Productivity and economic benefits of coconut based vegetable cropping systems under central dry zone of Karnataka

K.S. Naveen Kumar*, H.P. Maheswarappa1 and T.B. Basavaraju2

Horticulture Research Station (AICRP on Palms), Arasikere (UHS Bagalkot), Karnataka-573103, India
1ICAR-Central Plantation Crops Research Institute, Kasaragod -671 124, Kerala, India
2College of Horticulture (UHS Bagalkot), Kolar-573 103, Karnataka, India

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Abstract

Coconut based cropping systems with vegetables i.e., okra-fallow (2012-13) and tomato-fallow (2013-14), green manure-cucumber, baby corn-gherkin and coconut monocropping as control with four integrated nutrient management (INM) practices viz., inorganic fertilizer alone (100%), 5 ton farm yard manure (FYM)+75% NPK+25% N by vermicompost (VC), 5 ton FYM+50% NPK+25% N by vermicompost+25% N by composted coir pith (CCP)+ Indian Institute of Horticulture Research (IIHR) micronutrient spray and 5 ton FYM+50% N by vermicompost+50% N by CCP+vermiwash spray+Azatobacter were evaluated at HRS, Arsikere, Karnataka during the year 2012 to 2014 by adopting factorial RBD with five replications. All the vegetable crops gave the highest yield under integration of organic and inorganic manure treatments, viz., 5 tonne FYM+74% NPK +25% N by VC and 5 ton FYM+50% N by vermicompost+25% N by CCP+IIHR micronutrient spray, whereas the lowest vegetables yield was noticed with 5 ton FYM+50% N by vermicompost+25% N by CCP+vermiwash spray + Azatobacter. Cropping sequence, baby corn-gherkin resulted in the highest coconut equivalent yield of intercrops and cropping system (33,548 nuts ha⁻¹ and 44,414 nuts ha⁻¹, respectively). Pooled economic analysis indicated that, okra-fallow and tomato-fallow sequence resulted in significantly higher net income (₹ 4,03,551 ha⁻¹) compared to other sequences and it was on par with baby corn-gherkin sequence (₹ 3,60,365 ha⁻¹).

Keywords: Coconut, INM, intercropping, vegetables

Introduction

About 80 per cent of coconut in the world is cultivated by small farmers, and these small holdings are mainly committed to coconut monocrop, which normally occupy the land for about a century. Under such monocropping system, majority of the coconut holdings do not generate adequate income and employment for the dependent families. From the land utilization point of view, a pure stand of coconut utilizes 22 per cent of the area at a spacing of 7.5 x 7.5 m, and the remaining area can be utilized for growing variety of useful seasonal crops. The rooting pattern of coconut indicates that over 95 per cent of the roots are found in the top 0-120 cm, of which 19 and 63 per cent of roots are confined to top 0-30 cm and 30-90 cm depth, respectively (Maheswarappa et al., 2000) which suggests feasibility of growing intercrops. Cropping systems aim at crop diversification and intensive cropping in interspace available in the coconut and utilization of available natural resources like soil, water, light and other inputs such as fertilizers, labour etc., are efficiently utilized to produce nuts, edible and non-edible products in a profitable way. Several reports indicate the beneficial effects of such cropping systems (Bavappa and Jacob, 1982; Bavappa et al., 1986; Maheswarappa et al., 2003). Information on influence of vegetable cropping sequences with integrated nutrient management on yield and

*Corresponding Author: naveenshankar@gmail.com
profitability in coconut based system is meagre, hence, an experiment was undertaken to evaluate the vegetable based cropping systems in coconut garden.

**Materials and methods**

The experiment was undertaken at the Horticulture Research Station Arasikere, Karnataka, during the period 2012-14. The station received an average annual rainfall of 302.6 mm during 2012-13 and 518.7 mm during 2013-14. The mean maximum air temperature was higher in the month of April (34.1 °C) and May (38 °C) during 2012. The mean minimum temperature was less than normal during all the months of 2012 and 2013. The experiment consisting of cropping sequence and nutrient management was laid out in a Factorial Randomized Complete Block Design (FRBD) with five replications.

The seeds/seedlings of okra, baby corn, cucumber and gherkin were sown and tomato seedlings were planted as intercrop in coconut (Tiptur tall) garden aged 45 years, spaced at 10 m x 10 m. For growing intercrops, plots were prepared by leaving 2 m radius from the bole of the coconut and accordingly 60 per cent of the land was utilized

### Treatments details:

**Factor 1: Cropping sequence**

| Kharif (2012)       | Summer (2013)       | Kharif (2013)       | Summer (2014)       |
|---------------------|---------------------|---------------------|---------------------|
| M₁ Okra (Arka Abay) | Fallow              | Tomato (Arka Rakshak) | Fallow              |
| M₂ Green manure (Mucuna) | Cucumber (Shivneri) | Green manure (Mucuna) | Cucumber (Shivneri) |
| M₃ Baby corn (Syngenta G-5406) | Gherkin (Ajax) | Baby corn (Syngenta G-5406) | Gherkin (Ajax) |
| M₄ Coconut monocropping (Control) |

**Factor 2: Nutrient management practices**

- **S₁:** Inorganic fertilizer alone (100%)
- **S₂:** 5 t FYM + 75% NPK + 25% N by Vermicompost
- **S₃:** 5 t FYM + 50% NPK + 25% N by Vermicompost + 25% N by composted coir pith (CCP) + IIHR micronutrient spray
- **S₄:** 5 t FYM + 50% N by Vermicompost + 50% N by CCP + Vermiwash spray + Azatobactar

### Fertilizers and micronutrient dose

| Sl. No. | Common name | Recommended dose of fertilizer (NPK kg ha⁻¹) | IIHR vegetable special dosage (g L⁻¹ of water) |
|---------|-------------|---------------------------------------------|---------------------------------------------|
| 1       | Okra        | 125:75:63                                   | 2                                           |
| 2       | Tomato      | 250:250:250                                 | 5                                           |
| 3       | Baby corn   | 100:60:75                                   | 2                                           |
| 4       | Cucumber    | 60:50:80                                    | 1                                           |
| 5       | Gherkin     | 260:175:260                                 | 1                                           |

(Source: POP, UAS, Bangalore)

**Plot Size**

- Gross plot: 6 m x 5 m
- Net plot area:
  - Okra: 4.8 x 4.2 m
  - Tomato: 4.5 x 4.2 m
  - Baby corn: 4.0 x 4.8 m
  - Cucumber: 4.0 x 4.05 m
  - Gherkin: 4.0 x 4.05 m
to grow intercrops. Uniform quantity of farm yard manure was applied to each plot except S₃ at the rate of 5 tons per hectare. Different organic manures like vermicompost (VC) and composted coir pith (CCP) were applied to plots as per treatments. The organic manures were applied two weeks before sowing/transplanting of vegetable crops and mixed well with the soil. The recommended dose of fertilizers were applied in the form of urea, single super phosphate and muriate of potash as per the treatments. 50 per cent of the N fertilizer was applied before planting and 50 per cent as top dress at 30 days after sowing (DAS). Recommended dose of IHHR vegetable special was sprayed at 30 and 60 DAS. Vermiwash was sprayed by diluting 1:10 ratio with water at 30 and 60 DAS. Azatobacter was applied at the rate of 2 kg ha⁻¹ after thoroughly mixing with FYM i.e., 5 t ha⁻¹. Irrigation was provided during summer with drip irrigation system based on pan evaporation data of the region.

The gross returns from the economic produce of coconut and vegetable crops were worked out by considering the market price prevailed during 2012-2014. The cost of production was calculated considering labour charges, cost of manures, fertilizers, seeds and other inputs used for raising the crops. The net return was computed as the difference between the gross returns and the cost of production. The coconut equivalent yield (CEY) of intercrops, system productivity as well as economics was worked out for different crops based on prevailing market price of input and output. The data were subjected to statistical analysis as per the procedure given by Gomez and Gomez (1984).

### Results and discussion

#### Yield of vegetable crops

Yield obtained from different vegetable crops (Table 1) indicated that during the study period, okra (9.9 t ha⁻¹), baby corn (4.8 t ha⁻¹ and 4.4 t ha⁻¹), gherkin (74.0 t ha⁻¹ and 75.7 t ha⁻¹) and cucumber (6.6 t ha⁻¹ and 6.5 t ha⁻¹) vegetables gave significantly higher yield under integration of organic and inorganic manure treatment, viz., S₃. In okra integrated nutrient management practices had a significant impact on the yield and S₃ treatment recorded significantly the highest yield per hectare as intercrop (9.9 t ha⁻¹) and it was on par with S₁ treatment (8.8 t ha⁻¹). The lowest yield was recorded in S₄ treatment (7.4 t ha⁻¹). In case of tomato, yields under different nutrient management practices did not differ significantly. The availability of nutrients through the application of organic sources or inorganic sources of nutrients resulted in higher yield of tomato. Bahadur et al. (2004) also reported that application of organic manures combined with recommended dose of inorganic fertilizers showed superior performance in yield attributing characters in tomato.

In baby corn, during both the years, significantly higher yield per hectare was obtained as intercrop (4.8 and 4.4 t ha⁻¹) under S₃ treatment and the lowest yield per hectare (3.4 and 3.7 t ha⁻¹) was recorded under S₁ treatment. Significantly higher yield per hectare as intercrop was under S₃ treatment (4.6 t) and the lowest was under S₄ treatment (3.5 t) when pooled analysis of both the years was done. Application of different organic manures + 1/3rd NPK recorded significantly higher cob yield in baby corn when grown as intercrop in

Coconut equivalent yield of intercrops (nuts ha⁻¹) = \[
\frac{\text{Yield of intercrop} \times \text{Market price of intercrop (₹ kg⁻¹)}}{\text{Market price of coconut (₹)}}
\]

Total system productivity (nuts ha⁻¹) = \[
\frac{\text{Yield of coconut (nuts ha⁻¹)}}{\text{Market price of coconut (₹)}}
\]

Yield of intercrop (kg ha⁻¹) x Market price of intercrop (₹ kg⁻¹)
coconut garden and was on par with organic manures alone treatment (Maheswarappa et al., 2013). The beneficial role of integrated nutrient management in improving soil physical, chemical and biological properties which in turn helps in better nutrient absorption by plant and resulting in higher yield has been reported (Prabhu et al., 2002). It was also reported that, the INM has significant effect on growth parameters of maize crop in a field trial conducted at ICAR Research Complex at Umiam, Meghalaya (Panwar, 2008). Integrated nutrient management had positive effect on growth parameters of maize such as leaf area and plant height (Kannan et al., 2013).

In gherkin, during 2013 and 2014, fruit yield per hectare as intercrop (74.0 t ha⁻¹ and 75.7 t ha⁻¹, respectively) was significantly higher under S₃ treatment and was on par with S₂ during 2014 and the lowest yield (58.3 t ha⁻¹ and 64.5 t ha⁻¹, respectively) was recorded under S₄ treatment. In the pooled analysis also, S₃ recorded significantly higher yield (74.9 t ha⁻¹). The results are in agreement with the findings of Kumaran et al. (1995), who recorded an increase in fruit yield by the application of NPK with FYM and vermicompost.

In cucumber, during 2013 and 2014, significantly higher yield per hectare was observed as intercrop under S₃ treatment (6.6 and 6.5 t ha⁻¹, respectively) and the lowest yield per hectare (4.7 and 6.5 t ha⁻¹, respectively) was recorded in S₄ treatment. Higher yield of cucumber in present study could be due to the influence of combination of organic and inorganic sources of nutrients which enhanced the synthesis of photosynthates by increasing the synthesis of growth regulators like IAA, GA, amino acids, and vitamins. The number of fruits per vine, fruit length and fruit yield were significantly higher in cucumber with the combined application of organic manures + biofertilizers + 50 per cent of RDF compared to RDF (Narayanamma et al., 2010).

Use of both organic and inorganic nutrient sources together confirms the significance of conjunctive use of chemical and organic fertilizers than the individual one which might be due to the solubilization effect of plant nutrients by the addition of FYM and vermicompost leading to increased uptake of NPK (Subbiah et al., 1982). Besides supplying plant nutrients, vermicompost contains plant growth regulators and humic acid which probably have additive effect on plant growth (Tomati et al., 1988).

### Yield of coconut

A gradual increase in nut yield per palm was observed over the years under vegetable intercropped area. After two years of experiment, palm under intercropping area registered an increase in nut yield of 22 per cent (from initial 64 to 78 nuts per palm), whereas in monocropping area increase in nut yield was only 4.68 per cent (from initial 64 to 67 nuts per palm).

### Coconut equivalent yield of intercrops and total system productivity

Coconut equivalent yield (CEY) of the intercrops and system productivity of coconut based

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**Table 1. Yield (t ha⁻¹) of vegetable crops as intercrops under coconut as influenced by integrated nutrient management practices**

| Treatments/ Crops | Okra (Kharif) | Tomato (Kharif) | Baby corn (Kharif) | Gherkin (Summer) | Cucumber (Summer) |
|-------------------|---------------|-----------------|-------------------|------------------|------------------|
|                   | 2012          | 2013            | 2012              | 2013             | 2013             |
| S₁                | 8.77 ab       | 71.73           | 3.54 b            | 4.07 ab          | 64.42 c          |
| S₂                | 7.58 b        | 72.95           | 3.77 b            | 3.72 b           | 68.54 ab          |
| S₃                | 9.85 a        | 69.18           | 4.75 a            | 4.36 a           | 74.04 a           |
| S₄                | 7.35 b        | 68.51           | 3.40 b            | 3.68 b           | 58.34 b           |
| CD (P=0.05)       | 1.58 NS       | 0.82            | 0.51              | 7.45             | 0.63             |

S₁: Inorganic fertilizer alone 100%
S₂: 5 ton FYM + 75% NPK + 25% N by vermicompost
S₃: 5 ton FYM + 50% NPK + 25% N by vermicompost + 25% N by CCP + IIHR micronutrient spray
S₄: 5 ton FYM + 50% N by vermicompost + 50% N by CCP pith + vermiwash spray + Azatobacter

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cropping system were worked out and is presented in Table 2. Pooled analysis of coconut equivalent yield of intercrops showed that there was significant difference among the cropping sequences. Cropping sequence, M₁ (baby corn-gherkin) resulted in the highest coconut equivalent yield of 33,548 nuts ha⁻¹ followed by M₄ sequence (okra-fallow-tomato-fallow) of 29,960 nuts ha⁻¹, while M₂ (green manure-gherkin) recorded the lowest coconut yield of 22,459 nuts ha⁻¹. However, INM practices and the interaction of sequences of INM practices had no significant impact on coconut equivalent yield of intercrops. The coconut equivalent yield of cropping systems also showed the similar results. In the pooled analysis of both the years, M₁ (baby corn-gherkin) gave significantly the highest CEY of

Table 2. Effect of cropping sequence and integrated nutrient management practices on coconut equivalent yield of intercrops and cropping systems

| Treatments | Coconut equivalent yield of intercrops | Coconut equivalent yield of cropping systems |
|------------|---------------------------------------|---------------------------------------------|
|            | 2012-13 | 2013-14 | Pooled | 2012-13 | 2013-14 | Pooled |
| M₁         | 18640   | 41281   | 29960   | 28240   | 53414   | 40827  |
| M₂         | 15653   | 29265   | 22459   | 25253   | 41399   | 33326  |
| M₃         | 41797   | 25299   | 33548   | 51397   | 37432   | 44414  |
| M₄         | -       | -       | -       | 6300    | 6400    | 6350   |
| S.Em±      | 1168.8  | 879.12  | 825.30  | 1186.9  | 892.8   | 838.1  |
| CD (P=0.05)| 3363.0  | 2529.45 | 2374.6  | 3419.2  | 2571.7  | 2414.3 |
| S₁         | 25363   | 33190   | 29276   | 34963   | 45323   | 40143  |
| S₂         | 24392   | 33894   | 29143   | 33992   | 46027   | 40309  |
| S₃         | 28468   | 31252   | 29860   | 38068   | 43385   | 40726  |
| S₄         | 23230   | 29458   | 26344   | 32830   | 41592   | 37211  |
| S.Em±      | 1349.6  | 1015.13 | 952.97  | 1370.6  | 1030.9  | 967.7  |
| CD (P=0.05)| NS      | NS      | NS      | NS      | NS      | NS     |
| M₁S₁       | 14613   | 33476   | 24044   | 21813   | 42576   | 32194  |
| M₁S₂       | 12638   | 34976   | 23807   | 19838   | 44076   | 31957  |
| M₁S₃       | 16418   | 29019   | 22718   | 23618   | 38119   | 30868  |
| M₁S₄       | 12253   | 26372   | 19312   | 19453   | 35472   | 27462  |
| M₂S₁       | 12159   | 21715   | 16937   | 19359   | 30815   | 25087  |
| M₂S₂       | 10324   | 21780   | 16052   | 17524   | 30880   | 24202  |
| M₂S₃       | 12467   | 21593   | 17030   | 19667   | 30693   | 25180  |
| M₂S₄       | 12009   | 22709   | 17359   | 19209   | 31809   | 25509  |
| M₃S₁       | 30296   | 19486   | 24891   | 37496   | 28586   | 33041  |
| M₃S₂       | 31920   | 19505   | 25713   | 39120   | 28605   | 33863  |
| M₃S₃       | 35168   | 19704   | 27436   | 42368   | 28804   | 35586  |
| M₃S₄       | 28007   | 17201   | 22604   | 35207   | 26301   | 30754  |
| S.Em±      | 2337.6  | 1758.3  | 1650.6  | 2373.9  | 1785.5  | 1676.2 |
| CD (P=0.05)| NS      | NS      | NS      | NS      | NS      | NS     |

NS: Non Significant
M₁: Okra-fallow, Tomato-fallow
M₂: Green manure (Maccuna)-Cucumber
M₃: Babycorn- Gherkin
M₄: Coconut monocropping (Control)
cropping system of 44,414 nuts ha\(^{-1}\) followed by M\(_{1}\) sequence (okra-fallow-tomato-fallow) i.e., 40827 nuts ha\(^{-1}\). Significantly the lowest CEY of cropping system was recorded in M\(_{2}\) (green manure-gherkin) sequence with 33326 nuts ha\(^{-1}\). Higher coconut equivalent yield in above intercropping systems can be attributed to relatively better performance of vegetable crops and also better market prices for their produce. Similar increase in coconut equivalent yield in coconut based cropping system was reported by Basavaraju et al. (2008) and Kishnakumar et al. (2011). Interaction effect of integrated nutrient management practices and cropping sequences did not show any significant difference in the coconut equivalent yield.

Table 3. Effect of cropping sequence and integrated nutrient management practices on economics of coconut based cropping system

| Treatments | Total cost (\(\text{\` ha}^{-1}\)) | Gross income (\(\text{\` ha}^{-1}\)) | Net income (\(\text{\` ha}^{-1}\)) |
|------------|----------------------------------|-----------------------------------|----------------------------------|
|            | 2012 - 13 | 2013 - 14 | 2012-13 | 2013-14 | Pooled | 2012-13 | 2013-14 | Pooled |
| M\(_{1}\) | 220634 | 197078 | 423600 | 801213 | 612406 | 202966 | 604135 | 403551 |
| M\(_{2}\) | 214062 | 200866 | 378795 | 620982 | 33326 | 164733 | 420116 | 292425 |
| M\(_{3}\) | 297704 | 314001 | 770956 | 561479 | 66617 | 437232 | 247478 | 360365 |
| S.Em± | - | - | 17804 | 13391 | 12571 | 27344 | 13391 | 15744 |
| CD (P=0.05) | - | - | 51288 | 38576 | 36214 | 78770 | 38576 | 45354 |
| S\(_{1}\) | 192393 | 189974 | 524450 | 679843 | 602147 | 332057 | 489869 | 410963 |
| S\(_{2}\) | 222247 | 224673 | 509876 | 690405 | 600141 | 287629 | 465732 | 376681 |
| S\(_{3}\) | 254089 | 235903 | 571018 | 650774 | 610896 | 316929 | 414871 | 365900 |
| S\(_{4}\) | 280530 | 353254 | 492457 | 623876 | 558166 | 211927 | 270622 | 241275 |
| S.Em± | - | - | 20558 | 15463 | 15463 | 31575 | 15463 | 18180 |
| CD (P=0.05) | - | - | NS | NS | NS | NS | NS | 52370 |
| M\(_{1}\)S\(_{1}\) | 129462 | 147878 | 327188 | 638640 | 482914 | 197726 | 490762 | 344244 |
| M\(_{1}\)S\(_{2}\) | 137237 | 167797 | 297563 | 661133 | 479348 | 160326 | 493336 | 326831 |
| M\(_{1}\)S\(_{3}\) | 156827 | 174366 | 352463 | 571789 | 463026 | 197436 | 397423 | 297429 |
| M\(_{1}\)S\(_{4}\) | 167799 | 242524 | 291788 | 532076 | 411932 | 124079 | 289552 | 206815 |
| M\(_{2}\)S\(_{1}\) | 142564 | 135832 | 246240 | 363027 | 36214 | 130950 | 263942 | 218224 |
| M\(_{2}\)S\(_{2}\) | 131993 | 147502 | 262853 | 463200 | 463026 | 130950 | 305498 | 218224 |
| M\(_{2}\)S\(_{3}\) | 140814 | 163520 | 295001 | 460392 | 377696 | 154187 | 296872 | 225529 |
| M\(_{2}\)S\(_{4}\) | 187315 | 224718 | 288139 | 477129 | 382634 | 160824 | 252411 | 176617 |
| M\(_{3}\)S\(_{1}\) | 160858 | 143732 | 562434 | 428783 | 495608 | 401576 | 285051 | 343313 |
| M\(_{3}\)S\(_{2}\) | 230917 | 180014 | 586806 | 429079 | 507942 | 355889 | 249065 | 300277 |
| M\(_{3}\)S\(_{3}\) | 274059 | 192895 | 635526 | 432060 | 533793 | 361467 | 239165 | 300316 |
| M\(_{3}\)S\(_{4}\) | 276169 | 327579 | 528102 | 394515 | 461309 | 251933 | 66936 | 159434 |
| S.Em± | - | - | 35608 | 26783 | 25143 | 54689 | 26783 | 31489 |
| CD (P=0.05) | - | - | NS | NS | NS | NS | NS | NS |
| Control (M\(_{4}\)) | 44478 | 44478 | 94500 | 96000 | 95250 | 50022 | 51522 | 50772 |
| S.Em± | 41754 | 31405 | 29483 | 64128 | 31405 | 36924 |
| CD (P=0.05) | 83999 | 63180 | 53911 | 129009 | 63180 | 74281 |

NS: Non Significant
Economics of the coconut based cropping system

The total cost of production was higher in M₃ sequence compared to other sequences. Under INM practices, it was at higher side in S₄ treatment followed by S₃, S₂ and S₁ as the cost of organic manures were high compared to inorganic fertilizers. Maheswarappa et al. (2013) also reported higher total cost of production under organic treatment alone in coconut based high density multi species cropping system. Net income was significantly the highest under M₃ sequence (₹ 4,73,252 ha⁻¹) during 2012-13 and M₁ sequence (₹ 6,041,35 ha⁻¹) during 2013-14. Pooled analysis indicated that, M₃ sequence resulted in significantly higher net income (₹ 4,03,551 ha⁻¹) compared to other sequences but was on par with M₁ sequence (₹ 3,60,365 ha⁻¹). This was mainly attributed to inclusion of tomato crop which had recorded higher yield and there was good price for the produce. These results showed that crop diversification could help the farmers to realize better returns even if the price of one commodity gets reduced in any year. Girijadevi and Muraleedharan Nair (2003) obtained higher net income by intercropping various combinations of component crops such as banana, ginger, turmeric, elephant foot yam and vegetable cowpea in coconut garden. Elephant foot yam and banana were found to be ideal as companion crops for coconut (Raveendran, 1997). Under coconut based high density multi species cropping system in root (wilt) affected garden, growing tuber crops like amorphophallus, dioscoria and colocasia resulted in higher net income (Maheswarappa et al., 2003). The economic advantage of high density multi species cropping system in coconut over monocropping was 61 per cent with B:C ratio of 1.59 indicating that coconut based HDMSCS is economically viable in root (wilt) affected areas (Krishnakumar et al., 2011). Among the INM practices, S₁ treatment recorded significantly the highest net income (₹ 4,10,963 ha⁻¹) and was on par with S₃ (₹ 3,76,681/-) and S₂ treatment (₹ 3,65,900/). The net income recorded under S₃ treatment was significantly the lowest (₹ 2,41,275 ha⁻¹). There was no significant difference in net income due to interactions of cropping sequence and INM practices during both the years. Maheswarappa et al. (2013) also reported higher net return under integrated nutrient management practices in coconut based HDMSCS.

Conclusion

It is well accepted that intercropping system under coconut is more profitable than monocropping which promises to the farmers with additional productivity of crops, besides generating additional employment opportunity. These results clearly indicated that, vegetable cropping sequences with baby corn-gherkin or okra-fallow/tomato-fallow during kharif and summer months, respectively in coconut garden is the best sequence. However, application of inorganic fertilizers alone gave the highest net return, but considering the soil health, sustainability and proper utilization of organic waste of the coconut garden, integration of both organic and inorganic nutrient sources (5 t FYM + 50% NPK + 25% N by vermicompost + 25% N by composted coir pith (CCP) + IIHR micronutrient spray) found to be productive and profitable for growing intercrops in central dry zone of Karnataka.

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