according to Duncan’s Multiple Range Test. *Mean ± Standard Error. LSD (Least Significant Difference).
probability level (Steel et al. 1997). Other statistical techniques like Duncan Multiple Range Test (DMRT) (Gomez and Gomez, 1984 and Zar, 2010) at p<0.05 on personal computer software package, Costat Version 3.

**Results and Discussion**

The study of some morphological characters in coconut (Cocos nucifera L.) as affected by organic and inorganic fertilizers amendments in sandy loam soil of Karachi were summarized in Tables 2 to 4. The results showed that the stem girths at 20 cm had no significant difference among all the treatments (Table 2). Based on the stem girth at 20 cm height, T1 (NPK + NSP + GSL) produced maximum girth (173.77 cm) as compared to all other treatments. The study indicated that the stem girth at 1.5 m was non-significant in T1, T2 (NPK+ NSP), T3 (NPK+GSL), T5 (NPK), T6 (GSL) and T7 (NSP). Moreover, non-significant differences were also found in T2 to T5 and T8 (Control). However, the stem girth at 1.5 m was significantly (p<0.05) high in T1, T5 and T7 as compared to T4 (NSP + GSL) and T8. The results of the present study based on the stem girth at 20 cm height T1 produced maximum girth (173.77 cm) as compared to all other treatments. However, the stem girth at 1.5 m was significantly (p<0.05) high in T1, T6 and T7 as compared to T4 (NSP + GSL) and T8. Secretaria and Maravilla (1997) found that the application of the recommended rates of inorganic fertilizers and goat manure during the early stages of coconut growth significantly improved the vegetative growth characters of the palms. Santos (1990), however, reported that the morphological characters recorded in the field should be highly heritable, not influenced by age and easy to record with sufficient precision. The enlargement of stem base in some palm species is partially due to the growth of root system that a forced out the tissues at the stem base (Tomlison, 1961). An advantage of stem base enlargement is that it offers additional stability in regions subjected to storms, storming winds and hurricanes. Tomlison (1964) identified that the simple descriptive morphology requires no expensive facilities, although it may require a wealth of plant material.

The 11 leaf scars length (80.44 cm) was significantly (p<0.05) highest in T1 as compared to T3 to T8 treatments. The results showed that the 11 leaf scar length was significantly (p<0.05) high in T2 as compared to T4 to T8. This study reveals that the number of leaves (28.77) was significantly (p<0.05) greater in T1 as compared to T5 to T8 treatments. The results also showed that the number of leaves were significantly (p<0.05) high in T2, T3 and T4 as compared to T8 treatment, whereas non-significant result were recorded in T2 to T7 treatments.

The results showed that the 11 leaf scar length was significantly (p<0.05) high in T1 and T2 as compared to T4 to T8. This study reveals that number of leaves (28.77) were significantly (p< 0.05) greater in T1 as compared to T3 to T8 treatments. The results also showed that the number of leaves were significantly (p<0.05) high in T2, T3 and T4 as compared to T8 treatment. An advantage of stem base enlargement is that it offers additional stability in regions subjected to storms, storming winds and hurricanes. The production of leaves in coconut is slow during the first year, increases up to the early bearing stage and then remains steady until senescence when the rate decline. This is influenced by variety, soil fertility, seasonal conditions and management practices. The investigations indicated that the optimum number of leaves for maintenance of productivity is about eighteen (Magat, 1996).

The effects of organic and inorganic amendments on Petiole length (139.44 cm) of coconut were found significantly (p<0.05) highest in T1 as compared to T6 and T8 (Table 2). Similarly, the petiole width also showed non-significant differences in all treatments. In case of petiole thickness it was significantly (p<0.05) highest (3.27 cm) in T1 as compared to T8, whereas non-significant differences were found in T1 to T7.

The effects of organic and inorganic amendments on rachis length, leaflets length, leaflets width and number of leaflets of coconut were recorded (Table 3). The results showed that the rachis length was not significantly affected among all the treatments. Leaflets length was
Table 3. Effects of organic and inorganic amendments on petiole length, petiole width petiole thickness of coconut (Cocos nucifera L.)

| Treatments                  | Petiole length (cm) | Petiole width (cm) | Petiole thickness (cm) |
|-----------------------------|---------------------|--------------------|------------------------|
| T₁ (NPK + NSP + GSL)        | *139.44±2.18 a      | 7.37 ± 0.35 a      | 3.27 ± 0.20 a          |
| T₂ (NPK + NSP)              | 138.33±2.02 ab      | 7.13 ± 0.26 a      | 3.18 ± 0.16 a          |
| T₃ (NPK + GSL)              | 134.88±3.04 abc     | 7.01 ± 0.26 a      | 3.06 ± 0.13 a          |
| T₄ (NSP +GSL)               | 134.55±1.27 abc     | 6.94 ± 0.27 a      | 3.11 ± 0.22 a          |
| T₅ (NPK)                    | 138.88±2.68 ab      | 7.21 ± 0.26 a      | 3.16 ± 0.12 a          |
| T₆ (GSL)                    | 132.66±2.36 bc      | 6.92 ± 0.26 a      | 3.12 ± 0.17 a          |
| T₇ (NSP)                    | 134.00±2.70 abc     | 6.92 ± 0.20 a      | 2.92 ± 0.27 ab         |
| T₈ (Control)                | 131.33±1.04 c       | 6.88 ± 0.25 a      | 2.41 ± 0.27 b          |
| LSDₚ < 0.05                 | 5.71                | 0.76               | 0.58                   |

Statistical significance determined by analysis of variance. Numbers followed by the same letters in the same column are not significantly (p<0.05) different, according to Duncan’s Multiple Range Test. *Mean ± Standard Error. LSD (Least Significant Difference).

Table 4. Effects of organic and inorganic amendments on rachis length, leaflet length leaflet width and number of leaflets of coconut (Cocos nucifera L.)

| Treatments                  | Rachis length (cm) | Leaflet length (cm) | Leaflet width (cm) | Number of leaflets |
|-----------------------------|--------------------|---------------------|--------------------|-------------------|
| T₁ (NPK + NSP + GSL)        | *487.00 ± 12.30 a  | 116.22 ± 1.30 a     | 5.04 ± 0.08 a      | 128.33 ± 2.09 a   |
| T₂ (NPK + NSP)              | 470.88 ± 10.58 a   | 115.77 ± 1.93 a     | 4.40 ± 0.10 b      | 123.22 ± 4.08 a   |
| T₃ (NPK + GSL)              | 456.00 ± 14.50 a   | 108.11 ± 2.78 b     | 4.47 ± 0.15 b      | 113.11 ± 5.15 b   |
| T₄ (NSP +GSL)               | 460.77 ± 13.80 a   | 107.00 ± 3.01 bc    | 4.32 ± 0.14 b      | 107.33 ± 2.10 bcd |
| T₅ (NPK)                    | 462.88 ± 17.50 a   | 103.22 ± 2.19 bcd   | 4.19 ± 0.14 b      | 110.55 ± 2.17 bc  |
| T₆ (GSL)                    | 455.11 ± 11.43 a   | 104.66 ± 3.83 bcd   | 4.22 ± 0.24 b      | 100.44 ± 2.85 d   |
| T₇ (NSP)                    | 463.00 ± 12.06 a   | 99.77 ± 2.26 cd     | 4.39 ± 0.13 b      | 101.88 ± 2.59 cd  |
| T₈ (Control)                | 460.55 ± 13.82 a   | 98.00 ± 3.55 d      | 4.16 ± 0.09 b      | 100.88 ± 2.54 d   |
| LSDₚ < 0.05                 | 37.89              | 7.48                | 0.41               | 8.83              |

Statistical significance determined by analysis of variance. Numbers followed by the same letters in the same column are not significantly (p<0.05) different, according to Duncan’s Multiple Range Test. *Mean ± Standard Error. LSD (Least Significant Difference).
significantly (p<0.05) high in T₁ and T₂ as compared to rest of the treatments. T₃ treatment was significantly (p<0.05) high as compared to T₇ and T₈. The leaflets width (5.04cm) was significantly (p<0.05) high in T₁ as compared to rest of the treatments. Moreover, non-significant differences were recorded in T₂ to T₈ treatments. The number of leaflets was significantly (p<0.05) highest in T₁ and T₂ as compared to all other treatments. Similarly, T₃ showed significantly (p<0.05) high number of leaflets as compared to T₆, T₇ and T₈. The number of leaflets were also significantly (p<0.05) high in T₅ as compared to T₆ and T₈ treatments.

The coconut palm can adapt to a wide range of soil types. Although coarse sand is its natural habitat, best growth is obtained on deep soils with good physical structure and chemical properties. The need to apply phosphorus is also inevitable recognizing that almost 90% of soils in Pakistan are deficient in phosphorus at different severity levels (Alam et al., 1994). A chemical balance of inorganic elements in living organisms is a basic condition for their proper growth and development (Markert, 1990). Blair et al. (2006) reported the application of farmyard manure to soil has been practiced for many centuries and its application to soil has increased crop yield, improved soil fertility, increased soil organic matter, increased microbiological activities and improved soil structure for sustainable agriculture. Bonneau et al. (1993) indicated that growth and fruit set increased significantly when the standard N fertilizer rate was double and were greater with P and K at standard rates than with no fertilizer.

Amalu (1999) investigated that the growth performance was generally poor in the unfertilized palms compared to combined application of 4.41kg ammonium sulfate/palm/year plus 2.52kg KCl/palm/year which resulted in the best growth over 21 months. The results confirmed the finding of Mohandas, 2012. Nadheesha and Tennakoon, 2008 who reported that for a healthy growth and sustainable coconut production, nutrients must be available in correct quantities, proportion and in an uptakable form at the right time. Cecil and Khan, (1993) observed that in general the effect of N on vegetative growth of young palms was maximum, followed by K, whereas P showed favorable interaction with N and K. Emmanuel, (2002) and Uddin, (2003) who reported moderate diversity in vegetative characters of coconut populations. Selection

The effects of organic and inorganic amendments on Petiole length (139.44 cm) of coconut were found significantly (p<0.05) highest in T₁ as compared to T₆ and T₈ treatments. In case of petiole thickness it was significantly (p<0.05) highest (3.27cm) in T₁ as compared to T₈, whereas non-significant differences were found in T₁ to T₇. Morphometric characterization revealed that substantial variation were existing in stem base, crown shapes, petiole, young inflorescence and weight size of nut as well as types of treatments. Heterogeneous characters of the parents could have contributed to the observed variation (Foale, 1992). Moreover, the petiole, which extends to form the rachis, which bears leaflets on both sides, numbers about 200 to 230 in both sides.

Result showed that the Leaflets length was significantly (p<0.05) high in T₁ and T₂ as compared to the rest of the treatments, whereas T₃ was significantly (p<0.05) high as compared to T₇ and T₈. The leaflets width (5.04 cm) was significantly (p<0.05) high in T₁ as compared to the rest of the treatments. The number of leaflets was significantly (p<0.05) highest in T₁ and T₂ as compared to all other treatments. The number of leaflets were also significantly (p<0.05) high in T₅ as compared to T₆ and T₈ treatments. The coconut palm can adapt to a wide range of soil types. Although coarse sand is its natural habitat, best growth is obtained on deep soils with good physical structure and chemical properties. The need to apply phosphorus is also inevitable recognizing that almost 90% of soils in Pakistan are deficient in phosphorus at different severity levels (Alam et al., 1994). A chemical balance of inorganic elements in living organisms is a basic condition for their proper growth and development (Markert, 1990). Blair et al. (2006) reported the application of farmyard manure to soil has been practiced for many centuries and its application to soil has increased crop yield, improved soil fertility, increased soil organic matter, increased microbiological activities and improved soil structure for sustainable agriculture. Bonneau et al. (1993) indicated that growth and fruit set increased significantly when the standard N fertilizer rate was double and were greater with P and K at standard rates than with no fertilizer.

Long term studies in many cropping systems have clearly indicated that, neither chemical fertilizer nor organic sources of nutrient alone could sustain high productivity of intensive cropping systems. Nevertheless integrated use of fertilizers and inorganic sources have helped in maintaining yield stability through correlation of marginal deficiencies of secondary and micronutrients, enhancing the efficiency of applied nutrients and providing the favorable soil physical environment.
based on these characters might be of immense value in coconut improvement programs.

**Conclusion**

The cultivation of the coconut palm recently received considerable attention in many countries where it is grown. The maintenance of soil organic matter is important for the long term productivity of agro ecosystems. The benefits of balanced fertilization using crop residues, organic manures and green manuring in maintaining the levels of organic matter in agricultural soils have been increasingly emphasized. The soil amendment has value as a fertilizer and as a systemic pesticide.

In this investigation, it is concluded that the soil of coastal areas is sandy loam and low in macro and micro nutrients especially on the Karachi Coast. The application of organic amended with inorganic fertilizers, enhanced the growth of morphological characters in nutrient deficient soils. It is therefore, recommended that treatment $T_1 \{\text{NPK (1.0:0.5:1.0kg)} + \text{NSP (10.0kg)} + \text{GSL (20.0kg)}\}/\text{palm/year}$ was enough to improve the morphological characters specially the maximum number of leaves for high productivity, better income to coconut farmers and also economical.

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