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MODIFIED TRADITIONAL BIO-TECHNOLOGY IN CROP MANAGEMENT FOR ORGANIC FARMING AND SUSTAINABLE AGRICULTURE

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Abstract

Organic plant growth promotors play a vital role in organic farming and sustainable agriculture. The effect of organic plant growth promotors like Panchagavya, Vermiwash, Humic substances, Effective Microorganisms (EMOs) and Biomix were studied in Bendi and Tomato. In the present study organic plant growth promoters treatment enhanced the plant height, leaf area, chlorophyll content, protein, Biomass and yield of Bendi and Tomato. Foliar spray with soil treatment of Biomix showed effective growth performance and excellent result on plant growth and yield. It helps to improve to the ecological balance and maintain the ecosystem. In the above mentioned study at lower concentration (3%) Panchakavya, Vermiwash, EMO and Humic substances showed good result but Biomix (10%) showed very productive excellent results in crop management of Bendi and Tomato.

Keywords: Organic farming, Panchagavya, Vermiwash, Effective microorganisms, Humic substances

I. Introduction

Organic farming is our traditional method of Agriculture. It was disappear due to chemical usage in the form of green revolution. Indiscriminate usage of chemical fertilizer and pesticides polluted the soil, water and the whole ecosystem. Government promotes chemical fertilizer usage in agriculture. It is true in green revolution produced enough food but due courses of time pest and diseases are started attacking the crops. Poisoned pesticides are ended the seen for crop protection. Top soil getting hardened due to chemical residues. Ground water is polluted with nitrogen, Sulfur and other chemical impurities. The balance of nature is lost and pest attack ran out of control. In chemical farming only 20-30% of the nutrient gets observed and the remaining portion dissolved in water quickly and creating ground water pollution. Chemical fertilizers and residues are accumulated in soil making useless land for crop production. Excess irrigation creates saline and marsh lands. Decrease in organic matter and imbalanced chemical nutrients lead to micronutrient deficiency. Due to mass destruction of useful micronutrient decreased the disease resistance of plants. Crop becomes easily affected to pest and diseases. This increases the reapplication of chemical fertilizer again. Even then the production is coming down by year by year. Chemical residues like nitrates, sulphates and heavy metals are accumulated in soil and water, so the products from chemical fertilizer lost its food value. Chemical adulterated food leads to health problems to consumers. Just born baby have diabetics, girls get gray hair in early ages, and body become very old in young age and lot of new diseases are raised due to chemical pesticides and food adulteration. Farmers have purchased seeds, chemical fertilizer, and pesticides from outside. Hence the cast for production has gone up and profit from the farming become illusive this is the reason for the suicide case of farmers. The younger generation of farmers is searching for opportunity in cities. Government has not taken proper steps for this pathetic situation of farmers. If the situation is continue for longer period poor people will die due to hunger. Green revolution in the form of chemicals has become the war against the nature. But now we have lost the war, the only option is left with us is surrender to nature again. **Man is power, nature is super power if we disturb nature, nature will destroyed us. This is the lesson we learned from this natural world.**

Organic farming is the only solution for this complicated situation. It improves the health of plants and other living organism. It much enriches and protects the biodiversity. Hence it is a broad based organic system. The main system in organic farming is optimum use and conservation of locally available natural inputs increase the soil fertility over a period of time and protecting the soil microflora etc. Organic farming produces the healthy food to feed and to protect the health of the consumers. Thus organic farming can give a solution for destruction of environment, pollution and social imbalance Organic farming increase the soil fertility and hence the productivity in long run. Even pest and diseases will come down. It is clearly proved that systematic organic farming gives gain able high yield and sustainable agriculture.

Hence the present study focused on our traditional agriculture with some modified biotechnology. Experiments were carried out in Bendi and Tomato with application of Panchakavya, Vermiwash, Humic Substances, EMOs and Biomix of the parameters like plant height, Leaf area, Chlorophyll, Protein content, Biomass yield and growth rate were measured.

II. Materials and Methods

Study area

Standardization of methods and field experiments were conducted at Prist University, Arasanoor, Sivagngai from July 2019 to February 2020. Experiments were conducted in randomized design with three replicates. Production of plant growth regulators like Panchkavya, Humic substance, Effective micro organisms, Vermiwash and biomix were standardized and tested with plants like Tomato and Bendi. Two types of experiments were designed for the present study.

1. To study the effect of 3% and 10% Panchakavya, Humic Substance, Effective micro organisms, Vermiwash and Biomix foliar treatments on Bendi and Tomato.
2. To study the effect of 2% and 10% Panchakavya, Humic Substance, Effective micro organisms, Vermiwash and Biomix foliar treatments and foliar treatments with soil treatment on Bendi and Tomato to find out plant growth and development.

2.1Preparation of Panchagavya:

Take cow dung slurry (5kg), cow urine (3lit.), cow curd (2lit.), cow ghee (1lit.) is called traditional type of Panchagavya. In addition sugar cane juice (3lit.), banana fruits (3 Nos.) and tender coconut water (3 lit.,) this is called Modified Panchagavya. Mix these ingredients and store in a wide mouth earthen pot in open condition. Keep it in shade stir twice a day. After seven days the panchagavya will be ready. The production cost of one litre panchagavya is around 40 Rs. three litre of panchagavya is diluted with 100 litre of water used for foliar and soil treatment. Plate 1.

Plate1. Preparation of Panchagavya:

2.2Effective Micro Organisms (EMOs) Preparation:

EMOs preparation was made in the Lab**.** The details of the EMOs demonstration are as follows.

Things Needed:

Pumpkin– 5 Kg, Papaya – 5 Kg, Banana – 5 Kg, Sugar – 2 Kg, Eggs– 2 Nos.

Method of preparation:

Squeeze and mix all the fruits and sugar with 20 litre of water. Finally add eggs on the top of the solution and keep it in a cool place. After 15 days we can see the white layer on the top of the solution. It indicates the fermentation process is going well. We can use the solution from 15th day onwards. Dilute the solution 2%, 3% and 10% for crop treatments. This solution is sufficient for 1 acre of land, to be applied twice in each crop season, Plate 3.

Plate 2. Preparation of Effective micro organisms

2.3Humic Substances Preparation:

Humic substances are a major fraction of dissolved organic matter derived from plant and animal residue by microorganisms. Black to brown colored substances collect from soil organic matter, Humic substances derived from soil organic matter. Humic substance can serve as a one of the agent for soil nutrients and also contribute to the acid-base buffering ability of soil, reduction of collateral metals irons.

Take a container in the bottom of the container put one inch high of bricks followed by one inch of sand followed by organic waste like sawdust or leaf litters mix with microbes like Trichoderma viride + Pleurotes + Bacillus subtleties + Anorobic bacteria the top of this organic waste cover by 1 cm thick clay soil and maintain 50% - 60% moisture. After 15 days put one to two litre of water spray on the top of the bed. To collect the water (Brown to black colour) on the bottom out let tube. These liquid is rich in humic substances. Prepare 2%,3% and 10% of Humic substance for plant treatments. Plate 3.

Plate 3. Preparation of humic substances in our department.

2.4Vermiwash

Vermiculture biotechnology is a facet of biotechnology involving the utilization of earthworms as versatile natural bioreactors for Cleaning up the environment with cost-effective waste management technology Development of sustainable agriculture Wasteland development

Preparation Method of Vermicompost / Vermiwash

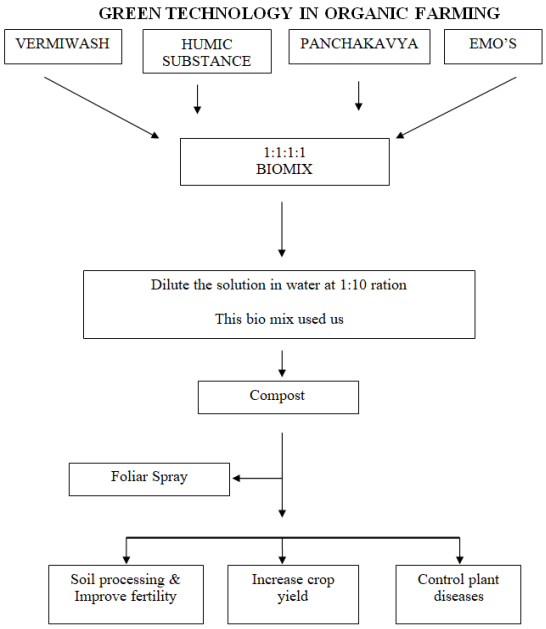
Take one big bucket and one mug. Set up one stop cork on the lower most a part of the bucket. Put a layer of broken bricks, pieces of stones having thickness of 10-15 cm within the bucket. Add a layer of sand having thickness of 10-15 cm. Then put a layer of partially decomposed trash having 30-45 cm thickness over it. Again put a layer of soil having 2-3 thicknesses. Add 100-200 nos. of earthworms in the bucket. After that put a layer of paddy straw having 6 cm thickness. After 10 days the liquid vermi wash will be produced in the bucket collect the vermiwash from the bottom hole of the container. And Prepare 2%, 3% and 10% of Vermiwash for plant treatments. Plate 4.

Plate 4. Vermiwash preparation

2.5Preparation of Biomix

Take Panchakavya, Humic substance, EMO's and Vermiwash in 1:1:1:1 ratio to prepare Biomix and dilute it to 10 times with water for foliar application and soil treatment, Plate 5.

Plate. 5 Bio mix solution (Plant growth promotor)



III. Results

3.1 Effect of Plant Growth Promotors like Panchakavya & EMOs on Bendi:

Bendi plants treated with 3%, 10% Panchakavya, EMOs and bio mix showed variation in plant height, Leaf area, Total chlorophyll and yield.

Plant Height (cm)

Compared to control, bendi plant treated with 3%, 10% panchakavya, EMOs and Biomix showed 132.86%, 90%, 108.41%, 123.41%, 145.58% and 172.08% Plant height respectively.

Leaf Area (cm^2)

Compared to control, bendi plant treated with 3%, 10% panchakavya, EMOs and Biomix showed 156.8%, 83.2%, 118.4%, 145.6%, 160.8 % and 123.2% Leaf area respectively.

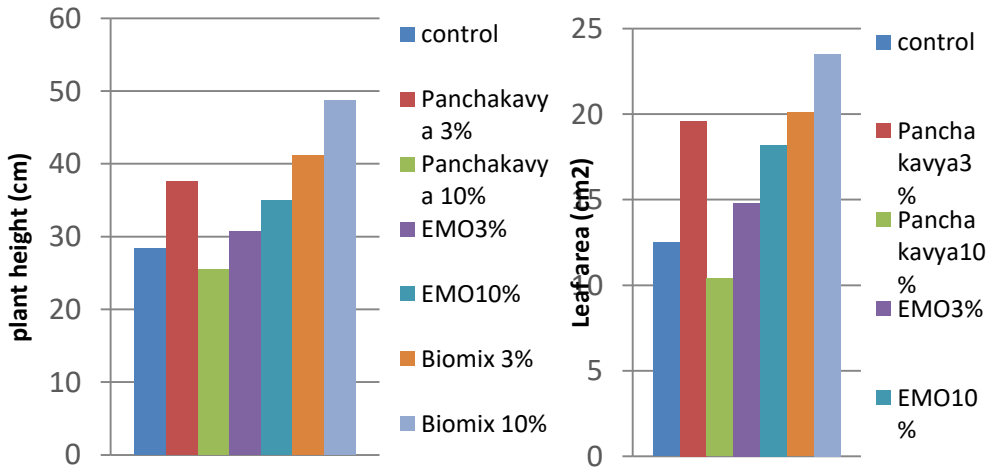
Total Chlorophyll (mg/g/f.w)

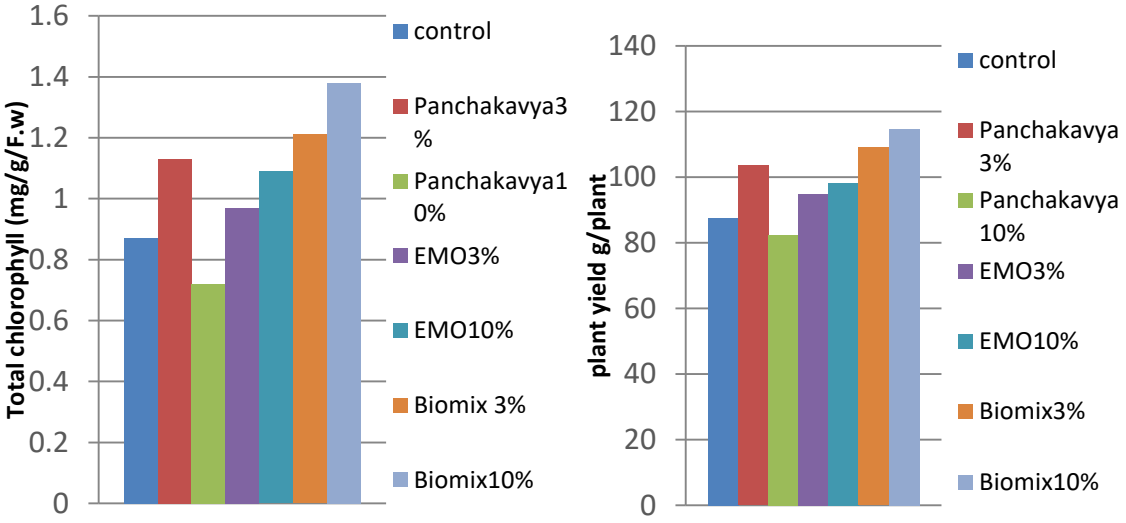
Compared to control, bendi plant treated with 3%, 10% panchakavya, EMOs and Biomix showed 129.8%, 82.75%, 111.49%, 125.2%, 139.08% and, 158.69% Total chlorophyll respectively.

Yield (g/plant)

Compared to control, bendi plant treated with 3%, 10% panchakavya, EMOs and Biomix showed 118.2%, 94.05%, 108.34%, 112.2%, 131.08% and 159.29% yield respectively. (Figure 1)

Figure.1 Effect of Plant Growth Promotors like Panchakavya & EMOs on Bendi (90 days):





3.2 Effect of Plant growth Promotors like Vermiwash and Humic Substance on Tomato:

Tomato plants treated with 3%, 10% vermiwash, humic substance and Bio mix showed variation in plant height, leaf area, total chlorophyll and yield.

Plant Height (cm)

Compared to control tomato plant treated with 3%, 10%, vermiwash and humic substance and Biomix showed 152.7%, 119.9%, 137.64%, 109.1% 160% and 189.7% plant height respectively.

Leaf Area (cm^2)

Compared to control, tomato plant treated with 3%, 10% vermiwash, humic substance and Biomix showed 160.8%, 134.7%, 126.08%, 104.34 %, 173.9% and 143.05% Leaf area respectively.

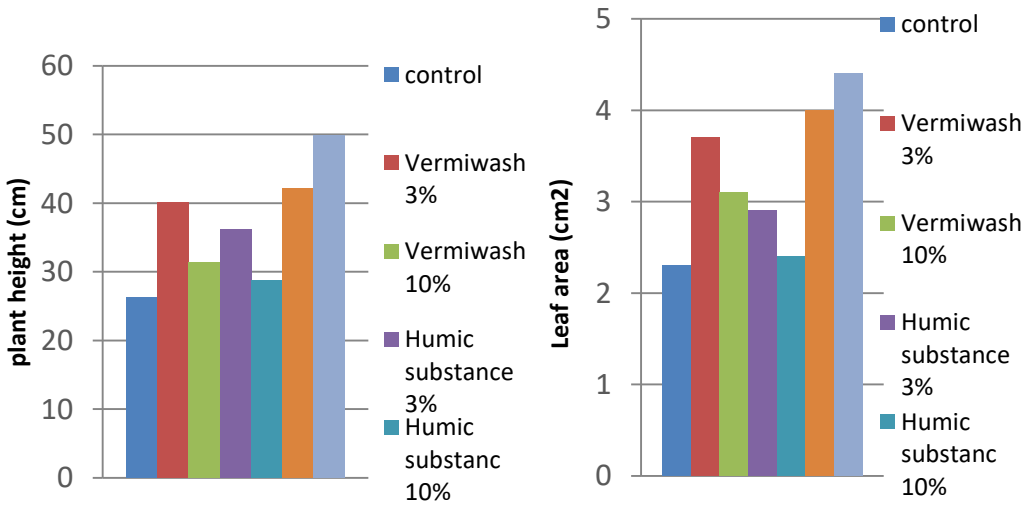
Total Chlorophyll (mg/g/f.w)

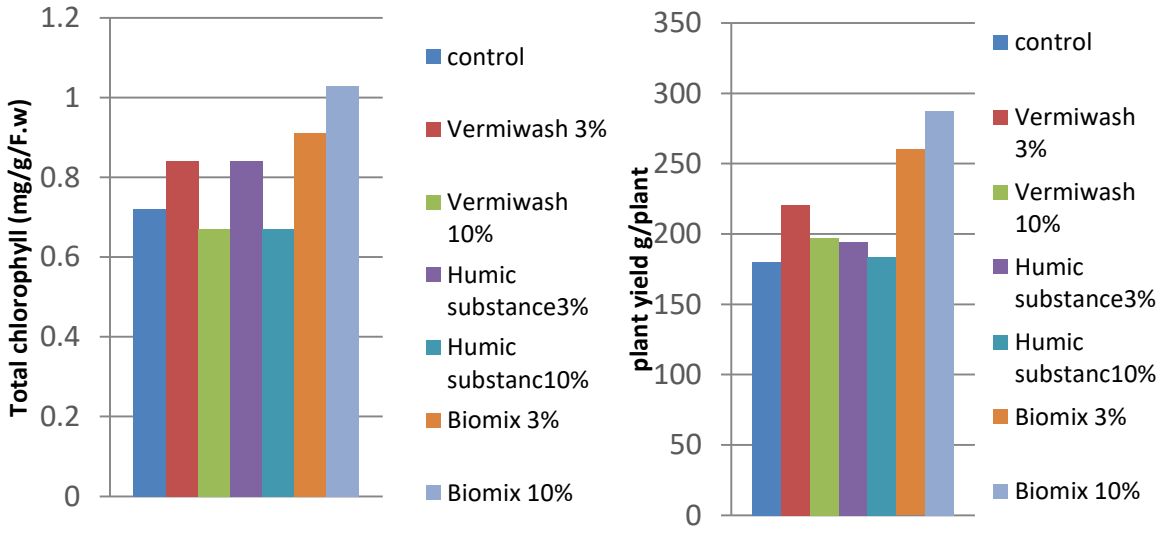
Compared to control, tomato plant treated with 3%, 10% vermiewash, humic substance and Biomix showed 116.66%, 90.54%, 116.66%, 95.71%, 126.3% and 143.05% Total chlorophyll respectively.

Yield (g/plant)

Compared to control, tomato plant treated with 3%, 10% vermiwash, humic substance and Biomix showed 122%, 109.37%, 107.65%, 101.83%, 144.25% and 159.29% yield respectively. (Figure. 2)

Figure.2 Effect of plant growth promotors like Vermiwash and Humic Substance on Tomato (90 days):





3.3 Effect of Plant Growth Promotors on Agricultural Crop – Bendi:

Bendi plant treated with 2% panchakavya foliar spray and panchakavya foliar spray with soil treatment, 10% Biomix foliar spray and Biomix foliar spray with soil treatment showed variation in plant height, leaf area, total chlorophyll, protein, plant biomass, plant yield and plant growth rate.

Plant height :(mm)

Compared to control bendi plant showed 2%, 5%, 19%, and 23% plant height increase in panchakavya foliar spray and panchakavya foliar spray with soil treatment, Biomix foliar spray and Biomix foliar spray with soil treatment respectively.

Leaf area :(mm^2)

Compared to control bendi plant showed 3%, 15%, 17%, and 36% leaf area increase in panchakavya foliar spray and panchakavya foliar spray with soil treatment, Biomix foliar spray and Biomix foliar spray with soil treatment respectively.

Total chlorophyll: (mg/g/fw)

Compared to control, bendi plant showed 8%, 17%, 40%, and 76% total chlorophyll increase in panchakavya foliar spray and panchakavya foliar spray with soil treatment, Biomix foliar spray and Biomix foliar spray with soil treatment respectively.

Leaf protein :(mg/g/fw)

Compared to control, bendi plant showed 13%, 39%, 100%, and 166% increase in panchakavya foliar spray and panchakavya foliar spray with soil treatment, Biomix foliar spray and Biomix foliar spray with soil treatment respectively.

Plant biomass: (g/plant)

Compared to control, bendi plant showed 13%, 37%, 53% and 98% bio mass increase in panchakavya foliar spray and panchakavya foliar spray with soil treatment, Biomix foliar spray and Biomix foliar spray with soil treatment respectively.

Plant yield: (g/plant)

Compared to control, bendi plant showed 16%, 21%, 21% and 49% plant yield increase in panchakavya foliar spray and panchakavya foliar spray with soil treatment, Biomix foliar spray and Biomix foliar spray with soil treatment respectively.

Plant growth: (rate /day)

Compared to control bendi plant showed 13%, 30%, 53%, 79% growth rate increase in panchakavya foliar spray and panchakavya foliar spray with soil treatment, Biomix foliar spray and Biomix foliar spray with soil treatment respectively (Figure. 3).

Figure. 3. Effect Of Plant Growth Promotors On Agricultural Crop - Bendi (75 days):

Effect Of Plant Growth Promotors On Agricultural Crop - Bendi					
Parameter	**Control**	**Panchakavya Foliar Spray (2%)**	**Panchakavya Foliar Spray+Soil Treatment (2%)**	**Biomix Foliar Spray (10%)**	**Biomix Foliar Spray + Soil Treatment (10%)**
Plant Height (mm)	185	188	195	207	228
Leaf area (mm^2)	387	402	447.36	456.14	528.7
Total Chlorophyil content (mg/g/m2)	1.69	1.83	1.98	2.37	2.99
leaf protein (mg/g/fw)	3.45	3.93	4.78	6.91	9.18
plant biomass (g/plant)	2.84	3.23	3.91	4.37	5.65
Plant yield (g/plant)	97	108.3	117.5	118	145
Growth (rate /day)	0.5	0.73	1.04	0.87	1.23

3.4 Effect of Plant Growth Promotors on Agricultural Crop - Tomato

Tomato plant treated with 2% panchagavya foliar spray, panchagavya foliar spray with soil treatment, 10% Biomix foliar spray and 10% Biomix foliar spray with soli treatment showed variation in plant height, leaf area, total chlorophyll, protein, plant biomass, plant yield and plant growth rate.

Plant height :(mm)

Compared to control, tomato plant showed 2%, 7%, 16% and 21% Plant height increase in panchagavya foliar spray, panchagavya foliar spray with soil treatment, Biomix foliar spray and Biomix foliar spray with soil treatment respectively.

Leaf area :(mm^2)

Compared to control, tomato plant showed 9%, 31%, 37% and 82% leaf area increase in panchagavya foliar spray and panchagavya foliar spray with soil treatment, Biomix foliar spray and Biomix foliar spray with soil treatment respectively.

Total chlorophyll: (mg/g/fw)

Compared to control, to tomato plant showed 9%, 14%, 49% and 104% total chlorophyll increase in panchagavya foliar spray and panchkavya foliar spray with soil treatment, biomix foliar spray and biomix foliar spray with soil treatment respectively.

Leaf protein :(mg/g/fw)

Compared to control, tomato plant showed 14%, 24%, 85% and 149% increase in panchagavya foliar spray and panchagavya foliar spray with soil treatment, biomix foliar spray and Biomix foliar spray with soil treatment respectively.

Plant biomass: (g/plant)

Compared to control, tomato plant showed 6%, 16%, 54% and 86% plant biomass increase in panchagavya foliar spray and panchakavya foliar spray with soil treatment, biomix foliar spray and Biomix foliar spray with soil treatment respectively.

Plant yield: (g/plant)

Compared to control, tomato plant showed 17%, 24%, 37% and 61% plant yield increase in panchagavya foliar spray and panchakavya foliar spray with soil treatment, biomix foliar spray and Biomix foliar spray with soil treatment respectively.

Plant growth: (rate /day)

Compared to control, 2% panchagavya foliar spray 2% panchagavya foliar spray with soil treatment, 10% biomix foliar spray, Biomix foliar spray with soil treatment showed 13%, 53%, 13% and 179% growth increase respectively (Figure. 4).

(Figure. 4). Effect of Plant Growth Promotors on Agricultural Crop - Tomato (75 days):

Effect Of Plant Growth Promotors On Agricultural Crop - Tomato					
Parameter	**Control**	**Panchakavya Foliar Spray (2%)**	**Panchakavya Foliar Spray+Soil Treatment (2%)**	**Biomix Foliar Spray (10%)**	**Biomix Foliar Spray + Soil Treatment (10%)**
Plant Height (mm)	239	244	257	278	290
Leaf area (mm^2)	226	248	298.3	310.7	414.3
Total Chlorophyil content (mg/g/m2)	1.43	1.56	1.78	2.14	2.93
leaf protein (mg/g/fw)	4.17	4.79	5.19	7.73	10.39
plant biomass (g/plant)	4.52	4.83	5.27	6.98	8.43
Plant yield (g/plant)	180	212.3	223.4	241.5	290
Growth (rate /day)	0.69	0.78	1.06	0.9	1.24

3.5 Foliar spray and foliar spray with soil treatment of tomato are shown in plate 6 and 7.

Plate.6 Foliar spray and foliar spray with Soil treatment of Panchakavaya in Tomato

Plate.7 Foliar spray and foliar spray with Soil treatment of Biomix in Tomato

Foliar spray and foliar with soil treatment of Bendi are shown in plate 8 and 9.

Plate. 8 Foliar spray and foliar spray with Soil treatment of Panchakavaya in Bendi

Plate.9 Foliar spray and foliar spray with Soil treatment of Biomix in Bendi

Analysis of variance (ANOVA) test showed various plant growth promotors treatments on Bendi and Tomato plant Height, Leaf area, Total chlorophyll, Leaf protein, Plant biomass, Plant yield were significanly differ in the present study. (Table 1 – 6).

Treatments – 1 Control, 2 panchagavya 2% foliar spray, 3 Panchakavya 2% foliar spray with soil treatment 4 Biomix 10% foliar spray, 5 Biomix 10% foliar spray with soill tratment

Parameters – 1 Plant height, 2 Leaf area, 3 Total chlorophyll, 4 Leaf protein, 5 Plant biomass , 6 Plant yield

Table.1 Anova - Bendi and Tomato plant heights at different treatments

Treatment Variation	9302.5	Block Variation	763.6
Within Variation	22	Total Variation	1382.7666667
Treatment Statistic	422.8409091	Its P-Value	0.00051
Block Statistic	34.7090909	Its P-Value	0.00465
Conclusion on Treatments Effects			
Very strong evidence against the null hypothesis			
Conclusion on Blocks Effects			
Very strong evidence against the null hypothesis			

Table.2 Anova - Bendi and Tomato plant Leaf area at different treatments

Treatment Variation	52403.121	Block Variation	8265.2464
Within Variation	161.2244	Total Variation	9567.6671333
Treatment Statistic	325.0321974	Its P-Value	0.00052
Block Statistic	51.2654809	Its P-Value	0.00251
Conclusion on Treatments Effects			
Very strong evidence against the null hypothesis			
Conclusion on Blocks Effects			
Very strong evidence against the null hypothesis			

Table.3 Anova - Bendi and Tomato plant Chlorophyll at different treatments

Treatment Variation	0.10404	Block Variation	0.631575
Within Variation	0.003615	Total Variation	0.2938667
Treatment Statistic	28.780083	Its P-Value	0.0038
Block Statistic	174.7095436	Its P-Value	0.00068
Conclusion on Treatments Effects			
Very strong evidence against the null hypothesis			
Conclusion on Blocks Effects			
Very strong evidence against the null hypothesis			

Table.4 Anova - Bendi and Tomato Leaf protein at different treatments

Treatment Variation	1.61604	Block Variation	12.285515
Within Variation	0.041315	Total Variation	5.6581511
Treatment Statistic	39.1150914	Its P-Value	0.00233
Block Statistic	297.3620961	Its P-Value	0.00056
Conclusion on Treatments Effects			
Very strong evidence against the null hypothesis			
Conclusion on Blocks Effects			
Very strong evidence against the null hypothesis			

Table.5 Anova - Bendi and Tomato plant biomass at different treatments

Treatment Variation	10.06009	Block Variation	3.73429
Within Variation	0.20654	Total Variation	2.8692678
Treatment Statistic	48.707708	Its P-Value	0.00169
Block Statistic	18.0802266	Its P-Value	0.01363
Conclusion on Treatments Effects			
Very strong evidence against the null hypothesis			
Conclusion on Blocks Effects			
Moderate evidence against the null hypothesis			

Table.6 Anova - Bendi and Tomato plant yield at different treatments

Treatment Variation	32194.276	Block Variation	1714.6525
Within Variation	290.8135	Total Variation	4468.46
Treatment Statistic	110.7042005	Its P-Value	0.00073
Block Statistic	5.8960554	Its P-Value	0.07262
Conclusion on Treatments Effects			
Very strong evidence against the null hypothesis			
Conclusion on Blocks Effects			
Suggestive evidence against the null hypothesis			

IV. Discussion

Organic farming alone could serve as the holistic approach towards achieving sustainable agriculture as it is eco-friendly and ensures the conservation of resources for the future. Organic plant growth promoters play a vital role in organic farming and sustainable agriculture. The effect of organic plant growth promoters on agricultural crops were studied by several authors Adebayo *et al*.,(2013), Muddasir basher (2013) and Agarwal,(2010) Rakesh joshi and Adarsh pal vig, (2010), Maheshwari *et al.*, (2016). Present study explores the growth promoting effect of Panchakavya, Humic substances, Effective micro organisms, vermiwawsh and Biomix on Tomato and Bendi. All growth promoters except biomix significantly increased plant height, leaf area, total chlorophyll and protein content, Biomass, yield and growth rate at 3%. Biomix showed excellent results at 10% concentration. It indicates that concentration of plant growth promoters is an important factor for plant growth and development. So it is necessary to analysis the concentration in which the plant respond well to increase the plant growth and development to make organic farming and sustainable agriculture. Based on our previous study, we selected panchakavya and Biomix for further study. And treated to Bendi and Tomato in four different combinations. They are panchakavya 2% foliar treatment, Foliar treated with soil treatment, Biomix 10% foliar treatment and Biomix 10% foliar treatment with soil treatment. All were significantly differing in plant height, leaf area, chlorophyll content, protein, plant biomass, plant yield, and plant growth rate. Analysis of variance (ANOVA) test showed the significant difference among the treatment and plants. These results were found to be consistent with the studies of Rajan and Murugesan (2012) and Nath and Singh (2012); however they were observed the marketing effects using Vermiwash. Importance of soil microbes on panchagavya based fertilizer for sustainable agriculture was studied by sumit pal and Neelam patel (2020). Likewise effect of foliar application of panchagavya and vermiwash on yield and quality of bitter gourd was studied by somashekar Gajjela and Ranjit chatterjee (2019).

In another study 15%vermiwash exhibited better growth. Promoting effects on *Ablemoscus esculentus (Elumalai et al., 2013).* vermiwash treated *Capsicum fruteocen* showed increase in root, shoot, lengths and number of leaves after 30 days than the vermiwash untreated plants (Varghese and prabhu, 2014). All these studies support the finding of present work carriedout in Bendi and Tomato with Biomix treatment. The improved plant growth and development of present study on Bendi and Tomato may be due to regulatory substances such as IAA,GA, Cytokinin essential plant nutrient, Effective micro organisms and biofertilizers like acetobacter, azosprillum and phosphor bacterium present within the panchakavya, vermiwash, humic substances and effective micro organisms (Esakkiammal *et al*., 2015); Somasundaram *et al., 2008).* The mixture of those four plant growth promoters the biomix gave very productive result once they were applied alone to the crops. Likewise better result obtained within the present study when the plants were sprayed with foliar treatment and soil treatment. Plant growth regulators to soil treatment enhanced the root absorption of the plant to achieve effective result in plant growth and development.

V. Conclusion

Biomix (10%) foliar spray with soil treatment in recommended for effective organic farming and sustainable agriculture.

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