

## Effect of different organic manures along with microbial consortia on growth and yield of Kalmegh (*Andrographis paniculata* Nees.)

**Comment [U1]:** REVIEW KEYWORDS IN TITLE AS UPPER CASE  
**Effect of Different Organic Manures along with Microbial Consortia on Growth and Yield of Kalmegh**

### ABSTRACT

Kalmegh has wide range of medicinal and pharmacological applications. The active ingredient andrographolide is most important bioprotectant. An experiment entitled “Effect of different organic manures along with microbial consortia on growth and yield of Kalmegh (*Andrographis paniculata* Nees)” was conducted in the Department of Horticulture, COA, University of Agricultural Sciences, GKVK, Bengaluru during 2021-2022. The experiment was laid out in Randomised Complete Block Design with thirteen treatments replicated thrice. Significantly higher plant height (34.30 cm) was observed with the application of 100% RDF through vermicompost. Maximum plant spread (2209.6 cm<sup>2</sup>) was recorded in the treatment consisting of 50% RDF through FYM + 50% RDF through neem cake + microbial consortia. Application of sheep manure in combination with neem cake resulted in higher number of branches per plant (14), higher number of leaves per plant (152.6), highest fresh weight (56.60g), highest dry weight (21.49 g), highest root to shoot ratio (0.59), highest fresh herbage yield (116 q/ ha) and highest B:C ratio (1.7).

**Comment [U2]:** consider deleting. the abstract could begin with..  
**In this study, the Effect of Different Organic Manures along with Microbial Consortia on Growth and Yield of .... grown Kalmegh.... was investigated.** Kalmegh has wide range of medicinal and pharmacological applications. The active ingredient andrographolide is most important bioprotectant hence the need to explore different manures along with microbial consortia to improve its yield...

### INTRODUCTION

Kalmegh (*Andrographis paniculata*) belongs to the family ‘Acanthaceae’ which is also known as Maha tita and Kalpanath. It has long been used in Indian system of medicine “Ayurveda”. Medicinal properties of plants had been mentioned in pharmacopoeias of India, Korea and China. Local herbal healers use this plant to prevent and cure fever, intestinal worm and infections. Herbal medicines have been main source of traditional medicines. The active principle compounds of plant activate metabolism through liver due to which many necrotic debris remove rapidly and cure mostly physiological disorder in human body. The plant possesses febrifuge, tonic alternative, stomachic, anthelmintic and cholagogue properties and also used in different types of liver complaints, colic constipation, cholera, dysentery, diarrhoea, diabetes, dyspepsia, general debility, hook worm infection, hyper acidity, influenza, bronchitis, malaria, swellings, itches, piles,

**Comment [U3]:** Abstract could end with.... The implication of the findings on a better performing derivative of manure was highlighted and discussed.

gonorrhoea, scabies, stomach disorder and stomach ache. It is also used as a cure for torpid liver and jaundice. In many parts of India, it is used as curative or preventive in snake venom poisoning. (Che, C.T., et al. 2017)

It is chiefly used in viral hepatitis, diminished appetite and drug induced liver damage. These properties of *A. paniculata* are prescribed by Ayurvedic physician for clinical treatment. A decoction of the plant is used as a blood purifier and a cure for torpid. Leaves contain two bitter substances, lactones named andrographolide and 'Kalmeghin'. Plant is very rich in chlorophyll; its ash contains sodium chloride and potassium salts. The plant has diterpenoids, andrographolide, 14-deoxy-11-oxo-andrographolide, 14-deoxy-11,12-didehydroandrographolide, 14-deoxyandrographalids and neoandrographolide. The roots give flavones, apigenin-7, 4'-dio-O-methyl ether, 5-hydroxy-7, 8, 2', 3'-tetra methoxy flavone, andrographin and panicolin and sitosterol. Leaves of Kalmegh contain homoandrographolide, andrographosterol and andrographone. Active compounds of Kalmegh sold in market by different trade names: Acene-n-pimple cream (Himalaya wellness), Liv 52 (Himalaya Drugs Company), Lerboh (Lupin Herbal Laboratory), Sage Liverex (Sage Herbals), Purodil syrup (Aimil Pharmaceuticals). Researches conducted in the past have confirmed that *A. paniculata* if properly administered, has a surprisingly broad range of pharmacological effects. The major source of supply of Kalmegh is Tropical forests and the estimated annual trade is 2000- 5000 MT.

Influence of organic nutrients on biological yield and bioactive principle of Kalmegh is well pronounced. Organic manures and bio-fertilizers improve soil quality and soil biodiversity. Keeping the importance of both organic cultivation and beneficial effects of organic manure, the present investigation, study on effect of different organic manures along with microbial consortia on growth and yield of Kalmegh (*Andrographis paniculata* Nees) was carried out.

## MATERIAL AND METHODS

### Comment [U4]:

**Comment [U5]:** the highlighted section should be totally expunged and credence be given to a rigorous literature review or search of the bioactive component of kalmegh while narrowing down on its efficacy in crop protection.

you cannot be talking of the medicinal value of a plant and ending up talking about its usefulness in fertilizer production. It is mismatch and a misnomer.

see

Bhaisare, S. et al (2023) Physiological Activities of kalmegh (*A. paniculata* Nees) of the king of bitters *Cureus* doi:10.7759/cureus.43515

Nyeem, MAB et al (2017) Indigenous King of Bitter (*A. paniculata*) J. of med Plt Studies 5(2), 318-324

Misrah, SK (2007)... Plant review *A. paniculata*, *Pharmacognosy Reviews*, 1, 2, 283-298

Niranjan, A (2010)... Biological Activities of kalmegh (*A. paniculata* Nees)

further search should be on:

organic manure: brief description

microbial consortia: brief description with examples.

### Comment [U6]: include

**Comment [U7]:** my thinking is that much emphasis should have been laid more on the bioactive component of kalmegh instead of the medicinal aspect in view of the direction of the study. Further, nothing much was said about organic nutrients ie organic manure, bio-fertilizers, etc.

even the standard of measure for biological yield and bioactive principle is absent.

also information of microbial consortia is sparing here.

it is only after talking about all these that a safe conclusion can be reached in this section on the need to study what the study is out for.

**Comment [U8]:** Under material and methods should have subheadings like

i. Place of Study

ii. Collection of Sample

iii. Preparation of Sample

iv. Materials (like specialized equipment used)

v. Reagents

vi. Preparation of Reagents

These should be described as brief as possible.

The research work entitled “Study on effect of different organic manures on growth, yield and quality of Kalmegh (*Andrographis paniculata* Nees.)” was conducted in *kharif* season during the year 2021-2022 at the Sanjeevini vatika, Medicinal plants block, Department of Horticulture, College of Agriculture, University of Agricultural Sciences, Gandhi Krishi Vigyana Kendra, Bengaluru. The experimental site is situated at 12° 58” North latitude and 77° 55” East longitude with an elevation of about 930 meters above mean sea level. The mean of maximum and minimum temperature recorded during the period of experiment was 27.7° C and 18.5° C, respectively. The average of total rainfall received from June to September was 156 mm. The mean maximum and minimum Relative Humidity (RH) of the location was 89.5 per cent and 58.7 per cent, respectively.

**Comment [U9]:** consider deleting or revising as ..The study was.....

Kalmegh seeds of variety CIM- Megha was collected from CSIR-Central Institute of Medicinal and Aromatic Plants, Bengaluru. The seedlings were raised in the nursery and 30 days old seedlings were transplanted in the experimental plots. Organic manures like Farm Yard Manure (FYM), Poultry manure, Sheep manure, Vermicompost and Neem cake were procured from Zonal Agricultural Research station (ZARS), University of Agricultural Sciences, Gandhi Krishi Vigyana Kendra, Bengaluru. Microbial consortia was purchased from bio-fertilizers production laboratory, Department of Microbiology, University of Agricultural Sciences, Gandhi Krishi Vigyana Kendra, Bengaluru.

The experiment was laid-out in Randomized Complete Block Design (RCBD) replicated thrice with thirteen treatments in open field condition. The treatments consisted of combination of different organic manures with and without microbial consortia.

**Treatment details:**

|                |  |
|----------------|--|
| T <sub>1</sub> | Control (No manure)                                      |
| T <sub>2</sub> | 100% RDF through FYM                                     |
| T <sub>3</sub> | 100% RDF through Sheep manure                            |
| T <sub>4</sub> | 100 % RDF through Poultry manure                         |
| T <sub>5</sub> | 100% RDF through Vermicompost                            |
| T <sub>6</sub> | 50% RDF through FYM + 50% RDF through Neem cake          |
| T <sub>7</sub> | 50% RDF through Sheep manure + 50% RDF through Neem cake |

|                 |   |
|-----------------|---|
| T <sub>8</sub>  | 50% RDF through Poultry manure + 50% RDF through neem cake                        |
| T <sub>9</sub>  | 50% RDF through Vermicompost + 50% RDF through Neem cake                          |
| T <sub>10</sub> | 50% RDF through FYM + 50% RDF through Neem cake 50% + Microbial consortium        |
| T <sub>11</sub> | 50% RDF through Sheep manure + 50% RDF through Neem cake + Microbial consortium   |
| T <sub>12</sub> | 50% RDF through Poultry manure + 50% RDF through Neem cake + Microbial consortium |
| T <sub>13</sub> | 50% RDF through Vermicompost + 50% RDF through Neem cake + Microbial consortium   |

Organic manures were calculated on N equivalent basis (RDF: 75: 75: 50 N, P and K kg/ha) and the spacing followed was 30 cm X 15 cm with the individual plot size of 2.7m X 2.1m.

## RESULTS AND DISCUSSION

### Growth parameters:

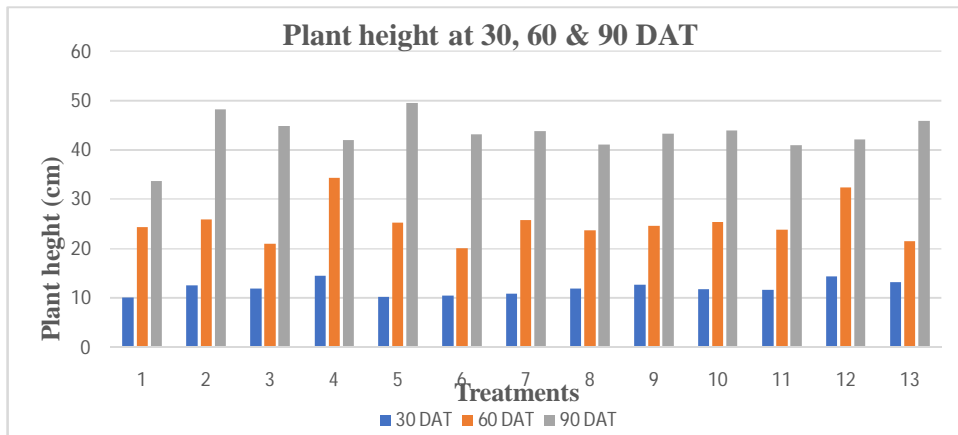
#### Plant height (cm)

The data pertaining to effect of different organic manures with and without microbial consortia on plant height of Kalmegh is presented in Table 1 and depicted in Figure.1

The result with respect to plant height at 90 Days After Transplanting (DAT) was found to be significant. Highest plant height (49.4cm) was recorded in the treatment T<sub>5</sub> (100% RDF through vermicompost) and least plant height was observed in the treatment T<sub>1</sub> (Control).

The significant increase in plant height with the application of poultry manure might be due to the fact that it is higher in nitrogen content which has instant nutrient releasing property and rich in organic matter content, might have resulted in recording the higher values of plant height. Similarly, vermicompost was found to be best due to presence of plant growth hormones in it and is rich in humus than other organic manure but slower in decomposition rate when compared poultry manure. Similar results were reported by Kumar and Topal (2015) and Detpiratmongkol *et al.* (2014) in Kalmegh and Thanuja *et al.* (2020) in Ajwain; Ronya *et al.* (2020) in Turmeric; Smitha *et al.* (2019) in sacred basil.

**Comment [U10]:** result from the study is ok but the discussion is shabbily done., Literature cited are few with no evidence of currency. in my view the entire discussion is to be reworked to bring the best out of the result obtained and by extension the study.



**Fig.1: Effect of different organic manures along with microbial consortia on plant height in Kalmegh**

#### Number of branches per plant

The data pertaining to effect of different organic manures on number of branches in Kalmegh is presented in Table 1.

The data recorded on number of branches per plant was found to be significant. The treatment provided with 100% RDF through poultry manure has recorded significantly highest number of branches (11.60) at 60 DAT, which was found to be on par with treatment T<sub>7</sub> (11.13) while the least (5.20) was recorded in the treatment T<sub>1</sub> (Control).

The data with respect to number of branches at 90 DAT was found to be significant. Highest number of branches (14) was recorded in the treatment T<sub>7</sub> (50% RDF through Sheep manure + 50% RDF through neem cake) which was followed by the treatment T<sub>4</sub> (13.67) and least number (10.0) of branches were observed in the treatment T<sub>1</sub> (Control).

#### Plant Spread (cm<sup>2</sup>)

The perusal of data presented in Table 1 indicate that different organic manures along with and without microbial consortia had significant influence on plant spread.

The result with respect to plant spread at 90 DAT was found to be significant. Highest plant spread (2209.6 cm<sup>2</sup>) was recorded in the treatment T<sub>10</sub> (50% RDF through FYM+ 50% RDF through Neem cake + Microbial consortium) which was on par with

treatment T<sub>4</sub> (1475.8 cm<sup>2</sup>) and least plant spread (775.2 cm<sup>2</sup>) was observed in the treatment T<sub>1</sub> (Control).

The significant difference in plant spread was noticed with the application FYM along with neem cake because FYM with combination of neem cake releases nutrients at a slower rate. So, at later stage plants treated with the combination of FYM, neem cake and microbial consortia might have shown better growth. The above findings are in corroborate with the findings of Tiwari *et al.* (2012) in Kalmegh. Similarly, Smitha *et al.* (2019) recorded maximum plant spread in sacred basil where organic manures and biofertilizers used in combination as compared to application of biofertilizer or organic manure alone. Singh *et al.* (2012) worked on *Coleus forskohlii* plants treated with Arbuscular Mychorriza, Neem cake and *Pseudomonas floescence* showed significantly increased plant spread.

**Comment [U11]:** wrong sentences that needed to be reworked.

## **Yield parameters**

### **Fresh weight of plant (g)**

The fresh weight of plant influenced by different organic manures along with microbial consortia in Kalmegh is shown in the Table 2 and Figure 2.

Different organic manures along with microbial consortia influenced significantly on fresh weight of plant after 90 DAT (at harvest). The highest fresh weight of 56.60g was recorded in plant provided with 50% RDF through Sheep manure + 50% RDF through Neem cake followed by 54.20 g in plants provided with 50% RDF through Poultry manure + 50% RDF through Neem cake + Microbial consortia and 53.86 g in treatment with 50% RDF through FYM + 50% RDF through Neem cake + Microbial consortia. Kalmegh plant grown without any organic manure or combination of organic manure recorded lowest fresh weight (30.01 g). The data is in conformity with the results of Saeidnejad and Rezvani (2010) in Cumin where highest yield was noticed in plants treated with sheep manure, compost, vermicompost and cow dung manure

### **Dry weight of plant (g)**

Effect of different organic manures along with microbial consortia on dry weight of Kalmegh is presented in Table 2 and depicted in Figure 2.

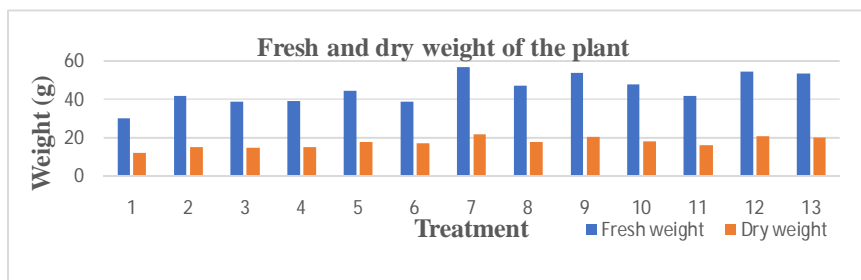
Different organic manures along with microbial consortia influenced significantly on dry weight of plant. The highest dry weight of 21.49 g was recorded in plant supplied with 50% RDF through Sheep manure + 50% RDF through Neem cake followed by 20.58 g in plants provided with 50% RDF through Poultry manure + 50% RDF through Neem cake + Microbial consortia) and 20.06 g in the treatment with 50% RDF through FYM + 50% RDF through Neem cake + Microbial consortia. Control treatment plants recorded least dry weight of 11.9 g. The results are in line with the experiments conducted by [Saeidnejad](#) and Rezvani (2010) in Cumin.

### Herbage yield per plot (kg) and per hectare (q)

Different organic manures along with microbial consortia influenced significantly fresh herbage yield at harvest and is presented in Table 3.

The results indicated that herbage yield per plot and per hectare was found to be significant. The highest fresh herbage yield of 6.60 kg/ plot and 116 q/ ha was recorded in treatment supplied with 50% RDF through Sheep manure + 50% RDF through Neemcake which was found to be on par with treatment supplied with 50% RDF through Poultry manure + 50% RDF through Neem cake + Microbial consortia (6.46 kg/ plot and 113 q/ ha). The least values for fresh herbage was observed in control (3.36 Kg/ plot and 59.3 q/ ha).

This significant difference due to the application of sheep manure along with neem cake and poultry manure in combination with neem cake and microbial consortia might due to the fact that the sheep manure enhances plant growth hormones, soil fertility and facilitate in availability of plant nutrients throughout the crop growth period whereas in poultry manure + neem cake + microbial consortia combination, poultry manure amends soil, neem cake facilitates plant nutrient uptake and stimulative activity of microflora in the rhizosphere leading to availability of nutrients and vigorous growth and it might have resulted in recording the higher herbage yield. Similarly, Kamal and Yousuf (2012) opined that among the various organic manures, Neem cake followed by poultry manure was superior to cowdung with regards to yield parameter in Turmaric. Wahab *et al.* (2016) indicated that the combination treatment of manure, compost with biofertilizer recorded increase in yieldin



Fennel crop.

**Comment [U12]:** where is the conclusion that will bring out the findings of the work for this study?

**Fig. 2: Effect of different organic manures along with microbial consortia on fresh and dry weight of the plant in kalmegh**

**Table 1: Influence of different organic manures along with microbial consortia on yield**

| Treatment          | Plant Height (cm) | Plant spread (cm <sup>2</sup> ) | Number of branches/plant |
|--------------------|-------------------|---------------------------------|--------------------------|
| T <sub>1</sub>     | 33.7              | 775.2                           | 10                       |
| T <sub>2</sub>     | 48.2              | 1160.2                          | 12.4                     |
| T <sub>3</sub>     | 44.8              | 1086.2                          | 12.4                     |
| T <sub>4</sub>     | 41.9              | 1475.8                          | 13.67                    |
| T <sub>5</sub>     | 49.4              | 1955.4                          | 13.6                     |
| T <sub>6</sub>     | 43.2              | 840.2                           | 11.6                     |
| T <sub>7</sub>     | 43.8              | 1108.8                          | 14                       |
| T <sub>8</sub>     | 41.1              | 1046.6                          | 10.8                     |
| T <sub>9</sub>     | 43.3              | 1372.4                          | 13.6                     |
| T <sub>10</sub>    | 43.9              | 2209.6                          | 10.8                     |
| T <sub>11</sub>    | 41.0              | 1137.2                          | 11.33                    |
| T <sub>12</sub>    | 42.0              | 847.0                           | 13.5                     |
| T <sub>13</sub>    | 45.8              | 804.2                           | 13.1                     |
| <b>'F' test</b>    | *                 | *                               | *                        |
| <b>S Em±</b>       | <b>0.27</b>       | <b>31.7</b>                     | <b>0.09</b>              |
| <b>CD (P=0.05)</b> | <b>0.80</b>       | <b>92.8</b>                     | <b>0.28</b>              |

parameters of Kalmegh  
Table 2: Influence of difference

**nt organic manures along with microbial consortia on yield parameters of Kalmegh**

| Treatment          | Fresh weight of plant (g) | Dry weight of plant (g) | Herbage yield / plot (kg) | Herbage yield / hactare (q) |
|--------------------|---------------------------|-------------------------|---------------------------|-----------------------------|
| T <sub>1</sub>     | 30.01                     | 11.9                    | 3.36                      | 59.3                        |
| T <sub>2</sub>     | 41.7                      | 14.72                   | 4.24                      | 75.0                        |
| T <sub>3</sub>     | 38.52                     | 14.52                   | 4.34                      | 76.0                        |
| T <sub>4</sub>     | 38.9                      | 14.64                   | 4.39                      | 77.0                        |
| T <sub>5</sub>     | 44.11                     | 17.5                    | 5.05                      | 89.0                        |
| T <sub>6</sub>     | 38.62                     | 16.9                    | 4.8                       | 85.0                        |
| T <sub>7</sub>     | 56.60                     | 21.49                   | 6.6                       | 116.0                       |
| T <sub>8</sub>     | 46.85                     | 17.5                    | 5.3                       | 95.0                        |
| T <sub>9</sub>     | 53.86                     | 20.06                   | 6.28                      | 110.0                       |
| T <sub>10</sub>    | 47.47                     | 17.75                   | 5.47                      | 96.0                        |
| T <sub>11</sub>    | 41.50                     | 15.95                   | 4.85                      | 85.0                        |
| T <sub>12</sub>    | 54.20                     | 20.58                   | 6.46                      | 113.0                       |
| T <sub>13</sub>    | 53.4                      | 19.91                   | 6.22                      | 109.8                       |
| <b>'F' test</b>    | *                         | *                       | *                         | *                           |
| <b>S Em±</b>       | <b>0.56</b>               | <b>0.20</b>             | <b>0.07</b>               | <b>1.25</b>                 |
| <b>CD (P=0.05)</b> | <b>1.65</b>               | <b>0.59</b>             | <b>0.20</b>               | <b>3.6</b>                  |

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**Comment [U13]:** the reference style is not queried depending on what the editors prefer in the instruction to authors. However, the literature cited are too scanty that require major rejigging. see paper for suggestion and details.

SAMANHUDI, A.Y., PUJIASMANTO, B. AND RAHAYU, M., 2014, Effect of organic manure and arbuscular mycorrhizal fungi on growth and yield of young ginger (*Zingiber officinale* Rosc.). *IOSR J. Agric. Vet. Sci.*, **7**(5): 1-5.

UNDER PEER REVIEW