# Effect of Organic Manure Source and NPK Fertilizer on Growth and Fruit Yield of Cucumber

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## Abstract

Two field experiments were conducted in sandy soil during the successive summer seasons of 2020/2021 and 2021/2022 at a private farm, Abu Hammad District , Sharkia Governorate, Egypt, to study the effect of cattle manure and chicken manure, and application with ( nitrogen, phosphorus and potassium fertilizer ) on the growth characteristics, and fruit yield, of cucumbers..

The experiment included 9 treatments with three replicates , where the main plot was o, cattle manure and chicken manure, and sub –plot was three rate of NPK ( 0-0-0, 50 – 50 – 50 , and 100 – 100 – 100 kg NPK / feddam). Split plot design was used,

Results indicated that chicken manure, being the most effective treatment on vegetative growth characters and fruit yield of cucumber plants, followed by cattle manure in this concern. The highest values of NPK at the of 100 – 100 – 100 kg NPK/ feddan, being the most effective of growth parameters and fruit yield of cucumber plans.

The interaction of chicken manure with the highest values of NPK fertilizer (100 – 100 – 100 kg NPK/ feddan), being the most effective treatment on vegetative growth characters and fruit yield of cucumber plant

**Conclusively:** it can be concluded that chicken manure with the highest values of NPK fertilizer (100 – 100 – 100 kg NPK/ feddan) , being the most effective treatment on vegetative growth characters and fruit yield of cucumber plant.

**Key words:** Cattle manure – chicken manure – NPK- cucumber.

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## Introduction

Cucumber (*Cucumis sativus* L.) is a popular vegetable belongs to the family cucurbitaceae. Cucumber is native to the tropics and is one of the oldest cultivated vegetable crops **(Yawalkar, 1985).** It is considered as quality dietary food due to its excellent digestibility and rich water content (96.3 g/100 g). Cucumber is a dependable laxative for those who suffer constipation.

The juice of cucumber is a valuable food in the treatment of hyper acidity, gastric and duodenal ulcers.Cucumber plants should be fertilized with adequate dose of nitrogen, phosphorus and potassium which are the main elements and they have significant effect on growth of plants. Nitrogen (N) is perceived as one of the principal macronutrients which is necessary for plants (**Ali et al., 2017**).

Nitrogen is a component of chlorophyll, the green pigment of plants that stimulates photosynthesis. Deficiency of nitrogen significantly reduces growth and yield of cucumber. The element phosphorus (P) is a must for photosynthesis. High level of available phosphorus throughout the root zone is essential for root development and good utilization of water and other nutrients by the plants (**Salman et al., 2021**). Potassium is absorbed in greater amounts by plants than any other mineral element with the exception of nitrogen and, in some cases, calcium as well. Potassium helps in some essential functions in plants like protein building, photosynthesis, maintaining fruit quality and diseases reduction (**Ramezani et al., 2017**).

The organic matter benefit the soil through; binding the soil particles together to form aggregates, improving the moisture – holding capacity of soil (especially in sandy and loamy soils), improving soil permeability to water, increasing the cation exchange capacity of soils, buttering the soil against excessive or abrupt pH change when soil amendments are added, favouring the formation of metal-organic matter complexes (e.g. with the Fe, Mn, Cu, Zn) which enhances the stable availability of these micronutrients throughout the growing period. Organic nutrients are important source of the micronutrients and also some secondary nutrients (S, Mg, Fe, Cu) such as cattle manure and chicken manure **(Shahboj and Prasad, 2022).** Cattle manure is a potential source of nutrients and also a potential benefit to soil amelioration especially for communal farmers who cannot afford fertilizers. However, getting the maximum value out of the manure requires applying it at proper rates and frequency in conjunction to a particular soil (**Pahla et al., 2013**). Cattle manure application rates in cucumber as a sole crop or as an intercrop since little work has been done on the effects of manure on cucumber growth and yield **(Musara, and Chitamba,2014, and Hamaiel et al., 2015).** Finally it could provide protection against drought and some soil borne diseases. Biofertilizers in comparison with chemical fertilizers have enormous economic and environmental advantages. The biological fertilizers have been shown to have a special importance as appropriate replacement for chemical fertilizers, through to improving of soil fertility and providing nutrition requirement of plant.

Bio-fertilization is agricultural practices in sustainable agriculture that used to promote plant nutrient and production. Several bacterial strains are used as bio-fertilizers such as nitrogen fixing bacteria and phosphate and potassium solubilizing bacteria (PSB and KSB). Bio-fertilizers application makes major essential macronutrients available to absorption by plants and causes enhancement in plant growth and yield (**Han et al. 2006**). Moreover, bio-fertilizers contain a variety of beneficial microorganisms and enzymes which promote and improve plant growth and protect plants from pests and diseases that led to increase yield and quality of agriculture crops and reduce pollution of soil and water by chemical fertilizers **Abou-Aly et al., 2006).** Using bio-fertilizers significantly increased vegetative growth characteristics in cucumber plants i.e, plant height, number of leaves, leaf area, plant fresh and dry weight shoot length, root length, number of branches, root fresh weight, shoot fresh weight, and dry weight of shoots and roots **(Han et al., 2006; Salhia, 2010; Isfahani and Besharati, 2012)** as compared to non-treated control

plants. Likewise inoculation soil or plants with bio-fertilizers cause a significant increment in early and total yield and fruit quality, such as fruit length, fruit diameter and fruit fresh weight **(Paramar et al., 2011;** On the other hand, the highest content of N, P and K was observed in plants and fruits treated with bio-fertilizers e.g., [Azotobacter + Phosphobacteria in cucumber **(Anjanappa et al., 2011).**

The purpose of this study was to compare different levels of chemical and biofertilizer on growth and yield of cucumber, also evaluate the relationship between quantitative traits of cucumber. One of the goals was to examine morphological traits effects on fruit yield using multivariate analysis and to investigate the improvement of cucumber nutrition and improvement of produce of highest yield via application of biofertilizers so if possible to able to recommend this fertilizers as replacement to the chemical fertilizers.

## MATERIAL AND METHODS

Two field experiments were conducted in sandy soil out during the successive summer seasons of 2020/2021 and 2021/2022 at a private farm, Abu Hammad District , Sharkia Governorate, Egypt, to study the effect of cattle manure and chicken manure, and application with ( nitrogen, phosphorus and potassium fertilizer ) on the growth characteristics, and fruit yield, of cucumbers.. A soil sample was taken at a depth at 30 cm. Soil physical and chemical properties and chemical properties of cattle manure and chicken manure of the experimental sites are presented in Tables (1, 2 and 3).

**Table (1): The experimental soil analysis showing the soil physical and chemical properties.**

| Properties | Value |
|---|---|
| pH in $H_2O$ | 5.11 |
| pH in KCL | 4.77 |
| Organic matter (%) | 1.51 |
| Organic carbon (%) | 0.27 |
| Nitrogen (%) | 0.77 |
| Phosphorus (mg/kg) | 1.97 |
| Magnesium (Cmol/kg) | 0.95 |
| Sodium (Cmol/kg) | 0.55 |
| Potassium (Cmol/kg) | 1.33 |
| Calcium (Cmol/kg) | 0.71 |
| Moisture content (%) | 0.95 |
| Silt (%) | 1.51 |

| Properties | Value |
|---|---|
| Clay (%) | 4.27 |
| Sand (%) | 94.22 |
| Soil texture | Sandy |

Table (2): The analysis of cattle manure:

| Properties | Value |
|---|---|
| N % | 0.95 |
| P % | 0.47 |
| K % | 0.63 |
| Ca % | 1.52 |
| Zn % | 4.70 |
| pH (1:5) | 6.7 |
| E.C (1 : 10) | 4.03 |
| OM % | 42.97 |
| O C % | 24.98 |
| CN ratio | 120.6 |
| Fe ppm | 61.27 |
| Mn ppm | 26.19 |
| Zn ppm | 18.03 |
| Cu ppm | 5.72 |

Table (3): The analysis of chicken manure:

| Properties | Value |
|---|---|
| pH (1 : 10) manure suspension) | 7.52 |
| EC (1 : 10) water extract, dS/m | 2.86 |
| O. M % | 17.67 |
| C/N rater | 8.21 |

| Soluble Cations (mg/L) | |
|---|---|
| Ca ++ | 3.06 |
| Mg ++ | 2.70 |
| No+ | 14.20 |
| K+ | 34.20 |
| Available nutrients (%) | |
| Nitrogen (N) | 1.25 |
| Phosphorus (P) | 1.04 |
| Potassium (K) | 2.10 |

The experiment included 9 treatments with three replicates , where the main plot was o, cattle manure and chicken manure, and sub –plot was three rate of NPK ( 0-0-0, 50 – 50 –50 , and 100 – 100 – 100 kg NPK / feddam). Split plot design was used , where the organic manure are distributed in the main plot , while the NPK rates are in the sub- plot.

The treatments in this experiment received the recommended dose of cattle and chicken manure were applied at (10 tons/fed) were applied as one dose at the time of bed preparation of the soil for agriculture. Nitrogen, phosphorus and potassium (NPK) (50:50:50 and 100:100:100 kg/fad) as ammonium sulphate (20 %N), potassium sulphate (48 % $K_2O$) which were added 3 doses 15 days after sowing, 15 days and 15 days after that. phosphorus was applied as one dose at the time of bed preparation of the soil for agriculture as calcium super phosphate ($P_2O_5$).

The seedlings sown at 1$^{st}$ of April 2021 and 2022 in both growing seasons which included 3 lines each were 3 m length and 90 cm width.

**The recorded data:-**

**The growth traits**

A. **Number of leaves / plant:** 5 plants were randomly selected/plot and their number of leaves counted and their mean taken at three weeks after planting (3WAP) and six weeks after planting (6WAP). This was achieved by counting.

B. **Plant fresh weight :** 5 plants were randomly selected per plot and there tape was used to measure the weight of the plant at harvests.

C. **Plant height:** This was determined using measuring tape. The tape was used to measure the height of the plant from the level of the soil to the top of the shoot apex.

**D. Plant dry weight:** 5 plants were randomly selected per plot and there tape was used to measure the weight of the plant at harvests.

**The yield and its components traits:**

**A- Number of fruits /plant:** Number of fruits per plant was taken at each harvest and recorded cumulatively.

**B- Fruit weight /g**: Mean ten fruits weight were measured at harvests using weighing scale.

**C- Fruit yield /plant**:- mean fruits weight of five plants were measured at harvests using weighing scale.

**D- Fruit yield fed/tons.**

**The Statistical Analysis:**

The experiments were laid out in split plot design with three replications. The obtained data were subjected to statistical analysis of variance using SAS program (SAS Instituet, 2004) and means were compared by using least difference (LSD) test at 5% level of significance according to the method described by **Snedecor and Cochran (1989).**

**RESULTS AND DISCUSSION:**

**Vegetative growth characters:**

**Effect of organic manure:**

Data in Table (4) revealed that organic manure, i.e. cattle manure and chicken manure significantly increased on vegetative growth characters of cucumber plants, i.e. plant height, number of leaves, plant fresh weight and plant dry weight compared to the control treatment. Chicken manure, being the most effective treatment on vegetative growth characters of cucumber plants, followed by cattle manure in this concern.

Regarding the effect of organic manure on vegetative growth of cucumber, **Pahla *et al.* (2013)** concluded that cattle manure is a potential source of nutrients and also a potential benefit to soil amelioration, especially for communal farmers who cannot afford fertilizers. However, getting the maximum value out of the manure require applying it at proper rates and frequency in conjunction to a particular soil. From these reasons, it can be increase the plant growth.

Moreover, chicken manure refers and important role to increase the plant growth that it promote the mievo-organisms in the soil and improved the soil fertility **(Mararni and Siahaan, 2022).**

These results are in close agreement with those reported by **Dawa *et al.* (2013)** who worked with cattle manure and chicken manure, respectively.

**Effect of NPK fertilizer:**

Data presented in Table (4) how that NPK fertilizer at the two rates of 50 – 50 – 50 and 100 – 100 – 100 kg NPK/ feddan significantly increased the vegetative growth characters of cucumber plants.

**Table (4): Effect of organic manure and NPK fertilizer on vegetative growth characters of cucumber plants at both seasons (Combined)**

| | Plant height (cm) | Number of leaves | Plant fresh weight (g) | Plant dry weight (g) |
|---|---|---|---|---|
| **Organic manure** | | | | |
| 0 | 100.04 | 91.03 | 813.87 | 90.20 |
| Cattle manure | 109..9 | 95.81 | 919.90 | 103.96 |
| Chicken manure | 113.60 | 97.92 | 957.34 | 111.82 |
| LSD (0.05) | 3.36 | 3.23 | 38.42 | 6.71 |
| **N P K** | | | | |
| 0 0 0 | 95.61 | 82.19 | 740.66 | 82.53 |
| 50 50 50 | 110.07 | 99.64 | 946.02 | 105.81 |
| 100 100 100 | 117.07 | 102.93 | 1004.44 | 117.65 |
| LSD (0.05) | 4.12 | 2.17 | 41.15 | 8.33 |
| **Interaction** | | | | |
| Organic manure X NPK | ** | ** | ** | ** |
| LSD (0.05) | 9.11 | 2.09 | 112.07 | 8.21 |

The highest values of NPK at the of 100 – 100 – 100 kg NPK/ feddan, being the mast effective of growth parameters of cucumber plans.

Regarding the important role of N, P, and K on cucumber plants, **Mohammed *et al.* (2021)** demonstrated that nitrogen is a component of chlorophyll, the green pigment of plants that stimulates photosynthesis Deficiency of nitrogen significantly reduces growth of cucumber.

They added that phosphorus (P) is a must for photosynthesis. High level of available phosphorus throughout the root zone is essential for root development and good utilization of water and other nutrients by the plants. Moreover, for potassium **Ramezani *et al.* (2017)** illustrated that potassium is absorbed in greater amounts by plants than any other mineral element with the exception of nitrogen, in some cases, and it helps in some essential functions in plants like protein building, photosynthesis and building good growth of plants. The obtained results are in harmony with those reported by **Ahmed *et al.* (2017), Alkharpotly *et al.* (2019), and Abdul Bari (2024).**

**Effect of interaction between organic manure and NPK fertilizer:**

Data in Table (5) confirmed that the interaction between organic fertilizer and NPK fertilizer vegetative growth characters of cucumber plant. The interaction of chicken manure with the highest values of NPK fertilizer (100 – 100 – 100 kg NPK/ feddan), being the most effective treatment on vegetative growth characters of cucumber plant. This treatment followed by cattle manure with the highest values of NPK/ feddan (100 – 100 – 100). The same trend with the lowest values of NPK fertilizer (50 – 50 – 50 kg / feddan) by chicken manure and cattle manure, respectively.

**Table (5): The interaction effect of organic manure and NPK fertilizer on vegetative growth characters of cucumber plants at both seasons (Combined)**

| **Organic Manure** | N P K | Plant height (cm) | Number of leaves | Plant fresh weight (g) | Plant dry weight (g) |
|---|---|---|---|---|---|
| 0 | 0 0 0 | 92.17 | 80.22 | 637.31 | 73.15 |
| | 50 50 50 | 102.63 | 74.66 | 887.21 | 96.22 |
| | 100 100 100 | 105.31 | 98.22 | 917.11 | 101.21 |
| Cattle manure (10 $m^3$/fed) | 0 0 0 | 95.37 | 82.15 | 763.36 | 83.26 |
| | 50 50 50 | 11.22 | 101.17 | 963.21 | 104.07 |
| | 100 100 100 | 119.67 | 104.11 | 1033.13 | 124.56 |
| Chicken Manure (10 $m^3$/fed) | 0 0 0 | 99.29 | 84.21 | 821.31 | 91.17 |
| | 50 50 50 | 115.35 | 103.09 | 987.63 | 117.13 |
| | 100 100 100 | 126.17 | 106.47 | 1063.07 | 127.17 |
| LSD (0.05) | | 9.11 | 2.09 | 112.07 | 8.21 |

**Fruit yield and its components:**

**Effect of organic manure:**

Data in Table (6) indicated that both of organic manure, i.e. cattle manure and chicken manure significantly increased fruit yield and its components of cucumber, i.e. number of fruits / plant, overage fruit weight and fruit yield /feddan. The chicken manure caused an increases than cattle manure in these concern. Regarding the important role of organic manure in increasing fruit yield of cucumber, **Shahbaj and Prasad (2022)** stated that the organic matter benefit the soil through; binding the soil particles together to form aggregates, improving the moisture holding capacity of soil (especially in sandy and 100 mg soils), improving soil permeability to water, increasing the cation exchange capacity of soils, buttering the soil against exessive or abrupt pH change when soil amendments are added, farouring the formation of metal – organic matter complexes with Fe, Mn, Cu and Zn, which enhances the stable availability of these micro-

nutrients throughout the growing period. These organic matter like as cattle manure and chicken manure.

These results are agreement with those reported **by Mararni and Siahaan (2022)** with cattle manure and chicken manure, respectively.

**Table (6): The interaction effect of organic manure and NPK fertilizer on fruit yield of cucumber plants at both seasons (Combined)**

| Treatments | Number of Fruits/plant | Average fruit weight (g) | Fruit yield/feddan (ton) |
|---|---|---|---|
| **Organic manure** | | | |
| 0 | 6.36 | 151.92 | 21.41 |
| Cattle manure | 9.16 | 160.33 | 24.17 |
| Chicken manure | 10.51 | 164.76 | 25.53 |
| LSD (0.05) | 2.17 | 3.23 | 2.31 |
| **N P K** | | | |
| 0 0 0 | 6.24 | 143.79 | 18.74 |
| 50 50 50 | 9.03 | 161.86 | 25.11 |
| 100 100 100 | 11.36 | 171.37 | 27.26 |
| LSD (0.05) | 2.11 | 8.22 | 1.17 |
| **Interaction** | | | |
| Organic manure X NPK | ** | ** | ** |
| LSD (0.05) | 1.17 | 9.13 | 1.07 |

**Effect of NPK fertilizer:**

The illustrated data in Table (6) cleared that NPK fertilizer significantly increased on fruit yield and its components of cucumber. The highest values, with NPK at the rate of 100 – 100 – 100 kg/feddan caused an increases in fruit yield of cucumber, followed by the highest rate of cattle manure compared to the lowest values.

As the role of NPK in increasing fruit yield of cucumber, Ali et al. (2017) pointed out that nitrogen, phosphorus and potassium are the main elements in building the tissues, improving the plant growth, promoting the bio chemical processes and then increased the fruit yield. These results according with those reported by **Mohammed *et al.* (2021).**

**Effect of interaction between organic manure and NPK fertilizer:**

Data in Table (7) revealed that chicken manure with highest values of NPK at the rate of 100 – 100 – 100 gave the highest values on fruit yield of cucumber. This treatment followed by cattle manure at the same highest values of NPK.

**Conclusively:** It can be concluded that chicken manure, 100 – 100 – 100 kg NPK fertilizer and the interaction between them caused an increases in plant growth characters and fruit yield and its components of cucumber.

**Table (7): Effect of organic manure and NPK fertilizer on fruit yield of cucumber plants at both seasons (Combined)**

| **Organic Manure** | N P K | Number of Fruits/plant | Average fruit weight (g) | Fruit yield/feddan (ton) |
|---|---|---|---|---|
| 0 | 0 0 0 | 5.33 | 139.14 | 16.87 |
| | 50 50 50 | 7.31 | 153.26 | 22.12 |
| | 100 100 100 | 8.26 | 163.36 | 25.23 |
| Cattle manure (10 $m^3$/fed) | 0 0 0 | 6.29 | 144.36 | 18.22 |
| | 50 50 50 | 9.11 | 165.43 | 26.07 |
| | 100 100 100 | 12.07 | 171.22 | 28.23 |
| Chicken Manure (10 $m^3$/fed) | 0 0 0 | 7.11 | 147.88 | 21.15 |
| | 50 50 50 | 10.66 | 166.89 | 27.13 |
| | 100 100 100 | 13.75 | 179.53 | 28.33 |
| LSD (0.05) | | 1.17 | 9.13 | 1.07 |

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