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# Effect of Organic, Inorganic and Biofertilizer on Growth and Yield Attributes in Groundnut (*Arachis hypogaea* L.)

Ganesh Narayan Meena*[1], Yashmin Akhtar[2], Jyoti Kumari Meena[3], Kusum Kurdiya[4] and Manju Sharma[5]

[1] Department of Botany, Deen Dayal Upadhyaya College, University of Delhi, Sector-3, Dwarka, New Delhi - 110 078, India
[2] Department of Botany, Kanoria P. G. Mahila Mahavidhyalaya, Jawahar Lal Nehru Marg, Jaipur - 302 004, Rajasthan, India
[3] Department of Biotechnology, University of Kota, MBS Marg, Kota - 324 005, Rajasthan, India
[4-5] Department of Botany, University of Rajasthan, Jawahar Lal Nehru Marg, Jaipur - 302 004, Rajasthan, India

## Abstract

Present experiment was conducted at University of Rajasthan, Jaipur to study the effects of organic and inorganic fertilizer on morphological parameters viz. germination percentage, total number of branches, total number of number of flowers, number of pegs, number of pods, number of seeds, average seed weight, 100 seed weight, number of leaves, plant height, length of petiole, inter-modal length, petiole length, leaflet length, leaflet width and leaf area etc., of groundnut (*Arachis hypogaea* L). There were five treatments named as $T_1$- Control, $T_2$- DAP, $T_3$- Cowdung, $T_4$- Vermicompost and $T_5$- biofertilizer. Results revealed that germination percentage, seedling fresh weight, seedling dry weight, number of flowers, number of pegs, number of pods, number of seeds, number of leaves, plant height, leaflet length, leaflet width and leaf area were recorded maximum with vermicompost treated plant ($T_4$) followed by biofertilizer treated plant ($T_5$) and least was observed with control ($T_1$). Number of branches, inter-nodal length, petiole length and seedling shoot length was recorded higher with vermicompost treated plant ($T_4$) followed by DAP treated plant ($T_2$) least was recorded with control ($T_1$). Root length, seedling root length, average seed weight and 100 seed weight were reported higher with biofertilizer treated plant ($T_5$) followed by vermicompost treated plant ($T_4$) least was observed with control (T ). Individual application of vermicompost and biofertilizer significantly influenced the growth, morphological and yield attributes.

***Key words*:** DAP, Cowdung, Vermicompost, *Rhizobium*, Seedling, Morphological parameters, Yield attributes

*Arachis hypogaea* L., frequently referred to as groundnut, is one of the world's oilseed crops. Groundnut is a legume plant and belongs to family Fabaceae. Peanut, kingpin of oilseeds, unpredictable legume, earthnut, moong fali, monkey nut, manilla nut, pinda, goober and energy capsule are alternative names for groundnut. Total groundnut production of world is 45 million tonnes. Largest groundnut producing country is China 17.39 million tonnes with 4.64 million hectares area followed by India with 6.695 million tonnes production with 4.94 million hectares area [1]. Three largest groundnut producing states of India are Gujarat 2.20 million tonnes, Rajasthan 1.38 million tonnes and Tamil Nadu .88 million tonnes [2]. Cultivation of groundnut in India is done in one or more season kharif, rabi and summer. Groundnuts constitute a part of the food of nearly all people. Groundnut seed contains oil, protein and good source of minerals like iron, calcium, phosphorus, zinc and boron [3]. Its seed also contains vitamin E, K and low amount of Vitamin B complex. According to Yadav *et al*. [4], peanut skin has a larger number of phenolic compounds, which have DPPH radical scavenging properties comparable to BHT. According to research by Mahatma *et al*. [5], Virginia groundnut is better reported in terms of its high O/L ratio, sucrose, antioxidants, phenolics, and protein content; as a result, it can be used in groundnut improvement programmes. South America was where groundnut agriculture first began, and it later moved to Brazil, Bolivia, and northwestern Argentina. Introduction of groundnut in India was done by the Portuguese from Brazil to West Africa and then to south western India in 16$^{th}$ century.

Fertilizers are used to improve yield and other growth parameters of plant crop. Total demand of fertilizers (Nitrogen n, phosphate $P_2O_5$, potash $K_2O$) in India is increased 16.7 million tonnes in 2000 to 27.37 million tonnes in 2018 [6]. More availability of nutrients mostly cations in soil and in

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**Correspondence to:** Ganesh Narayan Meena, Department of Botany, Deen Dayal Upadhyaya College, University of Delhi, Sector-3, Dwarka, New Delhi - 110 078, India, Tel: +91 8385898028; E-mail: matadin90@gmail.com

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pepper plant is secured by CD (cowdung) manure compared with NPK (chemical) fertilizer [7]. Earthworm's vermicompost is highly nutritive; powerful growth promoter; enhancer of physical, chemical and biological properties of soil; improver of natural fertility of soil over chemical fertilizer which decrease soil properties and its natural fertility [8]. *Azotobacter* is facilitated formation of phytohormones like Indole-3-Acetic Acid, prevention of varying stresses, nitrogen fixation, pesticides and oil globules break down, heavy metal metabolization [9]. The Northeastern Indian state of Sikkim was first fully organic state of the world and awarded 'Oscar for best policy' by UN for their 'state policy on organic farming 2004' and 'Sikkim organic mission 2010'.

## MATERIALS AND METHODS

*Experimental plant*: *Arachis hypogaea* L. (R.No: RUBL211553).

Present experiment was conducted during kharif season of 2017 at University of Rajasthan, Jaipur (Rajasthan) located at 26.8892006º North latitude, 75.8170806º east latitude and elevation from sea level 449 m. Study area is included in semi-arid eastern plains agro-climatic zone of Rajasthan. The soil's chemical characteristics included Zn of 1.02 ppm, Fe of 4.48 ppm, Copper of.24 ppm, Mn of 2.28 ppm, water holding capacity of 46.5%, pH of 8.5, conductivity of .15 ds/m, organic carbon percentage of.22%, phosphate of 23 kg/ha and potash of 242 kg/ha.

In order to investigate the effect of organic and inorganic fertilizers on plant growth and morphology, five treatments $T_1$, $T_2$, $T_3$, $T_4$ and $T_5$ with four replicates were taken to pot plants. $T_1$ was the control (no fertilizer), $T_2$ was the NPK (15:60:30 kg $ha^{-1}$; .59 gm DAP in 10 kg soil), $T_3$ was cow dung (10 t $ha^{-1}$; 45.50 gm in 10 kg soil), $T_4$ was vermicompost (10 t $ha_{-1}$; 45.50 gm in 10 kg soil), and $T_5$ was the biofertilizer (5 ml in 10 kg soil). Vermicompost and cowdung were applied before sowing. DAP (Diammonium phosphate) was applied in two splits first: before sowing and second after 20 days of sowing. Rhizobium biofertilzer was added to pot before sowing and also applied by seed inoculation method. Two times a week, tap water was used to irrigate pots. After 12 DAS (Days after sowing), measurements of seedling root length, seedling shoot length, seedling fresh weight, seedling dry weight and germination % data were taken. Number of flower and number of pegs were recorded after sowing 35 DAS and 45 DAS respectively. Data for number of branches, number of pods, number of seeds, seed weight, number of leaves, plant height, root length, inter-nodal length, petiole length, leaflet length, leaflet width, and leaf area were taken after harvesting of plant.

The statistical analysis was done by using OPSTAT, analyst at software and MS excel. To determine whether there was a significant difference between the various treatments at the p 0.05 significance level, one way ANOVA and the Post Hoc Tukey test were used. The significance of the difference between the means of the two groups was determined using the T test. Critical difference (CD) and standard error mean (SEm) were also calculated similar level of significance (0.05 probability level).

## RESULTS AND DISCUSSION

Germination percentage was recorded 66.67%, 72.22%, 72.22%, 94.44% and 88.89% in $T_1$, $T_2$, $T_3$, $T_4$ and $T_5$ treatments respectively. Maximum germination percentage reported in groundnut plant treated with vermicompost ($T_4$) followed by biofertilizer treated plant ($T_5$) and least observed in without any fertilizer treated control plant (66.67%) (Fig 5). Higher germination percentage was reported with vermicompost treated plant followed by biofertilizer treated plant over control [10-11]. Similar results also reported by Chinthapalli *et al*. [12] in faba bean (*Vicia faba* L.) and pea (*Pisum sativum* L.). They reported higher germination percentage with cowdung (organic fertilizer) followed by urea and potassium chloride (Inorganic fertilizer) over the control in faba bean and pea.


Fig 1(A) Comparative study of seedling growth in *Arachis hypogaea* L.

A: Seedling morphology of $T_1$ control, $T_2$ DAP treated plant, $T_3$ cowdung treated plant, $T_4$ vermicompost treated plant and $T_5$ biofertilizer treated plant

Table 1 Effect of DAP (Di-ammonium Phosphate), cowdung, vermicompost and biofertilizer (Rhizobium) on plant height, root length, inter-nodal length, petiole length, leaflet length, leaflet width and leaf area

| Treatment | Plant height (cm) | Root length (cm) | Inter-nodal length (cm) | Petiole length (cm) | Leaflet length (cm) | Leaflet width (cm) | Leaf area ($cm^2$) |
|---|---|---|---|---|---|---|---|
| $T_1$ | 43.75±3.19 | 25.83±.76 | 4.83±0.35 | 5.9±.5 | 3.97±.63 | 2.1±.30 | 25.87±4.01 |
| $T_2$ | 63.33±2.08*** | 32.5±0.5** | 8±0.9*** | 7±.7 $^{NS}$ | 4.70±.81 $^{NS}$ | 2.11±.21$^{NS}$ | 31.01±9.05 $^{NS}$ |
| $T_3$ | 54.17±4.19* | 32.33±0.29** | 5.23±0.64 $^{NS}$ | 5.93±.70 $^{NS}$ | 4.27±.41 $^{NS}$ | 2.06±.19$^{NS}$ | 26.74±8.35 $^{NS}$ |
| $T_4$ | 67±4.32*** | 36.33±2.26*** | 8.63±.12*** | 7.13±1.01 $^{NS}$ | 4.85±.46 $^{NS}$ | 2.5±.27$^{NS}$ | 35.83±7.44 $^{NS}$ |
| $T_5$ | 66.83±1.26*** | 40±1.53*** | 5.57±0.40 $^{NS}$ | 6.80±1.14 $^{NS}$ | 4.77±.87 $^{NS}$ | 2.16±.23$^{NS}$ | 33.28±6.91 $^{NS}$ |
| SEm± | 2.028 | .931 | .319 | 0.486 | 0.271 | 0.101 | 4.249 |
| CD (0.05) | 6.473 | 2.971 | 1.017 | NS | NS | 0.296 | NS |

***=p 0.001, **=p 0.01, *=p 0.05, NS= Non-significant

Seedling shoot length was observed 12.47±0.50 cm, 17.13±0.32 cm, 14.47±0.45 cm, 18.5±0.5 cm and 16.93±0.12 cm in $T_1$, $T_2$, $T_3$, $T_4$ and $T_5$ respectively (Table 3). Seedling shoot length was found maximum in vermicompost treated plant ($T_4$) followed by DAP ($T_2$) treated plant and least was observed in without any fertilizer treated plant (Fig 8). Seedling root length was measured 8.13±0.32 cm, 14±0.5 cm, 12.03±0.40 cm, 15.03±0.25 cm and 16±0.2 cm in $T_1$, $T_2$, $T_3$, $T_4$ and $T_5$ respectively (Table 3). Seedling root length was found maximum with biofertilizer treatment ($T_5$) followed by vermicompost treatment ($T_4$) and minimum was found in without any fertilizer treated control ($T_1$) (Fig 8). Seedling fresh weight was measured 2.48±0.13 gm, 3.43±0.40 gm, 3.07±0.15 gm, 4.2±0.26 gm and 4.02±0.20 gm in $T_1$, $T_2$, $T_3$, $T_4$ and $T_5$ respectively. Seedling dry weight was measured 0.40±0.03 gm, 0.58±0.02 gm, 0.47±0.05 gm, 0.62±0.03 gm and 0.59±.04 gm in $T_1$, $T_2$, $T_3$, $T_4$ and $T_5$ respectively (Table 3). Seedling fresh weight and seedling dry weight was significantly influenced with vermicompost treatment ($T_4$) followed by biofertilizer treatment ($T_5$) over without fertilizer treated control ($T_1$) (Fig 9). Increase in seedling shoot length, seedling root length, seedling fresh weight and seedling dry weight was reported in *Zea mays* by treating with different level of NPK fertilizers over without fertilizer treated control [13]. Joshi *et al*. [14] were reported higher seedling shoot length, seedling root length, seedling fresh weight and seedling dry weight with various biofertilizer treatment over without any fertilizer's treatment control in peanut and soybean crop.

Fig 2(A-E) Comparative study of morphological characters of mature plants of *Arachis hypogaea* L.
A: Plants grown in pot wiothout any fertilizer, B: Plants grown in pot with DAP fertilizer, C: Plants grown in pot with cowdung fertilizer, D: Plants grown in pot with Vermicompost fertilizer and E: Plants grown in pot with Biofertilizer

Table 2 Effect of DAP (Di-ammonium Phosphate), cowdung, vermicompost and biofertilizer (Rhizobium) on number of branches, number of flowers, number of pegs, number of pods, number of seeds, seed weight and number of leaves

| Treatment | Number of branches | Number of flowers | Number of pegs | Number of pods | Number of seeds | Seed weight | Number of leaves |
|---|---|---|---|---|---|---|---|
| $T_1$ | 2±0 | 5.69±.94 | 6.43±.96 | 19±3.05 | 32.81±4.61 | 0.42±0.03 | 21.67±3.51 |
| $T_2$ | 4±1 $^{NS}$ | 6.69±.87* | 7.25±.86 $^{NS}$ | 22±2.42* | 38.63±4.30** | 0.48±0.08 *** | 25±6.08$^{NS}$ |
| $T_3$ | 3±0 $^{NS}$ | 6.38±.89 $^{NS}$ | 7±.82 $^{NS}$ | 21±2.42 $^{NS}$ | 36.94±4.22 $^{NS}$ | 0.51±0.06 *** | 23±4.36$^{NS}$ |
| $T_4$ | 4.67±1.53* | 7.44±1.09*** | 8.44±.96*** | 25±3.06*** | 44±5.30*** | 0.55±0.08 *** | 37±9.17$^{NS}$ |
| $T_5$ | 3.67±.58 $^{NS}$ | 7.06±.85*** | 7.5±.97* | 23±2.76*** | 40.38±4.87*** | 0.61±0.08 *** | 27.67±4.93$^{NS}$ |
| SEm± | 0.494 | 0.234 | 0.229 | 0.689 | 1.169 | .007 | 3.432 |
| CD (0.05) | 1.578 | 0.660 | 0.646 | 1.946 | 3.301 | .019 | NS |

***=p 0.001, **=p 0.01, *=p 0.05, NS=Non-significant

Fig 3(A-D) Morphology of *Arachis hypogaea* L. Showing complete life cycle of the plant
A: Seed showing epigeal type of germination, B-C: Vegetative phase and D: Reproductive phase containing flower

Table 3 Effect of DAP (Di-ammonium Phosphate), cowdung, vermicompost and biofertilizer (Rhizobium) on seedling shoot length, seedling root length, seedling fresh weight and seedling dry weight

| Treatment | Seedling shoot length | Seedling root length | Seedling fresh weight | Seedling dry weight |
|---|---|---|---|---|
| $T_1$ | 12.47±0.50 | 8.13±0.32 | 2.48±0.13 | 0.40±0.03 |
| $T_2$ | 17.13±0.32* | 14±0.5* | 3.43±0.40* | 0.58±0.02* |
| $T_3$ | 14.47±0.45* | 12.03±0.40* | 3.07±0.15 | 0.47±0.05 |
| $T_4$ | 18.5±0.5* | 15.03±0.25* | 4.2±0.26* | 0.62±0.03* |
| $T_5$ | 16.93±0.12* | 16±0.2* | 4.02±0.20* | 0.59±.04* |
| SEm± | 0.234 | 0.203 | 0.145 | 0.016 |
| CD (0.05) | 0.748 | 0.649 | 0.462 | 0.050 |

***=p 0.001, **=p 0.01, *=p 0.05, NS=Non-significant

Number of branches was observed 2±0, 4±1, 3±0, 4.67±1.53 and 3.67±.58 in $T_1$, $T_2$, $T_3$, $T_4$ and $T_5$ treatments respectively (Table 2). Petiole length was recorded 5.9±.5 cm, 7±.7 cm, 5.93±.70 cm, 7.13±1.01 cm and 6.80±1.14 cm in $T_1$, $T_2$, $T_3$, $T_4$ and $T_5$ treatments respectively (Table 1). Inter-nodal length was recorded 4.83±0.35 cm, 8±0.9 cm, 5.23±0.64 cm, 8.63±.12 cm and 5.57±0.40 cm in $T_1$, $T_2$, $T_3$, $T_4$ and $T_5$ treatments respectively (Table 1). Number of branches, petiole length and intermodal length were observed maximum in vermicompost treated plant ($T_4$) followed by DAP treated plant ($T_2$) and least observed in without any fertilizer treated control plant ($T_1$) (Fig 6). Releasing of phytohormone or growth influencing substances by microorganisms present in vermicompost rich soil initiate and influence plant growth. Chanda *et al*. [15] reported higher number of branches, number of fruits and yield in tomato plant with vermicompost compare than chemical fertilizer, FYM manures and control. Rahman *et al*. [16] recorded higher germination percentage, plant height, root length and number of flowers with vermicompost compare than cowdung, NPK and control in chili. Kansotiya *et al*. [17] reported higher number of branches with vermicompost treatment compare than inorganic fertilizer and control in Indian mustard. Rekha *et al*. [18] reported higher number of leaves, number of branches and plant height with 50% vermicompost treatment compare than plant growth enhancers and control.

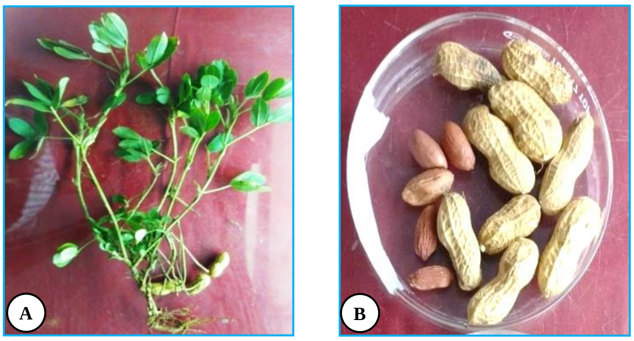


Fig 4(A-C) A: Reproductive phase containing pegs and pods and B: Pods and seeds

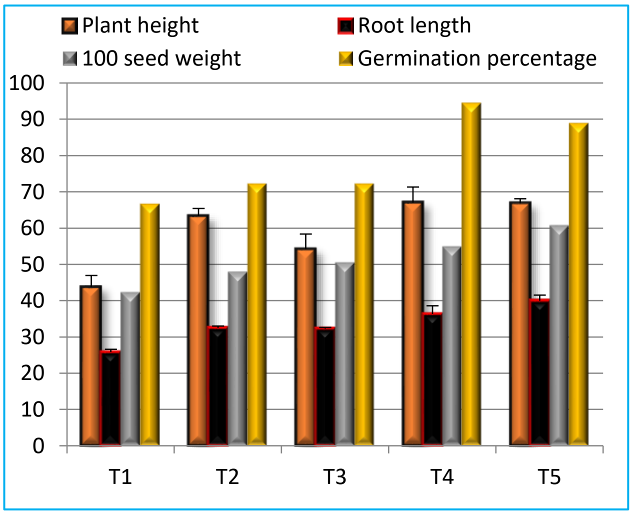


Fig 5 Effect of DAP (Di-ammonium Phosphate), cowdung, vermicompost and biofertilizer (Rhizobium) on plant height, root length, 100 seed weight and germination percentage

Plant height was recorded 43.75±3.19 cm, 63.33±2.08 cm, 54.17±4.19 cm, 67±4.32 cm and 66.83±1.26 cm in $T_1$, $T_2$, $T_3$, $T_4$ and $T_5$ treatments respectively (Table 1). Root length was measured 25.83±.76 cm, 32.5±0.5 cm, 32.33±0.29 cm, 36.33±2.26 cm and 40±1.53 cm in $T_1$, $T_2$, $T_3$, $T_4$ and $T_5$ treatments respectively (Table 1). Plant height observed maximum with vermicompost treatment ($T_4$) followed by biofertilizer treatment ($T_5$) and least observed in without any fertilizer treated control ($T_1$) (Fig 5). Maximum root length was reported higher in biofertilizer treated plant ($T_5$) followed by vermicompost treated plant ($T_4$) least observed in without any fertilizer treated control ($T_1$) (Fig 5).

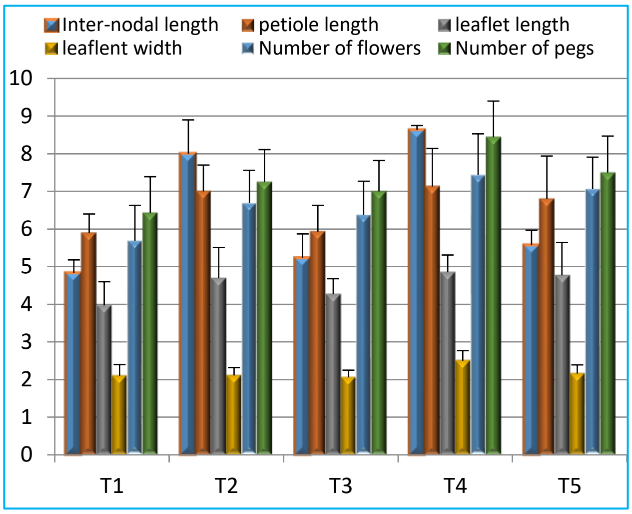


Fig 6 Effect of DAP (Di-ammonium Phosphate), cowdung, vermicompost and biofertilizer (Rhizobium) on inter-nodal length, petiole length, leaflet length, leaflet width, number of flowers and number of pegs

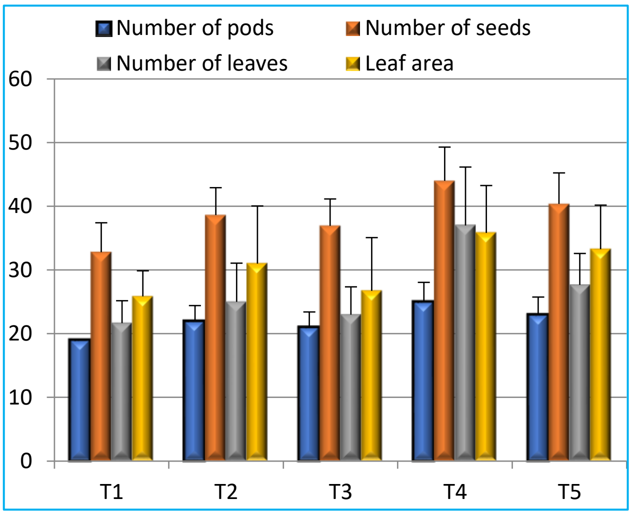


Fig 7 Effect of DAP (Di-ammonium Phosphate), cowdung, vermicompost and biofertilizer (Rhizobium) on number of pods, number of seeds, number of leaves and leaf area

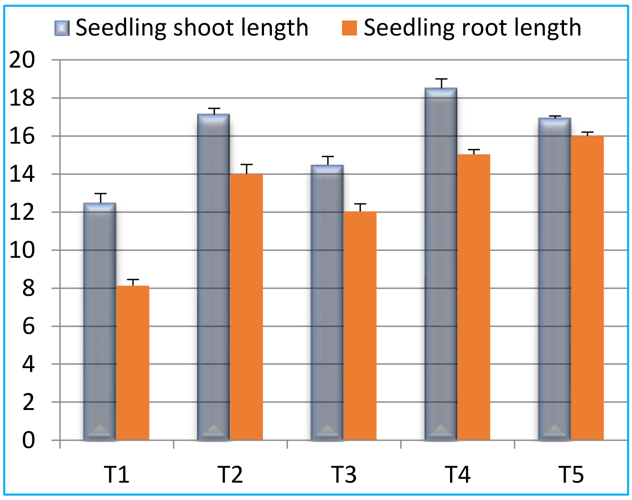


Fig 8 Effect of DAP (Di-ammonium Phosphate), cowdung, vermicompost and biofertilizer (Rhizobium) on seedling shoot length and seedling root length

Lenin *et al*. [19] was reported higher plant height, root length, number of leaves and leaf area in *Arachis hypogaea* L. with vermicompost compare than control. Study of *Zeinab et* *al*. [20] on three corn cultivars reported influence in plant height, number of leaves and leaf area with vermicompost application compare than chemical fertilizer. Increase in growth and yield parameters viz. germination percentage, plant height, root length, number of fruits, number of seeds, 100 seed weight in chili with biocompost and cowdung compost compare than control was reported by Rahman *et al*. [21]. Similar results also reported by Mahakavi *et al*. [22].

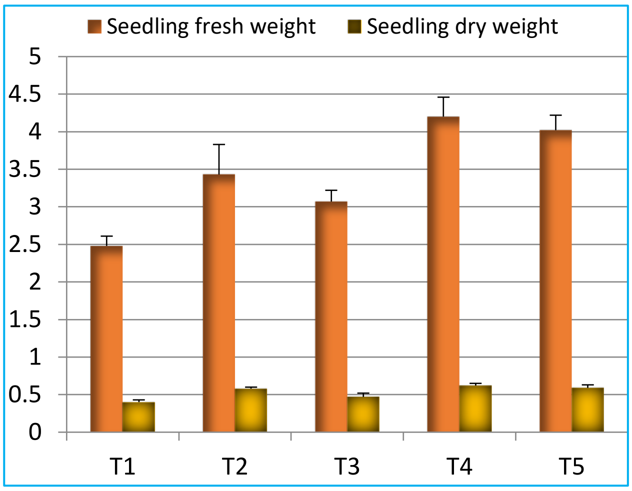


Fig 9 Effect of DAP (Di-ammonium Phosphate), cowdung, vermicompost and biofertilizer (Rhizobium) seedling fresh weight and seedling dry weight

Number of flowers per plant was recorded 5.69±.94, 6.69±.87, 6.38±.89, 7.44±1.09 and 7.06±.85 in $T_1$, $T_2$, $T_3$, $T_4$ and $T_5$ treatments respectively. Number of pegs per plant was measured 6.43±0.96, 7.25±0.86, 7±0.82, 8.44±0.96 and 7.5±0.97 in $T_1$, $T_2$, $T_3$, $T_4$ and $T_5$ treatments respectively (Table 2). Number of pods per plant was measured 19±3.05, 22±2.42, 21±2.42, 25±3.06 and 23±2.76 in $T_1$, $T_2$, $T_3$, $T_4$ and $T_5$ treatments respectively (Table 2). Number of seeds per plant analyzed 32.81±4.61, 38.63±4.30, 36.94±4.22, 44±5.30 and 40.38±4.87 in $T_1$, $T_2$, $T_3$, $T_4$ and $T_5$ treatments respectively (Table 2). Number of flowers per plant, number of pegs per plant, number of pods per plant and number of seeds per plant recorded maximum with vermicompost treatment ($T_4$) followed by biofertilizer treatment ($T_5$) and least observed in without any fertilizer treated control ($T_1$) (Fig 6-7). Mathivanan *et al*. [23] reported influence in number of pods per plant, number of seeds per plant, 100 seed weight per plant, shoot length and root length with vermicompost compare than control in *Arachis hypogaea* L. Increased in number of flower, number of pegs, number of pods by rhizobium indicated that this biofertilizer fix high amount of nitrogen to utilizes in production of flower, pegs and pods over other fertilizer and control [24]. Similar results also reported by Attarde *et al*. [25] in *Abelmoschus esculentus* (okra crop).

Average seed weight observed 0.42±0.03 gm, 0.48±0.08 gm, 0.51±0.06 gm, 0.55±0.08 gm and 0.61±0.08 *gm* in $T_1$, $T_2$, $T_3$, $T_4$ and $T_5$ treatments respectively. 100 Seed weight recorded 42.34 gm, 47.96 gm, 50.53 gm, 54.95 gm and 60.77 gm in $T_1$, $T_2$, $T_3$, $T_4$ and $T_5$ treatments respectively. Average seed weight and 100 seed weight were significantly influenced by biofertilizer ($T_5$) followed by vermicompost ($T_4$) compare than other fertilizers and control ($T_1$) [26-27].

Number of leaves was recorded maximum 21.67±3.51, 25±6.08, 23±4.36, 37±9.17 and 27.67±4.93 in $T_1$, $T_2$, $T_3$, $T_4$ and $T_5$ treatments respectively (Table 2). Leaflet length was measure 3.97±0.63 cm, 4.70±0.81 cm, 4.27±0.41 cm, 4.85±0.46 cm and 4.77±0.87 cm in $T_1$, $T_2$, $T_3$, $T_4$ and $T_5$ treatments respectively (Table 1). Leaflet width was measured 2.1±0.30 cm, 2.11±0.21 cm, 2.06±0.19 cm, 2.5±0.27 cm and 2.16±0.23 cm in $T_1$, $T_2$, $T_3$, $T_4$ and $T_5$ treatments respectively (Table 1). Leaf area was measured 25.87±4.01 $cm^2$, 31.01±9.05 $cm^2$, 26.74±8.35 $cm^2$, 35.83±7.44 $cm^2$ and 33.28±6.91 $cm^2$ in $T_1$, $T_2$, $T_3$, $T_4$ and $T_5$ treatments respectively (Table 1). Number of leaves, leaflet length, leaflet width and leaf area were measured maximum with vermicompost treated plant ($T_4$) followed by biofertilizer treated plant ($T_5$), but number of leaves, leaflet length and leaf area were not significantly different from other treatments (Fig 6-7). Kashem *et al*. [28] recorded higher number of leaves, plant height and number of fruits with vermicompost treatment compare than inorganic fertilizer and control in tomato (*Solanum lycopersicum* L.) [29-30]. Lenin *et al*. [19] was reported higher number of leaves and leaf area in *Arachis hypogaea* L. with vermicompost compare than control.

## CONCLUSION

Result of our study concluded that growth, morphological and yield parameters viz. germination percentage, seedling shoot length, seedling fresh weight, seedling dry weight, number of branches, number of flowers, number of pegs, number of pods, number of seeds, number of leaves, plant height, intermodal length, petiole length, leaflet length, leaflet width and leaf area increased with vermicompost treatment compare than other treatments. Average seed weight, 100 seed weight, seedling root length and mature plant root length increased with rhizobium biofertilizer. Petiole length, leaflet length, leaf area and number of leaves increased with vermicompost and biofertilizer but not significantly different from other treatments. It was also concluded that chemical fertilizer could replace by vermicompost and biofertilizer for better growth and yield from groundnut plant.


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