Effect of Organic Liquid Manure of *Kunapajala* on Growth and Yield of Bhindi [*Abelmoschus esculentus* (L.) Moench.]

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**ABSTRACT**

*Kunapajala* is a fermented liquid organic manure mentioned in Vrikshayurvedha and now a days popular among farmers. A field experiment was conducted to evaluate the soil and foliar efficacy of 2% and 5% herbal and non-herbal *Kunapajala* on plant growth by using bhindi. *Kunapajala* treatment was compared with inorganic fertilizers, Panchagavya and fish amino acid. Foliar application of 5% non-herbal *Kunapajala* recorded the highest growth and yield attributes such as plant height (124.4 cm), number of branches (3.73), leaf area index (1.42), dry matter production (3845.51 kg ha⁻¹), number of fruits per plant (25.5), length of fruits (15.24 cm), girth of fruits (7.22 cm), average fruit weight (20.8 g) and yield (20.78 t ha⁻¹).

**Key words:** Bhindi, Fish amino acid, *Kunapajala*, Panchagavya, Yield.

**INTRODUCTION**

Continuous use of chemical fertilizers has hardened the soil, reduced fertility, polluted air and water and released harmful gases, thus bringing threat to soil, plant and ultimately human health. In order to sustain the ecological diversity for future generations to maintain a balance the human race should be more responsible to take up ecofriendly measures of agriculture. This increasing responsibility leads our nation to propose, promote and perpetuate organic farming. We are at a verge to adopt the essential principles and practices of our traditional way of farming. Long back itself Indian had remarkable awareness and knowledge of the importance of organic farming. Use of organic manures can satisfy the food and nutrition needs of the society and will pave the way for sustainable production. Among the manures, organic liquid manures are promising and they are 20% more effective than others. The plant can absorb nutrients about 20 times faster through the leaves (Pathak and Ram, 2013). Liquid organic manures are aqueous products prepared from the plant or animal derivatives can work as nutrient sources and biopesticides. Use of traditional liquid organic manures such as Panchagavya, Fish Amino Acid (FAA) and *Kunapajala* is considered as viable means for enhancing crop growth and production.

The liquid bio fertilizer, kunapambu or *Kunapajala* (kunapa= corps, jala=water), was appropriately named because non-herbal *Kunapajala* involved fermentation of the animal remains, such as flesh, marrow, etc. and was used since ancient times in India. The complex molecules like proteins, fats, carbohydrates get broken down into simpler molecules during fermentation, thus becoming readily available to plants (Deshmukh *et al.*, 2012). Herbal *Kunapajala* is commonly available and widely used by the farmers in organic farming. *Kunapajala* can be applied to any crop at any growth stage.

Vegetables are important part of healthy eating and provide a source of many vitamins and minerals. The nutrients in vegetables are vital for health and maintenance of human body. Eating a diet rich in vegetables may reduce risk for stroke, cancer, heart diseases and diabetes. Among the different vegetables cultivated in Kerala, bhindi (*Abelmoschus esculentus* L. Moench.) gained its own place because of its nutritional value and benefits. Considering the challenges and importance of vegetable production without compromising environmental safety, we are at the border to adopt organic means of cultivation. Use of organic liquid manures such as *Kunapajala* ensures rapid availability of nutrients and sustainable production.

**MATERIALS AND METHODS**

**Herbal and Non-herbal *Kunapajala***

- **Herbal Kunapajala**
  - Weed leaves: 20 kg
  - Cow dung: 10 kg
  - Sprouted Black gram: 2 kg
  - Jaggery: 2 kg
  - Cow’s urine: 15 L
  - Water: 80 L

**Non-herbal Kunapajala**

- Weed leaves: 20 kg
- Cow dung: 10 kg
- Sprouted Black gram: 2 kg
- Jaggery: 2 kg
- Cow’s urine: 15 L
- Water: 80 L
Non herbal Kunapajala

- Meat/Fish: 2kg
- Egg: 25 nos
- Bone meal: 1 kg
- Rice husk: 1 kg
- Coconut oil cake: 1 kg
- Sprouted Black gram: 500g
- Water: 85L
- Fresh Cow dung: 10kg
- Cow’s Urine: 15 L
- Honey: 250 g
- Ghee: 250 g
- Jaggery: 1 kg
- Milk: 1 L

Panchagavya

- Fresh Cow dung: 7 kg
- Cow’s Urine: 10 L
- Ghee: 1 L
- Milk: 1 L
- Curd: 2 L
- Water: 10 L
- Tender coconut water: 3 L
- Jaggery: 3 kg
- Poovan Banana: 12 nos

FAA

- Fish: Jaggery; 1:1 ratio

The experiments were carried out at Model Organic Farm under the Department of Soil Science and Agricultural Chemistry, College of Agriculture, Kerala Agricultural University, Vellayani (8°50’ N latitude and 76°90’ E longitude and 29m above MSL), Trivandrum, Kerala, during the year 2018-2019. The soil of the experimental site was sandy clay loam. Bhindi variety ‘Varsha Uphar’ was used for the field experiments. The experiment was carried out in Randomized block design with thirteen treatments with three replication. The treatments comprised of KAU Package of Practices (T1), Organic Adhoc POP (T2), Organic Adhoc POP + 3% Panchagavya (T3), Organic Adhoc POP + 5% Fish Amino Acids (T4), 50% N as FYM + Water (T5), 50% N as FYM + 2% Herbal Kunapajala soil application (T6), 50% N as FYM + 5% Herbal Kunapajala soil application (T7), 50% N as FYM + 2% Non-Herbal Kunapajala soil application (T8), 50% N as FYM + 5% Non-Herbal Kunapajala soil application (T9), 50% N as FYM + Water for 1 st application and 5% Non-Herbal Kunapajala soil application (T10), 50% N as FYM + Water for 2 nd application and 5% Herbal Kunapajala soil application (T11), 50% N as FYM + Water for 2 nd application and 5% Non-Herbal Kunapajala soil application (T12), 50% N as FYM + Water for 1 st application and 5% Non-Herbal Kunapajala soil application (T13). Compost at 1 t ha⁻¹ was applied for the treatments T1, T3, T5, T9, T11, T12, and T13 at 10 days interval. Herbal and non-herbal Kunapajala was applied as per the treatments at 10 days interval.

The biometric observations were recorded from the representative plants in each plots. The data on growth, yield and yield attributes were statistically analysed. Statistical analysis of the experimental data was subjected to analysis of variance techniques as described by Cochran and Cox (1985). F test is followed in ANOVA for testing the significance of treatments. CD was calculated for the treatments that were found significant.

RESULTS AND DISCUSSION

The data presented in the Table-1 indicated that the effects of treatments on height of bhindi plants was found to be significant. Treatment receiving 50% N as FYM + 5% non-herbal Kunapajala as soil application recorded the highest plant height at first harvest (74.93 cm) and final harvest (124.40 cm). The lowest value was registered by 50% N as FYM + Water (T7) at first harvest (45.27 cm) and the final harvest (87.07 cm) and was significantly inferior than all other treatments (Fig 1).

The highest mean value for number of branches (3.73) was observed by the treatment 50% N as FYM + 5% Non-Herbal Kunapajala foliar application (T12) which was found to be significantly different from all other treatments. Foliar application of 5% non-herbal Kunapajala recorded significantly the highest dry matter production (3845.51 kg ha⁻¹). Leaf area index at first harvest was significantly influenced by the treatments and the best index (1.42) was reported with foliar application of 5% non-herbal Kunapajala along with 50% N as FYM (Table 1).

The results indicated that days taken for first flowering varied significantly among the treatments. The treatments receiving 5% fish amino acid, 5% herbal Kunapajala as foliar application and 2% non-herbal Kunapajala as soil application flowered earlier and was found to be on par with T12, T13, T9, T7 and T1. Treatment receiving foliar application of 5% non-herbal Kunapajala recorded 50% flowering at the earliest and which was found to be on par with 50% N as FYM + 2% Non-Herbal Kunapajala foliar application (T12) and 50% N as FYM + 5% Non-Herbal Kunapajala soil application (T13) (Table 2) The treatment with 5% non-herbal Kunapajala as foliar application had recorded the highest (25.5) number of fruits per plant and which was found to be on par with 50% N as FYM + 2% Non-Herbal Kunapajala foliar application (T13). 50% N as FYM + 5% Non-Herbal Kunapajala foliar application (T13) recorded the highest length, girth of fruits and average fruit weight (Fig 2).

The treatment 50% N as FYM + 5% Non-Herbal Kunapajala foliar application (T13) recorded the highest yield and which was found to be on par with treatment 50% N as FYM + 2% Non-Herbal Kunapajala foliar application (T12), (Fig 3).

The application of organic liquid manures significantly enhanced the plant growth parameters due to the better and rapid availability of essential plant nutrients. Kunapajala application enhanced the growth attributes and these observations are in lines with the report of Brajeshwari, (2002), Mishra (2007), Deshmukh et al. (2012), Ali et al. (2012), Sarkar et al. (2013) and Ankad et al. (2017).
Increased plant height might be due to increased uptake of nutrients. The sustained availability of higher levels of nitrogen from Kunapajala had resulted in higher plant height and leaf area. The better growth resulted by the foliar application of non-herbal Kunapajala may be due to the rapid availability of essential nutrients to the plants. The plant can absorb nutrients about 20 times faster through the leaves than if they are applied through the soil. Kunapajala application increased the length, diameter and fresh weight of fruits in tomato (Deshmukh et al., 2012). This might be due to the presence of hormones, enzymes and growth regulators in Kunapajala. Growth promoters, enzymatic activity and supply of nutrients through the foliage on the addition of liquid manures may increase the duration of crops.
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Table 2: Effect of treatments on days to first flowering and days to 50% flowering of bhindi.

| Treatments                                                                 | Days to first flowering | Days to 50% flowering |
|---------------------------------------------------------------------------|------------------------|-----------------------|
| T_1: KAU POP (FYM 20 t ha⁻¹, NPK 110:35:70 kg ha⁻¹)                       | 36.33                  | 41.00                 |
| T_2: Organic Adhoc POP T                                                  | 37.00                  | 42.00                 |
| T_3: Organic Adhoc POP T + 3% Panchagavya T                               | 37.00                  | 41.67                 |
| T_4: Organic Adhoc POP T + 5% Fish Amino Acids T                          | 36.00                  | 41.33                 |
| T_5: 50% N as FYM + Water                                                 | 39.33                  | 45.67                 |
| T_6: 50% N as FYM + 2% herbal Kunapajala soil application                 | 37.00                  | 41.00                 |
| T_7: 50% N as FYM + 5% herbal Kunapajala soil application                 | 36.33                  | 41.33                 |
| T_8: 50% N as FYM + 2% non-herbal Kunapajala soil application             | 36.00                  | 41.67                 |
| T_9: 50% N as FYM + 5% non-herbal Kunapajala soil application             | 36.67                  | 41.33                 |
| T_10: 50% N as FYM + 2% herbal Kunapajala foliar application              | 36.67                  | 41.33                 |
| T_11: 50% N as FYM + 5% herbal Kunapajala foliar application              | 36.00                  | 41.00                 |
| T_12: 50% N as FYM + 2% non-herbal Kunapajala foliar application          | 36.33                  | 39.67                 |
| T_13: 50% N as FYM + 5% non-herbal Kunapajala foliar application          | 36.33                  | 39.33                 |

SE 0.286 0.495
CD(0.05) 0.833 1.448

Fig 3: Effect of treatments on Yield (t ha⁻¹) of bhindi.

Comparison of treatments by ANOVA and Tukey's HSD test indicated significant differences. The treatments with significant differences are indicated by different letters above the bars. SE: Standard Error, CD: Critical Difference. P<0.05.

(Vemaraju, 2014). The fermentation of liquid manure breaks down into simpler forms, making it rapidly available to plants than the traditionally applied organic matter. The nutrients are readily available to the plants from the liquid organic manure. This might be the reason for better yield attributes of bhindi. Similar results were obtained also by the application of Panchagavya and fish amino acid (Muthuvel, 2002; Vemaraju, 2014; Krishnan, 2014; Parvathy, 2017 and Dhanalakshmi, 2017). Kunapajala is a rich source of beneficial micro organisms and these might be the reason for better yield and yield attributes of bhindi. The beneficial micro-organisms presented in the Kunapajala may produce growth hormones like IAA and GA and resulted in improvement in plant growth.

CONCLUSION
Application of 50% N as FYM + 5% non-herbal Kunapajala as foliar spray (T_13) was the best treatment which resulted in the highest growth, yield and yield attributes of bhindi and yield was on par with the treatment T_12 (50% N as FYM+ 2% non-herbal Kunapajala as foliar application). Application of non-herbal Kunapajala along with 50% N as FYM as foliar spray is essential to get higher crop yield in organic farming and inorganics can be substituted with foliar spray of Kunapajala along with quality organic manures. Present study confirmed that Kunapajala is a promising and eco-friendly plant stimulant for sustainable crop production and safe agro ecosystem.

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