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# Assessing the impact of cow-based bio-enhancers and organic manure on quality, nutrient content-uptake and soil nutrient-microbial dynamics in *kharif* groundnut under organic farming

**MH Chavda, PP Chaudhari, SN Makwana and YB Vala**

**Abstract**
A field experiment entitled, "Assessing the impact of cow-based bio-enhancers and organic manure on quality, nutrient content-uptake and soil nutrient-microbial dynamics in *kharif* groundnut under organic farming" was carried out during two consecutive *kharif* seasons of 2021 and 2022 on loamy sand soil of Agronomy Instructional Farm, Chimanbhai Patel College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar. The nine nutrient management treatments under organic farming applied to groundnut during *kharif* season were laid out in randomized block design and twenty-seven treatment combinations comprising nine nutrient management treatments of groundnut through organic manure along with cow-based bioenhancer with three replications. Significantly higher quality parameters, nutrient content of groundnut were found with the application of 100% RDN through vermicompost + *Panchgavya* @ 4% spray at 30 and 60 DAS, while application of 100% RDN through FYM + *Bijamrut* (seed treatment 200 ml/kg seed) + *Jivamrut* @ 500 lit/ha at 30 and 60 DAS recorded significantly higher available nutrient and microbial count in soil after harvest of groundnut and organic carbon is unaffected during course of study.

**Keywords:** Pod, shell, haulm, *Panchgavya*, nutrient content and microbial count

## Introduction
Groundnut (*Arachis hypogaea* L.) is an annual legume which is also known as peanut, earthnut, monkeynut and goobers. Groundnut is known as poor man's almond. It is the 13$^{th}$ most important food crop and 4$^{th}$ most important oilseeds crop of the world. Groundnut seed contains about 50% edible oil. The remaining 50% of the seed has high quality protein (21.4% to 36.4%), carbohydrates (6.0% to 24.9%), vitamin "E," niacin, falacin, calcium, phosphorus, magnesium, zinc, iron, riboflavin, thiamine and potassium (Das, 1997) [4]. The groundnut oil is generally used in the preparation of vanaspati ghee, soap, cosmetics and cold creams besides as cooking medium. Groundnut oil is light yellow in colour and sweet in taste and flavour. This contains about 20% saturated and 80% unsaturated fatty acids. Polyunsaturated fatty acid has 2 types *i.e.*, oleic acid (40% to 50%) and linoleic acid (24% to 35%) (Mathur and Khan, 1997) [14]. These multiple uses of groundnut make, it an excellent cash crop for domestic markets as well as for foreign trade in several developing and developed countries. Moreover, processed goods like sweets and dry powder made from kernels are used. Oil cake and groundnut haulms are utilized as organic manure or as animal fodder. Additionally, groundnut shells are used as boiler fuel and as a filler in a variety of organic and biological products, including hard boards, activated charcoal and cork alternatives. Being a legume, the groundnut plant fixes atmospheric nitrogen symbiotically and enhances the fertility of the soil.
One of the most valuable organic fertilizers for preserving soil fertility in alternative agricultural systems is farmyard manure (Jarvan *et al.*, 2017) [10]. Prior to the invention of chemical fertilizers in the middle of the nineteenth century, the only known sources of plant nutrients added to the soil were farmyard manure and compost (Hack, 1982) [8]. Regular addition of organic materials, especially composted ones, boosted aggregate stability and decreased soil bulk density, which in turn enhanced soil physical qualities (Diacono and Montemurro, 2010) [5]. Also addition of cattle manure resulted in significant increases in soil organic carbon, macro-aggregate stability and aggregate protected carbon. Addition of animal manure may increase biodiversity in the soil, thereby causing alteration in composition, size and activity of soil microorganisms and enzyme activities (Watts *et al.*, 2010) [26].

An earlier analysis revealed that, in terms of production, each tonne of farmyard manure was equivalent to 3 kg of fertilizer nutrients for single crops and 5 kg for double cropping. According to Gaur (1986) [7], 1,000 tonnes of fresh cow dung might theoretically include 15 tonnes of nitrogen and 4 tonnes each of P and K.

Vermicompost is a very effective organic manure created from farm waste that has the potential to boost production and enhance the quality of agricultural output. Vermicompost raises the NPK content, water retention capacity, and productivity of the land, increasing its value. The agricultural system benefits from the addition of farmyard manures and vermicompost by improving soil structure, soil microbial activity, and soil moisture conservation, all of which serve to enhance crop yield and productivity. Vermicompost is finely-divided mature peat-like materials with a high porosity, aeration, drainage and water-holding capacity and microbial activity which are stabilized by interactions between earthworms and microorganisms in a non-thermophilic process (Edwards and Burrows, 1988) [6].

Cow-based bio-enhancers, organic manure and bio-fertilizer play important role in crop production. Organic matter encourages the creation of soil crumb, which makes the soil friable and permits proper air and water flow as well as rainwater absorption, acting on the physical qualities of the soil. Using cow products like dung, urine, milk, curd, and ghee, the *Panchagavya*, *Jeevamrut* and *Bijamrut* are more affordable, environmentally friendly organic formulations.

A wealth of knowledge systems to protect the health and welfare of people, animals and plants can be found in ancient wisdom. It encourages a system that coordinates all agricultural activities with the five elements of *Panchamahabhutas* or Earth, Water, Air, Fire and Space. Due to imposed imbalances, issues arise of human dominance and exploitation of the natural world and the departure from a natural way of life. As a result, the condition of the soil, plants, and micro and macro-organisms grew poorer with time; chemical agriculture made things worse. An organic product called *panchagavya* has the potential to aid in promoting growth and supplying immunity to the plant system. *Panchagavya* is a bio-promoter with a combination of five products obtained from the cow *viz.*, cow dung, cow urine, cow milk, cow curd and cow ghee. Cow urine is a good source of nitrogen to plant growth however its excess application to soil needs monitoring to avoid salinity and its effect on soil microflora. Cow dung which is used in most of the liquid organic manure preparations is a good source of organic matter and encourages microbial population. Milk products like curd, butter and ghee which are generally used in most of the liquid organic manures encourages variety of beneficial microorganisms during fermentation process. *Panchagavya* acts as growth promoter (75%) and immunity booster (25%) and exactly fills the missing link to sustain the organic farming without any yield loss (Vedivel, 2007) [24].

Presence of naturally occurring, beneficial, effective microorganisms in *Panchagavya* predominantly and lactic acid bacteria, yeast, actinomycetes, photosynthetic bacteria and certain fungi besides beneficial and proven fertilizers such as *Acetobacter*, *Azospirillum* and *Phosphobacterium* were detected which have the beneficial effect especially in improving soil quality, growth and yield of crops (Xu and Xu, 2000 and Selvaraj *et al.*, 2007) [19]. *Panchagavya*, an organic product is a potential source to play great role for promoting growth and providing immunity in plant system. Bio-chemical properties of *Panchagavya* revealed that it possesses almost all the major nutrients like N, P, K and micro-nutrients essential for plant and growth hormones like IAA and GA required for crop growth (Selvaraj *et al.*, 2007) [19]. *Panchagavya* is an organic product recommended for crop improvement in organic agriculture (Sangeetha and Thevanathan, 2010) [28].

*Jivamrut*, organic liquid prepared from cow dung, cow urine, pulses flour, jaggery and soil found below the banyan tree, helps to enhance microbial population, soil fertility and productivity of the soil. In acidic soil when applied increases pH and in alkaline soil decreases pH, thus creates favourable condition for availability of maximum nutrients to plants, pH 6.5 to 7.8. This condition increases the crop yield, and cuts down an entire expense of chemical fertilizer. The plant growth promoting *Rhizobacteria*, *Bacillus pumillus* and *Bacillus licheniformis* produce high amount of physiologically active Gibberellins (Javier *et al.*, 2008) [11]. The word "Amrut" means the elixir of life capable of prolonging life. In our context, *Jivamrut* is for soil micro-organisms life. *Jivamrut* is the best culture to increase the count of microorganisms.

*Bijamrut*, a mix of cow dung, cow urine, water, lime and a handful of soil, a totally organic product helpful for the plant growth and protects the crop from harmful soil-borne and seed-borne pathogens. Smearing the seeds with *Bijamrut* before sowing control many diseases that attack the plant right from its seedling stage. At times, saplings are dipped in the *Bijamrut* before being transplanted. Presence of naturally occurring beneficial microorganisms predominantly bacteria, yeast, actinomycetes, photosynthetic bacteria and certain fungi were detected in cow-dung (Swaminathan, 2005) [21] which is one component of *Bijamrut*.

## Materials and Methods

A field experiment was conducted at Organic Unit, Agronomy Instructional Farm, Chimanbhai Patel College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar during the *kharif* seasons of 2021 and 2022, entitled with "Assessing the impact of cow-based bio-enhancers and organic manure on quality, nutrient content-uptake and soil nutrient-microbial dynamics in *kharif* groundnut under organic farming". The treatments consisted of nutrient management under organic farming *viz.*, $G_1$: 100 % RDN through FYM, $G_2$: 100 % RDN through castor cake, $G_3$: 100 % RDN through vermicompost, $G_4$: 100 % RDN through FYM + *Panchagavya* @ 4% spray at 30 and 60 DAS, $G_5$: 100 % RDN through castor cake + *Panchagavya* @ 4% spray at 30 and 60 DAS, $G_6$: 100 % RDN through vermicompost + *Panchagavya* @ 4% spray at 30 and 60 DAS, $G_7$: 100 % RDN through FYM + *Bijamrut* (seed treatment 200 ml/kg seed) + *Jivamrut* @ 500 lit/ha at 30 and 60 DAS, $G_8$: 100 % RDN through castor cake + *Bijamrut* (seed treatment 200 ml/kg seed) + *Jivamrut* @ 500 lit/ha at 30 and 60 DAS and $G_9$: 100 % RDN through vermicompost + *Bijamrut* (seed treatment 200 ml/kg seed) + *Jivamrut* @ 500 lit/ha at 30 and 60 DAS to groundnut in *kharif* season and replicated three times in Randomized Block Design. Organic manure *viz.*, farm yard manure, vermicompost and castor cake were applied to groundnut crop 15 days before sowing as per the treatments and uniformly mixed with soil at the time of bed preparation as per the treatment. The required quantity of

*Jivamrut* applied as soil application (drenching) after the 30 and 60 DAS of groundnut and foliar application of *panchagavya* @ 4% applied after the 30 and 60 DAS of groundnut. Before sowing, seeds were treated with *Rhizobium* and PSB biofertilizers @10 ml/kg seed during both the years. The seeds were sown manually at 45 cm row apart by maintaining the seed rate of 120 kg/ha and the seeds were sown in previously opened furrow at the depth of 5 to 6 cm and seeds were properly covered with soil and light irrigation was applied in each plot immediately after sowing. The plant samples were analyzed for N and P content as per the standard methods. The concentration of nutrients in seed and stover were used to calculate the uptake of nutrients by groundnut crop. The protein content of groundnut was worked out by multiplying nitrogen content with 6.25 (Hulse *et al.*, 1977) [9], to express as percentage on dry weight basis for each treatment. The oil content in kernels was determined by Nuclear Magnetic Resonance (NMR) at Centre for Oilseeds Research, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar (Gujarat) as per the method suggested by Tiwari *et al.* (1974) [23]. The soil samples were collected from each net plot after harvest of groundnut crop at 0-15 cm depth. Organic carbon, available N and $P_2O_5$ and $K_2O$ status of soil were analyzed by Walkley and Black method, alkaline permanganate, olsen's method and Flame photometric method, respectively. The soil samples for total bacterial count, *rhizobium*, PSB, KSB and *azotobacter* were collected from 0-15 cm depth from different spots of each net plot before sowing and after harvest of groundnut. The data were statistically analyzed for various characters as described by (Panse and Sukhatme, 1967) [15].

## Results and Discussion

### Effect on quality parameters

A perusal of data indicated (Table 2) that application of 100 % RDN through vermicompost + *panchgavya* @ 4% spray at 30 and 60 DAS ($G_6$) to groundnut registered significantly higher protein content (22.31 per cent) in pooled study, which remained statistically at par with $G_5$ (22.17 per cent), $G_9$ (22.09 per cent) and $G_4$ (21.82 per cent), $G_8$ (21.41 per cent) and $G_7$ (20.95 per cent) in pooled study. The mean data presented in Table 2 indicated that different treatments tried in the experiment were found to be non-significant in the improvement of oil content (%) in kernel during both the years of experimentation and in pooled study. This might be due to better supply of nitrogen and phosphorus by vermicompost helped in better absorption and utilization of all plant nutrients. Organic manures increase availability of nitrogen in soil and thereby increase in nitrogen content in kernel that resulted in increased protein content in kernel as nitrogen is basic constitute of amino acids which are building block of molecules of protein. Nitrogen is an integral part of protein and phosphorus is an integral part of certain co-enzyme involved in a protein synthesis. So increase the concentration of nitrogen and phosphorus in plant increase the protein content in kernel. These findings are in close conformity with those reported by Kamdi *et al*. (2014) [12] and Choudhary *et al.* (2017) [3] in groundnut.

### Effect on nutrient content

An examination of data (Table 3) indicated that the different treatments tried in the experiment did not exert any significant effect on the nitrogen content in shell during both the years of experimentation and in pooled study. A critical examination of data showed that application of 100 % RDN through vermicompost + *panchgavya* @ 4% spray at 30 and 60 DAS to groundnut registered significantly higher nitrogen content in kernel (3.569 %) and haulm (1.642 %) during pooled study. Treatment $G_6$ remained at par with treatments $G_5$ (3.547 %), $G_9$ (3.535%), $G_4$ (3.491 %), $G_8$ (3.425 %) and $G_7$ (3.352 %) during pooled in case of N content in kernel and haulm. An examination of data (Table 3) indicated that the different treatments tried in the experiment did not exert any significant effect on the phosphorus content in kernel during both the years of experimentation and in pooled study. A perusal of data indicated that the application of 100 % RDN through vermicompost + *panchgavya* @ 4% spray at 30 and 60 DAS ($G_6$) to groundnut registered significantly higher phosphorus content in shell (0.178 %) and haulm (0.467 %) during pooled study. Treatment $G_6$ was remained at par with $G_5$, $G_9$ and $G_4$ in pooled study of shell and haulm. An examination of data (Table 4) indicated that the different treatments tried in the experiment did not exert any significant effect on potassium content in kernel, shell and haulm of groundnut during both the years of experimentation and in pooled study. Higher rate of vermicompost and higher content of nutrient in vermicompost promoted increase in available nutrient in soil and improved soil structure due to increased organic matter that increased nutrients availability. The favourable conditions for microbial as well as chemical activities resulted in increased nutrient content of kernel and haulm. These results are in the line of those reported by Takar *et al*. (2017) [22] and Bhutadiya *et al.* (2019) [2]. In addition, foliar spray of *panchagavya* which contains macro and micronutrients and growth regulators like auxins, GA helped in producing higher biomass and also in better recovery of nutrient content in pod of groundnut. Similar results were also reported by Patel *et al.* (2018) [16].

### Effect on nutrient uptake (kg/ha)

It can be inferred from the data (Table 5, Table 6 and Table 7) that application of 100 % RDN through vermicompost + *panchgavya* @ 4% spray at 30 and 60 DAS show significantly higher N, P and K uptake by kernel, by shell and by haulm of groundnut crop during pooled analysis and remained statistically at par with treatment $G_5$, $G_9$ and $G_4$ during pooled study, respectively. Data further inferred that significantly higher total nitrogen, phosphorus and potash uptake by groundnut crop observed under treatment $G_6$ and which was statistically at par with $G_5$ and $G_9$ pooled study. The maximum nutrient uptake by kernel and haulm of groundnut might be due to fact that vermicompost released nutrients easily and furthermore, because of prolonged availability of moisture due to vermicompost might be resulted into increased uptake of nutrients and also higher yield recorded with application of vermicompost which directly related with the higher uptake of nutrients observed by groundnut. These results are in close proximity with the findings of Takar *et al*. (2017) [22] and Bhutadiya *et al.* (2019) [2]. The regulation of stomata was favourably influenced by the bioactive substances produced by beneficial microorganisms present in *Panchgavya*, which also enhanced the uptake of nutrients by kernel and haulm of the groundnut resulted higher nutrient uptake by haulm of groundnut. Similar findings were also reported by Shwetha *et al.* (2009) [20].

**Effect on available nutrients status in soil**

An application of 100 % RDN through FYM + *bijamrut@* seed treatment 200 ml/kg seed + *jivamrut* @ 500 lit/ha at 30 and 60 DAS observed significantly higher available soil nitrogen $G_7$ (157.3 kg/ha) after harvest of groundnut (Table 8) and which was statistically at par with treatment $G_4$ (154.2 kg/ha) and $G_8$ (150.9 kg/ha) during pooled study. An assessment of data (Table 9) reveals that available soil phosphorus (46.3 kg/ha) obtained after harvest of groundnut crop was significantly higher under treatment $G_7$ and which remained at par with treatment $G_4$ (46.1 kg/ha), $G_8$ (45.8 kg/ha), $G_9$ (45.5 kg/ha) and $G_1$ (45.2 kg/ha) during pooled study. Data revealed (Table 8) that effect of various treatments on available $K_2O$ (kg/ha) and organic carbon (%) in soil after harvest of groundnut crop were found non-significant during both the years of investigation and in pooled study. Increase the available nitrogen and phosphorus in soil after harvest through addition of organic manures. This might be due to lower loss of nutrients due to slow release and continuously available nutrient in soil. It increases nitrates, cation exchange capacity, improve soil structure, bacterial population and biological activity. The results were in line with the findings of Rajanikanth *et al*. (2008) [17] and Wagadre *et al*. (2010) [25]. It might be due to lower loss of nutrients due to slow release in the vermicompost amended plots may be responsible for an increase in available phosphorus in soil most nutrients are found continuously available in vermicompost such as phosphates, soluble potash as well as micronutrients. It increases cation exchange capacity and improve soil structure, bacterial population and biological activity. The results were in line with the findings of Laharia *et al*. (2013) [13].

**Microbial count of soil**

The total microbial (283.77 CFU × $10^5$/g soil), *rhizobium* (248.33 CFU × $10^5$/g soil) and PSB (265.76 CFU × $10^5$/g soil) count in soil after harvest of groundnut crop (Table 9) was noted significantly higher with application of 100 % RDN through FYM + *bijamrut* @ seed treatment 200 ml/kg seed + *jivamrut* @ 500 lit/ha at 30 and 60 DAS ($G_7$) during both the years and in pooled analysis, respectively. Treatment $G_7$ remained at par with treatments $G_4$, $G_9$, $G_8$, $G_1$ and $G_6$ during both pooled study in case of total microbial count, *rhizobium* and PSB in soil. It might be due to increased organic matter content, aeration and water holding capacity of soil promotes the growth and development of bacteria. Microbial activity in soil was significantly increase with the application of vermicompost. Similar result was also reported by Bhatt (2011) [1] in greengram. Data revealed (Table 9) that effect of various treatments on *azotobacter* (CFU × $10^5$/g soil) and KSB count (CFU × $10^2$/g soil) in soil after harvest of groundnut crop were found non-significant during both the years of investigation and pooled study. It might be due to increased organic matter content, aeration and water holding capacity of soil promotes the growth and development of bacteria. Microbial activity in soil was significantly increase with the application of vermicompost. Similar result was also reported by Bhatt (2011) [1] in greengram.

**Table 1:** Pod yield and haulm yield of groundnut as influenced by nutrient management under organic farming (Pooled of 2 year)

| Treatments | Pod yield (kg/ha) | Haulm yield (kg/ha) | Shelling percent age |
|---|---|---|---|
| $G_1$: 100 % RDN through FYM | 1145 | 1652 | 65.15 |
| $G_2$: 100 % RDN through castor cake | 1163 | 1730 | 65.77 |
| $G_3$: 100 % RDN through vermicompost | 1183 | 1797 | 65.89 |
| $G_4$: 100 % RDN through FYM + *Panchgavya* 4% spray at 30 and 60 DAS | 1342 | 2021 | 66.98 |
| $G_5$: 100 % RDN through castor cake + *Panchgavya* 4% spray at 30 and 60 DAS | 1448 | 2158 | 67.24 |
| $G_6$: 100 % RDN through vermicompost + *Panchgavya* 4% spray at 30 and 60 DAS | 1488 | 2263 | 67.65 |
| $G_7$: 100 % RDN through FYM +*Bijamrut* (seed treatment 200 ml/kg seed) + *Jivamrut* @500 lit/ha at 30 and 60 DAS | 1231 | 1913 | 66.03 |
| $G_8$: 100 % RDN through castor cake + *Bijamrut* (seed treatment 200 ml/kg seed) + *Jivamrut* @ 500 lit/ha at 30 and 60 DAS | 1269 | 1937 | 66.90 |
| $G_9$: 100 % RDN through vermicompost + *Bijamrut* (seed treatment 200 ml/kg seed) + *Jivamrut* @ 500 lit/ha at 30 and 60 DAS | 1437 | 2075 | 67.07 |
| S.Em.± | 57.80 | 78.40 | 1.14 |
| C. D. (P = 0.05) | 166 | 226 | NS |
| Interaction (Y × G) | NS | NS | NS |
| C. V. % | 10.89 | 9.85 | 4.19 |

(This data for review only)

**Table 2:** Protein and oil content in kernel of groundnut as influenced by nutrient management under organic farming (Pooled of 2 year)

| Treatments | Protein content (%) | Oil Content (%) |
|---|---|---|
| $G_1$: 100 % RDN through FYM | 19.88 | 46.03 |
| $G_2$: 100 % RDN through castor cake | 20.30 | 46.31 |
| $G_3$: 100 % RDN through vermicompost | 20.58 | 46.39 |
| $G_4$: 100 % RDN through FYM + *Panchgavya* 4% spray at 30 and 60 DAS | 21.82 | 46.66 |
| $G_5$: 100 % RDN through castor cake + *Panchgavya* 4% spray at 30 and 60 DAS | 22.17 | 47.02 |
| $G_6$: 100 % RDN through vermicompost + *Panchgavya* 4% spray at 30 and 60 DAS | 22.31 | 47.16 |
| $G_7$: 100 % RDN through FYM +*Bijamrut* (seed treatment 200 ml/kg seed) + *Jivamrut* @500 lit/ha at 30 and 60 DAS | 20.95 | 46.60 |
| $G_8$: 100 % RDN through castor cake + *Bijamrut* (seed treatment 200 ml/kg seed) + *Jivamrut* @ 500 lit/ha at 30 | 21.41 | 46.63 |

| | | |
|---|---|---|
| and 60 DAS | | |
| $G_9$: 100 % RDN through vermicompost + *Bijamrut* (seed treatment 200 ml/kg seed) + *Jivamrut* @ 500 lit/ha at 30 and 60 DAS | 22.09 | 46.84 |
| S.Em.± | 0.59 | 0.92 |
| C. D. (P = 0.05) | 1.71 | NS |
| Interaction (Y × G) | sNS | NS |
| C. V. % | 6.83 | 4.85 |

**Table 3:** Nitrogen and phosphorus content in kernel, shell and haulm of groundnut as influenced by nutrient management under organic farming (Pooled of 2 year)

| Treatments | Nitrogen content (%) | | | Phosphorus content (%) | | |
|---|---|---|---|---|---|---|
| | Kernel | Shell | Haulm | Kernel | Shell | Haulm |
| $G_1$: 100 % RDN through FYM | 3.181 | 0.910 | 1.338 | 0.698 | 0.158 | 0.400 |
| $G_2$: 100 % RDN through castor cake | 3.248 | 0.895 | 1.350 | 0.683 | 0.165 | 0.402 |
| $G_3$: 100 % RDN through vermicompost | 3.293 | 0.890 | 1.407 | 0.680 | 0.166 | 0.420 |
| $G_4$: 100 % RDN through FYM + *Panchgavya* 4% spray at 30 and 60 DAS | 3.491 | 0.880 | 1.557 | 0.675 | 0.168 | 0.438 |
| $G_5$: 100 % RDN through castor cake + *Panchgavya* 4% spray at 30 and 60 DAS | 3.547 | 0.880 | 1.622 | 0.675 | 0.171 | 0.455 |
| $G_6$: 100 % RDN through vermicompost + *Panchgavya* 4% spray at 30 and 60 DAS | 3.569 | 0.860 | 1.642 | 0.672 | 0.178 | 0.467 |
| $G_7$: 100 % RDN through FYM +*Bijamrut* (seed treatment 200 ml/kg seed) + *Jivamrut* @500 lit/ha at 30 and 60 DAS | 3.352 | 0.847 | 1.447 | 0.668 | 0.167 | 0.435 |
| $G_8$: 100 % RDN through castor cake + *Bijamrut* (seed treatment 200 ml/kg seed) + *Jivamrut* @ 500 lit/ha at 30 and 60 DAS | 3.425 | 0.839 | 1.472 | 0.667 | 0.167 | 0.438 |
| $G_9$: 100 % RDN through vermicompost + *Bijamrut* (seed treatment 200 ml/kg seed) + *Jivamrut* @ 500 lit/ha at 30 and 60 DAS | 3.535 | 0.832 | 1.597 | 0.658 | 0.170 | 0.45 |
| S.Em.± | 0.095 | 0.020 | 0.044 | 0.015 | 0.003 | 0.010 |
| C. D. (P = 0.05) | 0.273 | NS | 0.126 | NS | 0.010 | 0.028 |
| Interaction (Y × G) | NS | NS | NS | NS | NS | NS |
| C. V. % | 6.82 | 6.01 | 7.19 | 5.23 | 5.05 | 5.53 |

**Table 4:** Potassium content in kernel, shell and haulm of groundnut as influenced by nutrient management under organic farming (Pooled of 2 year)

| Treatments | Potassium content (%) | | |
|---|---|---|---|
| | Kernel | Shell | Haulm |
| $G_1$: 100 % RDN through FYM | 0.543 | 0.725 | 1.156 |
| $G_2$: 100 % RDN through castor cake | 0.557 | 0.732 | 1.163 |
| $G_3$: 100 % RDN through vermicompost | 0.566 | 0.735 | 1.168 |
| $G_4$: 100 % RDN through FYM + *Panchgavya* 4% spray at 30 and 60 DAS | 0.584 | 0.759 | 1.183 |
| $G_5$: 100 % RDN through castor cake + *Panchgavya* 4% spray at 30 and 60 DAS | 0.593 | 0.770 | 1.188 |
| $G_6$: 100 % RDN through vermicompost + *Panchgavya* 4% spray at 30 and 60 DAS | 0.603 | 0.776 | 1.197 |
| $G_7$: 100 % RDN through FYM +*Bijamrut* (seed treatment 200 ml/kg seed) + *Jivamrut* @500 lit/ha at 30 and 60 DAS | 0.569 | 0.748 | 1.179 |
| $G_8$: 100 % RDN through castor cake + *Bijamrut* (seed treatment 200 ml/kg seed) + *Jivamrut* @ 500 lit/ha at 30 and 60 DAS | 0.584 | 0.759 | 1.183 |
| $G_9$: 100 % RDN through vermicompost + *Bijamrut* (seed treatment 200 ml/kg seed) + *Jivamrut* @ 500 lit/ha at 30 and 60 DAS | 0.588 | 0.767 | 1.184 |
| S.Em.± | 0.014 | 0.017 | 0.025 |
| C. D. (P = 0.05) | NS | NS | NS |
| Interaction (Y × G) | NS | NS | NS |
| C. V. % | 5.80 | 5.45 | 5.12 |

**Table 5:** Nitrogen uptake by kernel, shell, haulm and total nitrogen uptake by groundnut as influenced by nutrient management under organic farming (Pooled of 2 year)

| Treatments | Nitrogen uptake (kg/ha) | | | |
|---|---|---|---|---|
| | Kernel | Shell | Haulm | Total |
| $G_1$: 100 % RDN through FYM | 23.59 | 3.24 | 22.12 | 48.96 |
| $G_2$: 100 % RDN through castor cake | 25.08 | 3.26 | 23.36 | 51.69 |
| $G_3$: 100 % RDN through vermicompost | 25.77 | 3.26 | 25.27 | 54.29 |
| $G_4$: 100 % RDN through FYM + *Panchgavya* 4% spray at 30 and 60 DAS | 31.38 | 3.64 | 31.47 | 66.48 |
| $G_5$: 100 % RDN through castor cake + *Panchgavya* 4% spray at 30 and 60 DAS | 34.61 | 3.91 | 35.01 | 73.54 |
| $G_6$: 100 % RDN through vermicompost + *Panchgavya* 4% spray at 30 and 60 DAS | 35.90 | 3.98 | 37.23 | 77.11 |
| $G_7$: 100 % RDN through FYM +*Bijamrut* (seed treatment 200 ml/kg seed) + *Jivamrut* @500 lit/ha at 30 and 60 DAS | 27.23 | 3.38 | 27.68 | 58.29 |
| $G_8$: 100 % RDN through castor cake + *Bijamrut* (seed treatment 200 ml/kg seed) + *Jivamrut* @ 500 lit/ha at 30 and 60 DAS | 29.18 | 3.38 | 28.52 | 61.08 |
| $G_9$: 100 % RDN through vermicompost + *Bijamrut* (seed treatment 200 ml/kg seed) + *Jivamrut* @ 500 lit/ha at 30 and 60 DAS | 34.11 | 3.82 | 33.23 | 71.16 |

| | | | | |
|---|---|---|---|---|
| S.Em.± | 1.64 | 0.15 | 1.58 | 2.41 |
| C. D. (P = 0.05) | 4.73 | 0.45 | 4.54 | 6.95 |
| Interaction (Y × G) | NS | NS | NS | NS |
| C. V. % | 13.56 | 10.76 | 13.17 | 9.58 |

**Table 6:** Phosphorous uptake by kernel, shell, haulm and total phosphorous uptake by groundnut as influenced by nutrient management under organic farming (Pooled of 2 year)

| Treatments | Phosphorous uptake (kg/ha) | | | |
|---|---|---|---|---|
| | Kernel | Shell | Haulm | Total |
| $G_1$: 100 % RDN through FYM | 5.24 | 0.63 | 6.60 | 12.47 |
| $G_2$: 100 % RDN through castor cake | 5.23 | 0.65 | 6.94 | 12.82 |
| $G_3$: 100 % RDN through vermicompost | 5.26 | 0.66 | 7.55 | 13.47 |
| $G_4$: 100 % RDN through FYM + *Panchgavya* 4% spray at 30 and 60 DAS | 6.06 | 0.75 | 8.84 | 15.65 |
| $G_5$: 100 % RDN through castor cake + *Panchgavya* 4% spray at 30 and 60 DAS | 6.57 | 0.81 | 9.82 | 17.20 |
| $G_6$: 100 % RDN through vermicompost + *Panchgavya* 4% spray at 30 and 60 DAS | 6.77 | 0.85 | 10.57 | 18.19 |
| $G_7$: 100 % RDN through FYM +*Bijamrut* (seed treatment 200 ml/kg seed) + *Jivamrut* @500 lit/ha at 30 and 60 DAS | 5.43 | 0.70 | 8.33 | 14.45 |
| $G_8$: 100 % RDN through castor cake + *Bijamrut* (seed treatment 200 ml/kg seed) + *Jivamrut* @ 500 lit/ha at 30 and 60 DAS | 5.70 | 0.70 | 8.54 | 14.94 |
| $G_9$: 100 % RDN through vermicompost + *Bijamrut* (seed treatment 200 ml/kg seed) + *Jivamrut* @ 500 lit/ha at 30 and 60 DAS | 6.34 | 0.81 | 9.33 | 16.48 |
| S.Em.± | 0.34 | 0.04 | 0.44 | 0.57 |
| C. D. (P = 0.05) | 0.98 | 0.11 | 1.27 | 7.38 |
| Interaction (Y × G) | NS | NS | NS | NS |
| C. V. % | 14.26 | 12.13 | 12.69 | 10.04 |

**Table 7:** Potassium uptake by kernel, shell, haulm and total potassium uptake by groundnut as influenced by nutrient management under organic farming (Pooled of 2 year)

| Treatments | Potassium uptake (kg/ha) | | | |
|---|---|---|---|---|
| | Kernel | Shell | Haulm | Total |
| $G_1$: 100 % RDN through FYM | 4.08 | 2.89 | 19.08 | 26.05 |
| $G_2$: 100 % RDN through castor cake | 4.28 | 2.91 | 20.10 | 27.29 |
| $G_3$: 100 % RDN through vermicompost | 4.48 | 2.92 | 20.98 | 28.38 |
| $G_4$: 100 % RDN through FYM + *Panchgavya* 4% spray at 30 and 60 DAS | 5.25 | 3.36 | 24.00 | 32.61 |
| $G_5$: 100 % RDN through castor cake + *Panchgavya* 4% spray at 30 and 60 DAS | 5.79 | 3.65 | 25.65 | 35.08 |
| $G_6$: 100 % RDN through vermicompost + *Panchgavya* 4% spray at 30 and 60 DAS | 6.09 | 3.72 | 27.10 | 36.92 |
| $G_7$: 100 % RDN through FYM +*Bijamrut* (seed treatment 200 ml/kg seed) + *Jivamrut* @500 lit/ha at 30 and 60 DAS | 4.62 | 3.13 | 22.56 | 30.32 |
| $G_8$: 100 % RDN through castor cake + *Bijamrut* (seed treatment 200 ml/kg seed) + *Jivamrut* @ 500 lit/ha at 30 and 60 DAS | 4.97 | 3.17 | 22.75 | 30.89 |
| $G_9$: 100 % RDN through vermicompost + *Bijamrut* (seed treatment 200 ml/kg seed) + *Jivamrut* @ 500 lit/ha at 30 and 60 DAS | 5.67 | 3.64 | 24.65 | 33.95 |
| S.Em.± | 0.30 | 0.16 | 0.93 | 1.22 |
| C. D. (P = 0.05) | 0.88 | 0.47 | 2.94 | 3.56 |
| Interaction (Y × G) | NS | NS | NS | NS |
| C. V. % | 14.84 | 12.14 | 10.88 | 9.68 |

**Table 8:** Available nitrogen, phosphorus, potash and organic carbon in soil after harvest of groundnut as influenced by nutrient management under organic farming (Pooled of 2 year)

| Treatments | Available nutrients (kg/ha) | | | OC |
|---|---|---|---|---|
| | N | $P_2O_5$ | $K_2O$ | |
| $G_1$: 100 % RDN through FYM | 147.3 | 45.2 | 241.9 | 0.319 |
| $G_2$: 100 % RDN through castor cake | 142.2 | 41.9 | 237.3 | 0.312 |
| $G_3$: 100 % RDN through vermicompost | 140.8 | 41.5 | 237.0 | 0.313 |
| $G_4$: 100 % RDN through FYM + *Panchgavya* 4% spray at 30 and 60 DAS | 154.2 | 46.1 | 244.4 | 0.321 |
| $G_5$: 100 % RDN through castor cake + *Panchgavya* 4% spray at 30 and 60 DAS | 144.3 | 43.3 | 241.2 | 0.317 |
| $G_6$: 100 % RDN through vermicompost + *Panchgavya* 4% spray at 30 and 60 DAS | 142.5 | 42.5 | 240.9 | 0.319 |
| $G_7$: 100 % RDN through FYM +*Bijamrut* (seed treatment 200 ml/kg seed) + *Jivamrut* @500 lit/ha at 30 and 60 DAS | 157.3 | 46.3 | 245.0 | 0.325 |
| $G_8$: 100 % RDN through castor cake + *Bijamrut* (seed treatment 200 ml/kg seed) + *Jivamrut* @ 500 lit/ha at 30 and 60 DAS | 150.9 | 45.8 | 243.5 | 0.319 |
| $G_9$: 100 % RDN through vermicompost + *Bijamrut* (seed treatment 200 ml/kg seed) + *Jivamrut* @ 500 lit/ha at 30 and 60 DAS | 149.1 | 45.5 | 243.3 | 0.321 |
| S.Em.± | 2.41 | 0.73 | 7.38 | 0.009 |

| | | | | |
|---|---|---|---|---|
| C. D. (P = 0.05) | 6.94 | 2.09 | NS | NS |
| Interaction (Y × G) | NS | NS | NS | NS |
| C. V. % | 7.16 | 7.62 | 7.19 | 7.19 |

**Table 9:** Total microbial, *rhizobium*, PSB, *azotobacter* and KSB count after harvest of groundnut as influenced by nutrient management under organic farming (Pooled of 2 year)

| Treatments | Total microbial count (CFU × $10^5$/g soil) | *Rhizobium* count (CFU × $10^5$/g soil) | PSB count (CFU × $10^5$/g soil) | *Azotobacter* count (CFU × $10^5$/g soil) | KSB count (CFU × $10^2$/g soil) |
|---|---|---|---|---|---|
| $G_1$: 100 % RDN through FYM | 264.81 | 234.35 | 243.96 | 127.21 | 50.57 |
| $G_2$: 100 % RDN through castor cake | 229.01 | 205.80 | 216.12 | 121.88 | 50.01 |
| $G_3$: 100 % RDN through vermicompost | 235.13 | 211.48 | 222.43 | 122.21 | 49.66 |
| $G_4$: 100 % RDN through FYM + *Panchgavya* 4% spray at 30 and 60 DAS | 279.97 | 247.69 | 257.04 | 132.19 | 53.57 |
| $G_5$: 100 % RDN through castor cake + *Panchgavya* 4% spray at 30 and 60 DAS | 237.26 | 213.43 | 228.89 | 123.60 | 49.90 |
| $G_6$: 100 % RDN through vermicompost + *Panchgavya* 4% spray at 30 and 60 DAS | 262.61 | 226.42 | 241.80 | 125.58 | 50.40 |
| $G_7$: 100 % RDN through FYM +*Bijamrut* (seed treatment 200 ml/kg seed) + *Jivamrut* @500 lit/ha at 30 and 60 DAS | 283.77 | 248.33 | 265.67 | 133.25 | 54.14 |
| $G_8$: 100 % RDN through castor cake + *Bijamrut* (seed treatment 200 ml/kg seed) + *Jivamrut* @ 500 lit/ha at 30 and 60 DAS | 269.07 | 240.35 | 252.41 | 127.82 | 51.90 |
| $G_9$: 100 % RDN through vermicompost + *Bijamrut* (seed treatment 200 ml/kg seed) + *Jivamrut* @ 500 lit/ha at 30 and 60 DAS | 273.55 | 243.43 | 251.41 | 129.97 | 53.70 |
| S.Em.± | 8.83 | 6.40 | 7.18 | 2.79 | 1.57 |
| C. D. (P = 0.05) | 25.44 | 18.44 | 20.69 | NS | NS |
| Interaction (Y × G) | NS | NS | NS | NS | NS |
| C. V. % | 8.34 | 6.81 | 7.27 | 5.37 | 7.48 |

## Conclusion

Based on the findings of two years of experimentation, it is concluded that for securing higher nutrient content and uptake of groundnut under organic farming, apply 100 % RDN either through vermicompost or castor cake along with either *panchgavya* @ 4% spray at 30 and 60 DAS, while higher microbial count and available nutrient after harvest of groundnut recorded under 100 % RDN through FYM with seed treatment with *bijamrut* @ 200 ml/kg seed + two spray of *jivamrut* @ 500 lit/ha at 30 and 60 DAS to groundnut.

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