
ORIGINAL ARTICLE

Effect of different level of Vermicompost and FYM Organic manure on growth and yield of Cucumber intercropped with Citrus based Agroforestry System

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ABSTRACT

The present study was conducted to find out the effect of different level of vermicompost and FYM organic manure on growth and yield of Cucumber intercropped with Citrus based Agroforestry at Forest nursery and Research Centre, SHUATS, Prayagraj, India, during June – September 2017. The experiment was laid in a Randomized Block Design with 9 treatments and 3 replications. The results indicated maximum plant height 86.15 cm at 30 days, 272 cm at 60 days, 370 cm at 90 days in T₈ treatment. The number of branches/plant maximum was recorded (2.80) at 30 days, 3.40 at 60 days, 3.51 at 90 days in T₈. The maximum number of leaves 19.73 at 30 days, 83.87 at 60 days, 119.89 at 90 days in T₈, number of days for first flowering 31.24 days in T₈, maximum days are taken for 50% flowering 43.33% in T₈. Maximum harvest is 56.00 days in T₈, maximum number of fruit/plant (62.67), maximum fruit diameter 14.80 cm, maximum fruit length (15.03 cm), maximum fruit weight (198.93 g), fruit yield per plot (11.87), fruit yield per ha (296.75 q/ha). Therefore, the results showed that the best treatment T₈ was more effective in yield and significantly improved the growth parameters as well as the quality of plants.

Keys Words: Agroforestry, FYM, vermicompost, yield.

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INTRODUCTION

Cucumber (*Cucumis sativus* L.) is one of the most popular and widely spread grown Vegetables all over India. It belongs to the family Cucurbitaceae and is reported to have originated in India. It is one of the quickest maturing vine vegetable crops and the second most widely cultivated Cucurbit after watermelon. Cucumber is thought to have originated in India [1] because of the fact *Cucumis sativus* var. *Hardwiickii* progenitor of cultivated Cucumber is found in the Himalaya foothills of the country. It is cultivated throughout the country in the area extending from high altitude to the plains and along the river beds [2]. At present, it is cultivated globally in 19,03,926 hectare with an annual production of 5,75,59,836 tones. In India, it is cultivated in 45,000 hectare with a total production of 6,98,000 tones.

The immature fruits of Cucumber are used as salad and for pickling. The fruit and seed possess cooling properties. The fruit is also used as an astringent and antipyretic. The seed oil is used as antipyretic. Fruit are good for people suffering from constipation, jaundice and indigestion.

Cucumber is very popular, widely cultivated and important market vegetable rich in minerals and vitamin and constituent of medicines values. The edible portions of fruits contains about 95% water and provide vitamins, potassium, sodium, magnesium, sulphur, silicon, fluorides etc, In good quantity. The alkaline forming minerals in the cucumber represent 64.05% and the acid forming minerals are about 35.95%. This makes it useful in maintaining the alkalinity of the human blood. It is a low energy and high water

content water salad crop. It contain 0.6 g protein, 2.6 g carbohydrates, 12 cal energy, 18 mg Ca, 0.2 mg Fe, 0.02 mg thiamine, 0.02 mg riboflavin, 0.01 mg niacin, and 10 mg Vitamin C/100g of edible portion [3].

Organic manure is a rich source of macro and micronutrients, vitamin and growth hormones [4]. Farmyard manure (FYM) is the traditional organic manure and is most readily available to the farmers. Neem cake (NC) is rich in nitrogen and also contain phosphorus and potash. Because of low C/N ratio (3:15), its decomposition rate is faster than cereal residues and other bulky organic manures. The green manure crop supplies organic matter enriching soil fertility, acts as a supplement for nutrients, improves soil structure, prevents soil erosion and aids in controlling weeds.

In recent years, chemical fertilizers have played a significant role in providing nutrients for intensive crop production which heralded green revolution in the country. But increased use of chemical fertilizers in an unbalanced manner has created problem of multiple nutrient deficiencies, diminishing soil fertility and unsustainable crop yields. This necessitated a investigation of various approaches for ensuring effective use of available renewable source of plant nutrients for supplementing and complementing commercial fertilizers and biofertilizers to find out the feasibility of their use for improving soil health. As INM is the prescription for soil health, it is viable strategy for advocating judicious and efficient use of chemical fertilizers with matching addition of organic manures and biofertilizers.

Organic manures constitute a dependable source of macro and micro nutrients and are helpful in improving physical, chemical and biological health of soil, reduces nutrient losses, increases nutrient availability and uptake leading to sustainable production devoid of harmful residues, beside improving quality of vegetables [5]. It has been observed that soil application of organic manures or inorganic fertilizers are not able to sustain the soil fertility and crop productivity. However their integration has proved superior to individual component with respect to yield, quality and nutrient uptake.

Among the organic manures vermicompost is easily prepared and much effective manure. By feeding earthworms with biomass and watching properly the food (bio-mass) of earthworm. The required quantities of vermicompost can be produce. Vermicompost contains two times more N, 2-3 times P₂O₅ and K₂O and also rich in Ca, Mg, Mo, Cu, Mn etc. Thus play a vital role in improvement of soil fertility through its influence on available NPK, electrical conductivity, Organic carbon, pH, as well as serves fast proliferation of beneficial microbes which either helps in fixing nitrogen through biological processes or enhances availability of phosphorus through socialization. Vermicompost consist of N 1.5- 2.0%, P 0.9- 1.7% and K 1.5-2.5%.

Among the organic source, the old age concept of nutrient application is the utilization of farm yard manure. Well rotten farmyard manure being good source of essential plant nutrients especially NPK and give good crop stand by virtue of improvement in physical, chemical and biological characteristic of the soil. Apart from this provides an excellent micro-climate for proliferation of beneficial microbes, improvement in available soil NPK and maintenance of soil pH by the incorporation of FYM. FYM consist of 0.5% N, 0.2% P, and 0.5% K.

Vegetables play an important role in human nutrition. During recent years, the interest in organic vegetable production has assumed greater importance as a result of increased health awareness. Organically produced vegetables have good taste and quality and since, cucumber is mostly consumed as salad, quality is an important factor. It was aiming to reduce the usage of chemical fertilizers and to integrated organic and beneficial biological organisms in cucumber production system for the better income of the farmer. Keeping in view the importance of the study the present investigation was carried out with the objective to find out the effect of different levels of Vermicompost and FYM on growth and yield of Cucumber (*Cucumis sativus*) under Citrus based Agro forestry system.

MATERIAL AND METHODS

The present investigation was conducted from June to September 2017. The experiment was laid out in a Randomized Block Design with 9 treatments and 3 replications in Prayagraj, agro climatic condition at the experimental field Forest Nursery and Research Centre, College of Forestry, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj. The experimental site is located at a latitude of 20° and 15° North and longitude of 60° 3' East and at an altitude of 98 meters above mean sea level (MSL) [6] (Table.1). The site selected for the experiment was uniform and well leveled. In order to study the physical and chemical properties of the soil, a composite soil sample was taken from 0-30 cm depth by adopting appropriate soil sampling technique before sowing. The soil selected for the experiment was medium black with good texture and drainage (Table.2 and 2a). The land was prepared in usual manner by ploughing, crushing and was brought to the fine tilth. The area of a Prayagraj District come under subtropical belt in the South Eastern part of Uttar Pradesh, which experience extremely hot summer and fairly cold winter. The maximum temperature of the location reaches up to 46° C- 48°C. The relative

humidity ranges between 20 - 29 percent, with maximum annual rainfall of 100 cm from July to September, with a few showers during winter months [6]. The sowing was done on a raised bed method with spacing of 60 cm and 1.5 m plant and row to row, respectively, each plot with 5 plants. Adopting the recommended cultivation practice for raising a healthy crop and use to trellis system for vines climbing. Land area inside the Citrus base Agroforestry System was thoroughly dug to a depth of 15 to 20 cm one month prior to planting. Weeds and stubbles were removed completely and brought the soil to a fine tilt. Two days later, farmyard manure is mixed in the soil. F1 hybrid Malviya (Sulabh seeds) were procured from the local market for the research work. The pit was made 60 cm × 180 cm a part means the distance between plant × plant and row to row was 60 cm and 150 cm respectively two seed were sown in each pit 5 cm part with 1.5 to 2cm depth. Thinning of seedling was done within a period of three weeks and single healthy plants were maintained at each pit in furrow. The cultural practice such as irrigation weeding and plant protection measure was carried out uniformly as and when required. All the recommended package of practice was followed during the crop growth period. The entire plot was kept weed free by hand weeding at regular interval. First weeding and hoeing were done 30 days after sowing and later on as when required. The plots were irrigated uniformly at an interval of 5 days depending upon the soil and climate condition so as to maintain adequate moisture in the root zone. Soil was treated by Mancozeb @0.70% before sowing to control diseases and insect-pest. Viral diseases observed and control by spray of virokill @ 2 ml per 3 l at 4-5 days interval. Virus infected plants were also uprooted. Insect pest observed were, thrips, mites and aphids, severally infested plant were uprooted and sprayed with Calibre @ 29 ml per l and Coragan @ 0.2% at 4-5 interval respectively. Cucumber was ready to get harvested in 50-60 DAS. The green matured fruit was harvested as and when they attained good length. The fruits were harvested from all the five tagged plant earlier for recording the yield parameters. In the field experiment detail study of entire population was very difficult, for convenience, plants were selected randomly in each plot/per replications (5 plants) and they were tagged for identification and further investigation for the following parameters viz: Plant height (cm) after 30, 60, and 90 DAS, Number of branches after 30, 60, and 90 DAS, Number of leaves after 30, 60, and 90 DAS, Days of first flowering, Days to 50% flowering, Days to first harvest and yield parameters i.e., Total number of fruit per plant, diameter of fruit (cm), length of fruit (cm), average fruit weight (g), fruit yield per plots (kg), fruit yield (q/ha). The experiment was conducted in Randomized Block Design (RBD) replicated thrice on 10 June 2017 as per the treatment (Table.2). The raw data obtained during the experimental observations were subjected to statistical analysis as per method [7]. The significance and non- significance of the treatment effects were judged with the help of 'F' variance ratio test. Calculated 'F' value (variance ratio) was compared with the table value of 'F' at 5% level of significance.

RESULTS AND DISCUSSION

The effect of different combination of Vermicompost and FYM organic manure on plant height (cm) presented in table.3, the effect of different combination of organic manure shows the significant result at 30, 60, and 90 days after sowing.

At 30 days after sowing the maximum plant height (86.15 cm) was recorded in T₈ (Vermicompost @ 2t/ha + FYM @ 15 t/ha) followed by T₇ (Vermicompost @ 2 t/ha + FYM @ 10 t/ha). The minimum value was observed in T₁ (Vermicompost @ 0 t/ha + FYM @ 10 t/ha) i.e. 65.80 cm. At 60 days after sowing the maximum plant height (272cm) was recorded in T₈ (Vermicompost @ 2t/ha + FYM @ 15 t/ha) followed by T₇ (Vermicompost @ 2 t/ha + FYM @ 10 t/ha). The minimum value was observed in T₀ (Control) i.e. 213.07 cm. At 90 days after sowing the maximum plant height (370cm) was recorded in T₈ (Vermicompost @ 2t/ha + FYM @ 15 t/ha) followed by T₇ (Vermicompost @ 2 t/ha + FYM @ 10 t/ha). The minimum value was observed in T₀ (Control) i.e. 314.87 cm. Plant height, root length and root girth of carrot significantly increased with increasing levels of potassium and farmyard manure (FYM) [8]. In radish the residual nutrients due to application of 30t vermicompost in onion resulted as significant increase in bulb yield (42.03 t ha⁻¹)[9]. Application vermicompost, FYM and other organic manures significantly influence the growth and development of chilli [10].

Number of branches per plant

The effect of different level of vermicompost and FYM on number of branches per plant in cucumber presented in table 3, the effect of different combination of FYM and vermicompost manure showed the significant result at 30, 60, and 90 days after sowing. At 30 days after sowing the maximum number of branches per plant (2.80) was recorded in T₈ Vermicompost@ 2t/ha and FYM@ 15t/ha followed by T₇ Vermicompost@ 2t/ha and FYM@ 10t/ha which was (2.60) while the minimum number of branches per plant was recorded in T₁ Vermicompost@ 0t/ha and FYM@ 10t/ha i.e (2.06). At 60 days the maximum number of branches per plant (3.40) was recorded with T₈ Vermicompost@ 2t/ha + FYM@ 15t/ha

followed by T₇ Vermicompost@ 2t/ha + FYM@ 0t/ha i.e. (3.17). However the minimum of branches per plant was observed in T₀ (control) (2.77). At 90 days after sowing plants adversely affected by different combination of Vermicompost and FYM in terms of branches per plant. The maximum number of branches per plant (3.51) was recorded in T₈ Vermicompost@ 2t/ha and FYM@ 15t/ha, followed by T₆ Vermicompost@ 2t/ha and FYM@ 0t/ha which was (3.48). While the minimum number of branches per plant was recorded in T₀ (control), i.e. (2.80). In bitter gourd, application of vermicompost from 10-30 t / ha⁻¹ significantly increased the plant height and number of branches per vine [11]. Plant height, root length and root girth of carrot significantly increased with increasing levels of potassium and farmyard manure (FYM)[8].

Number of leaves per plant

The effect of different combination of organic manure on number of leaves per plant presented in table 4. the effect of different level of combination of organic manure show the significant result at 30, 60, and 90 DAS on cucumber of leaves per plant. At 30 DAT, the maximum number of leaves per plant (19.73) was recorded in T₈ Vermicompost@ 2t/ha + FYM@ 15t/ha followed by T₇ Vermicompost@ 2t/ha + FYM@ 10t/ha i.e. (18.00) whereas the minimum number of leaves per plant was recorded in T₀ (control) i.e. (12.80). At 60 DAT, the maximum number of leaves per plant (83.87) was recorded with T₈ Vermicompost@ 2t/ha + FYM@ 15t/ha followed by T₇ Vermicompost@ 2t/ha + FYM@ 10t/ha which was (83.40) and (82.40) with T₆ Vermicompost@ 2t/ha + FYM@ 0t/ha. However the minimum number of leaves per plant was observed in T₀ (control) i.e.(67.20). At 90 DAT, the maximum number of leaves per plant (119.84) was recorded with T₈ Vermicompost@ 2t/ha + FYM@ 15t/ha followed by T₆ Vermicompost@ 2t/ha + FYM@ 0t/ha which was (115.80) and (115.13) with T₇ Vermicompost@ 2t/ha + FYM@ 10t/ha. However the minimum number of leaves per plant was observed in T₀ (control) i.e. (104.73). The organic manure applied in the form of FYM, poultry manure and vermicompost might have improve the soil physical and chemical properties and leading to the adequate supply of nutrients to the plants which might have promoted the maximum vegetative growth while the minimum plant growth was due to non - availability of nutrients in Cucumber [12]. The number of leaves of cucumber increased as week after planting (WAP) increased. Based on the result obtained it is evident that poultry manure as organic manure is a good source of soil amendment, since it influenced the growth and yield component of cucumber[13].

Days to first flowering

The effect of different combination of organic manure like Vermicompost and FYM on days to first flowering presented in table 5, the effect of different combination of organic fertilizers show the significant result at days to first flowering. At the maximum days to first flowering 31.24 days was recorded in T₈ Vermicompost@ 2t/ha + FYM@ 15t/ha followed by T₇ Vermicompost@ 2t/ha + FYM @ 10t/ha i.e. 31.33 and T₅ Vermicompost@ 1t/ha and FYM @ 15t/ha which was 33.33 days respectively. While the minimum days to first flowering was recorded in T₀ (control), which was 34.00 days. The time to the first flower appearance is an important pre-requisite which decides the early fruit yield. The earliness to flowering in treatment T₈ might be due to the better translocation of nutrients to the areal parts. In cucumber[14] and in tomato[15] similar results were also reported. The yield of cucumber intercropped with citrus increased with population. This suggests the aggressivity of cucumber to compete for growth resources when intercropped with Cleopatra mandarin [16].

Days to 50% Flowering

The effect of Vermicompost and FYM on days to 50% flowering presented in table 4, the effect of these manure shows the significant result on days to 50% flowering.

Maximum Days taken to 50% flowering was recorded 43.33 with treatment T₈ Vermicompost@ 2t/ha + FYM@ 15t/ha followed by T₇ Vermicompost@ 2t/ha + FYM@ 10t/ha and T₅ Vermicompost@ 1t/ha + FYM@ 15t/ha which was 44.43 and 45.53. Whereas minimum days taken to 50% flowering was recorded in T₀ (control) which was 47.59 days. The time taken to the 50% flower appearance is an important pre-requisite which decides the early fruit yield. The earliness to flowering in treatment T₈ might be due to the better translocation of nutrients to the aerial parts[14].

Earlier of days to 50% flowering was observed when 20 mt/ ha FYM is applied. The highest No. of fruit cluster (6.90), maximum fruit weight (52.80) and fruit yield (25.74 mt/ha) were recorded with 16.66 mt/ha FYM + 8.33 mt/ha Vermicompost + NPK (150:100:50 kg/ha) in tomato[15].

Days to first harvest

The effect of Vermicompost and FYM manure on days to first harvest presented in table .5, the effect of these fertilizers combination of Vermicompost and FYM shows the significant result at days to first harvest.

Maximum days to first harvest 56.00 days was recorded in T₈ Vermicompost@ 2t/ha + FYM@ 15t/ha followed by T₇ Vermicompost@ 2t/ha + FYM@ 10t/ha and T₅ Vermicompost@ 1t/ha + FYM@ 15t/ha which was 57.00 at 66 days respectively. While the minimum days to first harvest was recorded in T₀ (Control), which was 62.67.

Application of organic manures not only improves the physical condition of crop, but also helps in better root growth, nutrients uptake and in turn increases the yield. Application of 30 to 35 tonnes of FYM / ha⁻¹ along with NPK fertilizer gave economic yields of onion [17].

Input cost was reduced from one lakh to 40,000 rupees per hectare with the application of vermicompost (5t/ha⁻¹) in grape vineyard, reported increased concentration of nutrients in petiole of leaf and increased yield which were on par with fertilizer applied plots. The quality of grape bunch, berry attachment, taste and attractive luster were higher in vermicompost applied plots [18].

Total Number of fruit/plant

The effect of different combination of Vermicompost and FYM on total numbers of fruit per plant presented in table 5, the effect of these combination of organic manure show the significant result on total number of fruits per plant.

The maximum number of fruit per plant (62.67) was recorded in T₈ Vermicompost@ 2t/ha + FYM@ 15t/ha followed by T₇ Vermicompost@ 2t/ha + FYM@ 10t/ha which was (51.20) While the minimum total number of fruit per plant was recorded in T₀ (control), which was (23.66)

Higher the number of fruit per plant was the application of organic manures not only improves the physical condition of crop, but also helps in better root growth, nutrients uptake and in turn increases the yield. Application of 30 to 35 tonnes of FYM / ha⁻¹ along with NPK fertilizer gave economic yields of onion [17] [18].

The carrot yields increased significantly with the application of organic manures as compared to that of control; the increase being from 1613 to 1682 q /ha⁻¹[19].

Fruit Diameter

The effect of different combination of Vermicompost and FYM on the diameter of fruit (cm) presented in table 5, the effect of the combination of these organic manure show the significant result as the diameter of fruit (cm).

The maximum diameter of fruit (14.80) was recorded in T₈ Vermicompost@ 2t/ha + FYM@ 15t/ha followed by T₇ Vermicompost@ 2t/ha + FYM@ 10t/ha and T₆ Vermicompost@ 2t/ha + FYM@ 0t/ha which was (14.07) and (13.68). And the minimum diameter of fruit (cm) was recorded in T₀ (control), which was (12.10). Higher core diameter and pericarp thickness of fruit resulted into higher diameter of fruit. The number of leaves of cucumber increased as week after planting (WAP) increased [13]. Based on the result obtained it is evident that poultry manure as organic manure is a good source of soil amendment, since it influenced the growth and yield component of cucumber. The results were also supported by Thongney *et al.* (2018)[20].

The yield of beans and tomato were constantly higher under organic soil management as compared to normal practice [21].

Length of Fruit (cm)

The effect of different combination of Vermicompost and FYM organic manure on the length of fruit (cm) presented in table 5, The effect of this combination of organic manure shows the significant result at the fruit length (cm). The maximum fruit length (15.03 cm) was recorded in T₈ Vermicompost@ 2t/ha + FYM@ 15t/ha followed by T₇ Vermicompost@ 2t/ha + FYM@ 10t/ha and T₆ Vermicompost@ 2t/ha + FYM@ 0t/ha which was (14.80 cm) and (14.43 cm). Whereas minimum fruit length (cm) was recorded in T₀ (control), which was (13.27 cm).

Krishnamurthi *et al.* (1995) observed and increase in yield of pods per plant in okra from 163.66 g to 207.66 g with FYM and vermicompost treatments respectively. The increase in yield over FYM treatments was 27 per cent with the application of vermicompost. They also obtained 7.73 pods per plant using FYM and 9.06 pods plant⁻¹ using vermicompost.

Application of organic manures not only improves the physical condition of crop, but also helps in better root growth, nutrients uptake and in turn increases the yield. Application of 30 to 35 tonnes of FYM / ha⁻¹ along with NPK fertilizer gave economic yields of onion [17].

Average fruit weight (g)

The effect of the combination of Vermicompost and FYM organic manure on the average fruit weight (g) presented in table 5, the effect of the combination of these organic fertilizers show the significant result at the average fruit weight (g).

In term of maximum average fruit weight (198.93gm) was recorded with treatment T₈ Vermicompost@ 2t/ha + FYM@ 15t/ha followed by T₇ Vermicompost@ 2t/ha + FYM@ 10t/ha and T₆ Vermicompost@

2t/ha + FYM@ 0t/ha which was (175.3gm) and (172.4g) respectively, and the minimum average fruit weight (g) was recorded in T₀ (control), which was (139.13 g).

The yield of beans and tomato were constantly higher under organic soil management as compared to normal practice [21]. Sharma and Aryan [22] reported that the application of farmyard manure @ 20 t ha⁻¹ significantly increases the cabbage yield (18.7 t ha⁻¹) compare to control (14.59 t ha⁻¹) and attributed it to the additional nutrients supplied by the farmyard manure.

Anon (1995) reported that while in case of Nagpur mandarin orchard, growing of soyabean and cowpea as intercrops was found profitable which produced 2.82 q/ha and 6.82 q/ha respectively [23]. The increase in yield parameters may be due to better root proliferation, more uptake of nutrients and water, higher plant growth, more photosynthesis and enhanced food accumulation. These findings are in conformity with those of Wange and Kale [24] in Okra.

Table 1. Meteorological data recorded during experimental period (June - September 2017).

| Weeks | Temperature °C | | Rainfall (mm) | Relative Humidity (%) | |
|----------------------|----------------|---------|---------------|-----------------------|---------|
| | Maximum | Minimum | | Maximum | Minimum |
| June 2017 | | | | | |
| 1 st week | 44.43 | 24.74 | 1.29 | 50.71 | 27.14 |
| 2 nd week | 40.46 | 29.63 | Nil | 59.86 | 32 |
| 3 rd week | 40.91 | 30.6 | Nil | 62.43 | 32.71 |
| 4 th week | 41.4 | 30.04 | Nil | 63.56 | 32.56 |
| July 2017 | | | | | |
| 1 st week | 36.57 | 26.43 | 18.03 | 79.74 | 53.86 |
| 2 nd week | 30.71 | 26.06 | 25.54 | 89.57 | 71.57 |
| 3 rd week | 36.34 | 28.8 | Nil | 90.14 | 51 |
| 4 th week | 32 | 27.58 | 14 | 91.56 | 65.6 |
| August 2017 | | | | | |
| 1 st week | 35.29 | 28.66 | 1.17 | 90 | 53 |
| 2 nd week | 34.8 | 29.03 | 6.31 | 90.86 | 53.29 |
| 3 rd week | 35.23 | 29.37 | Nil | 89.57 | 52.71 |
| 4 th week | 34.91 | 28.91 | 2.62 | 88.22 | 52.5 |
| September 2017 | | | | | |
| 1 st week | 36.03 | 30 | 0.11 | 84.71 | 45.86 |
| 2 nd week | 36.83 | 30.34 | Nil | 83.29 | 44.86 |
| 3 rd week | 36.97 | 29.49 | Nil | 86.57 | 47.86 |
| 4 th week | 35.91 | 29.36 | 1.84 | 87.78 | 53.78 |

(Source: Agro-meteorological Observatory Unit, College of Forestry, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj.

Table 2. Physical properties of soil experimental field

| Ingredients | Percentage | Method Employed |
|-------------|------------|-----------------|
| Sand | 68.5% | Hydro |
| Silt | 11.9% | -do- |
| Clay | 19.6% | -do- |

Textural Class: Sandy Loam

Table 2 a. Experimental Field Soil Properties analysis methods

| Ingredients | Method Employed | Open | Shade |
|----------------|-----------------------------------|----------|------------|
| Organic carbon | Walkely and black [27] | 12% | 17% |
| Nitrogen (N) | Alkaline permanganate method [28] | 57 Kg/ha | 43 Kg/ha |
| phosphorus (P) | Olsen' calorimeter method [29] | 11Kg/ha | 14.6 Kg/ha |
| Potash (k) | Flame photometric method [30] | 193Kg/ha | 245 Kg/ha |
| Soli pH | Digital pH meter | 8.1 | 7.6 |
| Ec (dSm-1) | Digital conductivity meter | 0.16 | 0.17 |

Table 3. Effect of Different Level of Vermicompost and FYM Organic Manure on plant height in (cm) and Number of Branches of Cucumber under Citrus based Agroforestry System.

| Treatments No | Treatments combination | Plant height (cm) | | | No. of branches per plant | | |
|----------------|-----------------------------------|-------------------|---------------|---------------|---------------------------|-------------|-------------|
| | | 30 DAS | 60 DAS | 90 DAS | 30 DAS | 60 DAS | 90 DAS |
| T ₀ | Vermicompost@ 0t/ha - FYM@ 0t/ha | 69.13 | 213.07 | 314.87 | 2.06 | 2.77 | 2.80 |
| T ₁ | Vermicompost@ 0t/h - FYM@10t/ha | 65.80 | 226.13 | 332.80 | 2.00 | 2.97 | 3.00 |
| T ₂ | Vermicompost@ 0t/ha FYM@ 15t/ha | 73.95 | 226.93 | 337.07 | 2.20 | 3.20 | 3.23 |
| T ₃ | Vermicompost@ 1t/ha - FYM@ 0t/ha | 67.40 | 235.07 | 343.67 | 2.40 | 2.80 | 2.83 |
| T ₄ | Vermicompost@ 1t/ha - FYM@ 10t/ha | 75.09 | 237.73 | 344.47 | 2.65 | 3.20 | 3.38 |
| T ₅ | Vermicompost@ 1t/ha - FYM@ 15t/ha | 74.87 | 245.27 | 330.07 | 2.40 | 3.20 | 3.43 |
| T ₆ | Vermicompost@ 2t/ha - FYM@ 0t/ha | 76.47 | 247.93 | 345.20 | 2.67 | 3.33 | 3.48 |
| T ₇ | Vermicompost@ 2t/ha - FYM@ 10t/ha | 82.30 | 258.40 | 353.13 | 2.60 | 3.17 | 3.20 |
| T ₈ | Vermicompost@ 2t/ha - FYM@ 15t/ha | 86.15 | 272.00 | 370.00 | 2.80 | 3.40 | 3.51 |
| | F - test | S | S | S | S | S | S |
| | C.D. at 0.5% | 3.99 | 2.42 | 2.29 | 0.42 | 0.31 | 0.30 |
| | S.Ed (±) | 1.88 | 1.14 | 1.08 | 0.20 | 0.14 | 0.14 |

Table 4. Effect of Different Level of Vermicompost and FYM Organic Manure on Number of Leaves, days to first flowering and 50 % flowering

| Treatments No | Treatments combination | Number of leaves per plant | | | Days to First Flowering | Days to 50% Flowering |
|----------------|-----------------------------------|----------------------------|--------------|---------------|-------------------------|-----------------------|
| | | 30 DAS | 60 DAS | 90 DAS | | |
| T ₀ | Vermicompost@ 0t/ha - FYM@ 0t/ha | 12.80 | 67.20 | 104.73 | 34.00 | 47.59 |
| T ₁ | Vermicompost@ 0t/h - FYM@10t/ha | 14.73 | 71.60 | 108.07 | 33.63 | 47.10 |
| T ₂ | Vermicompost@ 0t/ha FYM@ 15t/ha | 15.87 | 72.27 | 108.60 | 33.00 | 47.33 |
| T ₃ | Vermicompost@ 1t/ha - FYM@ 0t/ha | 14.97 | 78.67 | 110.07 | 33.33 | 47.00 |
| T ₄ | Vermicompost@ 1t/ha - FYM@ 10t/ha | 15.93 | 80.87 | 114.93 | 32.33 | 45.00 |
| T ₅ | Vermicompost@ 1t/ha - FYM@ 15t/ha | 16.13 | 80.62 | 114.80 | 33.33 | 45.53 |
| T ₆ | Vermicompost@ 2t/ha - FYM@ 0t/ha | 16.80 | 82.40 | 115.80 | 31.43 | 44.76 |
| T ₇ | Vermicompost@ 2t/ha - FYM@ 10t/ha | 18.00 | 83.40 | 115.13 | 31.33 | 44.43 |
| T ₈ | Vermicompost@ 2t/ha - FYM@ 15t/ha | 19.73 | 83.87 | 119.84 | 31.24 | 43.33 |
| | F - test | S | S | S | S | S |
| | C.D. at 0.5% | 2.20 | 3.04 | 3.00 | 1.74 | 2.29 |
| | S.Ed (±) | 1.04 | 1.44 | 1.41 | 0.82 | 1.08 |

Table No 5. Effect of Different Level of Vermicompost and FYM Organic Manure on yield parameter

| Treatments No | Treatments combination | Days to First Harvest | Total Number of fruit /plant | Diameter of Fruit (cm) | Length of fruit (cm) | Average Fruit Weight (g) | Fruit Yield Per Plot (Kg) | Fruit Yield (q/ha) |
|----------------|-----------------------------------|-----------------------|------------------------------|------------------------|----------------------|--------------------------|---------------------------|--------------------|
| T ₀ | Vermicompost@ 0t/ha - FYM@ 0t/ha | 62.67 | 23.66 | 12.10 | 13.27 | 139.13 | 3.12 | 78.00 |
| T ₁ | Vermicompost@ 0t/h - FYM@10t/ha | 61.67 | 28.01 | 13.10 | 13.53 | 162.13 | 4.25 | 106.25 |
| T ₂ | Vermicompost@ 0t/ha FYM@ 15t/ha | 62.00 | 31.33 | 13.22 | 13.67 | 168.53 | 5.08 | 127.00 |
| T ₃ | Vermicompost@ 1t/ha - FYM@ 0t/ha | 61.33 | 29.50 | 13.18 | 13.55 | 140.33 | 3.60 | 90.00 |
| T ₄ | Vermicompost@ 1t/ha - FYM@ 10t/ha | 60.00 | 38.10 | 13.57 | 13.80 | 153.27 | 5.57 | 139.25 |
| T ₅ | Vermicompost@ 1t/ha - FYM@ 15t/ha | 57.66 | 33.30 | 13.53 | 14.13 | 168.40 | 5.42 | 135.5 |
| T ₆ | Vermicompost@ 2t/ha - FYM@ 0t/ha | 58.00 | 41.84 | 13.68 | 14.43 | 172.40 | 7.04 | 176.00 |
| T ₇ | Vermicompost@ 2t/ha - FYM@ 10t/ha | 57.00 | 51.20 | 14.07 | 14.80 | 175.3 | 8.62 | 215.5 |
| T ₈ | Vermicompost@ 2t/ha - FYM@ 15t/ha | 56.00 | 62.67 | 14.80 | 15.03 | 198.93 | 11.87 | 296.75 |
| | F - test | S | S | S | S | S | S | S |
| | C.D. at 0.5% | 2.90 | 5.42 | 0.95 | 0.58 | 4.61 | 0.88 | 7.07 |
| | S.Ed (±) | 1.37 | 2.56 | 0.45 | 0.27 | 2.17 | 0.42 | 3.34 |

Fruit yield per plot (kg)

The effect of the combination of Vermicompost and FYM organic manure on the fruit yield per plot (Kg) presented in table 6, the effect of the combination of Vermicompost and FYM fertilizers show the significant result as fruit yield per plot (kg)

The highest fruit yield per plot (11.87) was recorded in T₈ Vermicompost @ 2t/ha + FYM @ 15t/ha followed by T₇ Vermicompost @ 2t/ha + FYM@ 10t/ha which was (8.62kg), where as minimum fruit yield per plot (kg) was recorded in T₀ (control), which was (3.12kg)..

The yield of cucumber intercropped with citrus increased with population. This suggests the aggressively of cucumber to compete for growth resources when intercropped with Cleopatra mandarin[16]. Application of earthworm casts in cucumber increased yield by 42.5 per cent over control, while direct released of earthworm in grape, orange, apple and nuts increased the fruit yields[18].

Fruit yield (q/hectare)

The effect of the combination of Vermicompost and FYM on the fruit yield per hectare (q h⁻¹) presented in table 6, the effect of the combination of these organic manure show the significant result at fruit yield per hectare (q ha⁻¹).

The highest fruit yield per hectare (296.75 q ha⁻¹) was recorded in T₈ Vermicompost@ 2t/ha + FYM@ 15t/ha followed by T₇ Vermicompost@ 2t/ha + FYM@ 10t/ha which was (215.5 q ha⁻¹), where minimum fruit yield per hectare (q ha⁻¹) was recorded in T₀ (control), which was (78.00 q ha⁻¹).

The maximum yield per ha in T₈ Vermicompost @ 2t/ha + FYM@ 15t/ha might be due to increase yield per plot which might have increased total yield per ha.

Daniel *et al*, (2002) reported that the carrot yields increased significantly with the application of organic manures as compared to that of control; the increase being from 1613 to 1682 q /ha⁻¹[19].

The maximum yield of French bean was (2.64 Kg/plot) intercrops in bearing Khasi mandarin orchard at Barapani. Fruit weight might have accelerated the mobility of photosynthetic from source to the sink which was influenced by the growth hormones which released from Vermicompost[23], the organic

sources. Similar findings were reported by Mudiganti *et al.* [25] in Chilli crop and Yadav *et al.* (2019) in Maize[26].

CONCLUSION

The results of the research trail of Cucumber grown under the Citrus based Agroforestry System with different level of vermicompost and FYM organic manure show significant with reference to growth and yield. The best treatment overall was T₈ (Vermicompost@ 2t/ha - FYM@ 15t/ha) which gave the maximum positive results in all parameters i.e. the growth and development. So this can be recommended to the farmer under Citrus based agroforestry farming.

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