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# Production Competence, Cost-effectiveness and Nutrient Uptake as Influenced by Diversenutrient Management in Summer Groundnut (*Arachis hypogaea*)

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***Authors' contributions***

*This work was carried out in collaboration among all authors. Author AHKN designed the study, wrote the protocol and wrote the first draft of the manuscript. Authors GM and GMC managed the analyses of the study and performed the statistical analysis. Author MH managed the literature searches. All authors read and approved the final manuscript.*

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## ABSTRACT

A field experiment was carried out during summer 2019 and 2020 at Zonal Agricultural and Horticultural Research Station, Hiriyur University of Agricultural and Horticultural Sciences, Shivamogga to study the influence of natural farming practices on growth, yield attributes and yield

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of ground nut in black soils. Pooled analysis of two years revealed that recommended dose of fertilizer significantly recorded higher pod (1969 kg $ha^{-1}$), kernel (1516 kg $ha^{-1}$) and haulm (3699 kg $ha^{-1}$) yield as compared to other nutrient management practices. Similar trend was noticed in other yield parameters. Significantly higher nutrient uptake was observed in treatment receiving recommended package of practice i.e., nitrogen (101.75 kg $ha^{-1}$), phosphorus (28.41 kg $ha^{-1}$) and potassium (94.54 kg $ha^{-1}$), respectively. However, the natural farming treatment receiving significantly recorded higher gross returns (Rs. 1,62,458 $ha^{-1}$), net returns (Rs.1,14,063) and B:C ratio (3.36) as compared to other nutrient management practices. In 2019 and 2020 the same treatment recorded significantly higher growth, yield parameters and economics.

*Keywords: Groundnut; natural farming; uptake; yield.*

## 1. INTRODUCTION

Farming has been the mainstay of the Indian economy for centuries. Over half the country's population today depends on agriculture and allied services for their livelihoods. Agriculture constitutes 17.4 per cent of the gross value added (GVA) to the national economy. Out of the nine planetary boundaries identified as "safe functioning spaces for humanity" two have been completely transgressed biosphere integrity and biogeochemical flows with agriculture being an important driver of both. Agriculture in its prevailing form requires farmers to rely heavily on inorganic external chemical inputs such as fertilizers and pesticides. These contaminate groundwater and other water dependent ecosystems leads to reduction soil fertility over time and contribute to biodiversity loss in farmlands. The use of such inputs exposes smallholder farmers to a high degree of credit risk and traps them in a perpetual cycle of debt. Prevailing agricultural practices such as monocropping decrease soil moisture content, causing tremendous stress on water resources. The use of external inputs by adoption of uniform, hybridized and genetically modified crop varieties erodes genetic diversity of seeds, and reduces their capacity to adapt to changing climatic conditions. These practices, coupled with widespread farmland degradation, make agriculture a major contributor to global greenhouse gas (GHG) emissions, and climate change. Alternative low input farming practices have emerged in pockets across the world promising reduced input costs and higher yields for farmers, chemical free food for consumers and improved soil fertility. This is likely to reduce the reliance on resources such as water and electricity for irrigation. Substituting chemical fertilizers and pesticides with natural inputs might reduce input costs and farmers' exposure to credit risks; the increase in net income will improve the cash flow of poor and vulnerable farmers, and may enhance their ability to deal with economic shocks and the reduced resource dependence and improved soil quality might then help farmers adapt better to extreme climate events. There is growing evidence that sustainable intensification can increase crop yields by redesigning ecosystems on and around farms [1-3].

However, proper package of practices increase the productivity of the groundnut crop in the same time maintain soil fertility status. Among the various agronomic practices, nutrient management has an important role in maximizing the biological yield, increase the uptake of macro nutrients and sustaining the postharvest soil nutrient status. In semiarid regions its cultivation is mainly under rainfed situation and judicial use of manures and fertilizers including micronutrients is necessary for increasing productivity and reduced environmental pollution because continuous use of chemical fertilizers has deleterious effects on soil which in turn cause decline in productivity. The appropriate management of soil fertility as well as soil productivity makes it feasible to increase the efficiency on the use of soil and added nutrients [4]. In this context a study was investigated to know the effect of natural farming practices on growth, yield and economics of ground nut.

## 2. MATERIALS AND METHODS

The field experiment was conducted during summer 2019 and 2020 at Zonal Agricultural and Horticultural Research Station, Hiriyur, University of Agricultural and Horticultural Sciences, Shivamogga. The station is situated at 13º 57' 32" North latitude and 70º 37' 38" East longitude and an altitude of 606 meters above mean sea level (MSL). The soil of the experimental site is vertisol with slightly alkaline pH (8.10), organic carbon (1.90 g $kg^{-1}$), available nitrogen (258 kg $ha^{-1}$), available phosphorus (35 kg $ha^{-1}$) and

available potassium (315 kg $ha^{-1}$). The treatments included in the experiment were $T_1$ = Natural Farming, $T_2$ = Organic production system, $T_3$ = Recommended package of practice (RPP) and $T_4$ = Absolute control. The experiment was laid out in a randomized complete block design with five replications and variety used was TMV-2.The plot size of experimental site was 20 m X 10 m. Application of fertilizers for recommended package of practice were through urea, DAP and muriate of potash and for the organic treatment nitrogen was supplied in the farm of vermicompost on P Equivalent basis for ZBNF treatment, jeevamrutha was applied through soil once in 10 days. Observations on growth parameters were recorded at regular intervals 30,60, 90 days after sowing and at harvest. Experimental data collected was subjected to statistical analysis by adopting Fisher's method of Analysis of Variance (ANOVA) as outlined by Gomez and Gomez [5]. Critical Difference (CD) values were calculated whenever the 'F' test was found significant at 5 per cent level. For economic studies non premium price was considered for ZBNF and organic production treatment as suggested by Karnataka Krishi Marata Vahini [6].

### 2.1 Preparation and Application Jeevamrutha

Jeevamrutha was prepared by mixing 10 kg of cow dung, 10 litre of cow urine, 2 kg of local jaggery, 2 kg of pulse flour and hand full of soil collected from farm. All these were put in 200 litre capacity plastic drum and mixed thoroughly and volume was made up to 200 litre. The mixture was stirred well in clock wise direction and kept in shade covered with wet jute bag. The solution was regularly stirred clockwise in the morning, afternoon and in the evening continuously for 10 days and it was used for soil application. Jeevamrutha was applied when the soil was wet near the root zone of the crop as per the treatments.

The field experiment was conducted for two consecutive years of summer 2019 and 2020. During the year 2019 higher rainfall of 203.2 mm was received as against normal rainfall of 278.9 mm with uneven distribution. During the pre-monsoon period rainfall was good in the month of May (51.6 mm). During the year 2020 higher Rainfall of 282.5 mm was received as against Normal Rainfall of 278.9 mm with uneven distribution. The groundnut crop required total of 600 mm water out of this crop required water for different growth stages with different quantity, *i.e.,* land preparation to complete emergence (150 mm), for emergence to uprooting (420 mm) and moisture required for uprooting (30 mm). Whereas, in 2019 and 2020 rainfall was deficit of 396.8 mm and 317.5 mm, respectively. The remaining quantity of water will be supplied through protection irrigation.

## 3. RESULTS AND DISCUSSION

### 3.1 Yield Attributes

In the present investigation, pooled analysis showed that, among different nutrient management practices recommended package of practices recorded significantly higher pod yield (1969 kg $ha^{-1}$) with an increase of 33.82 per cent over absolute control (1303 kg $ha^{-1}$). Similarly, significantly higher haulm yield was also recorded with recommended package of practices (3699 kg $ha^{-1}$) with an increase of 35.24 per cent over absolute control (2735 kg $ha^{1}$) (Table 3). Further, organic production system and natural farming treatments were on par with each other. Crop yield is the complex function of physiological processes and biochemical activities, which modify plant anatomy and morphology of the growing plants. Significantly higher pod yield recorded with application recommended nutrient package (POP) was due to better yield attributing characters like pod weight (61.6 g $plant^{-1}$) and test weight (30.8 g) (Table 4). Higher pod yield could be attributed to favourable changes in physical and chemical characteristics of the soils which might have enabled better pod formation. Moreover, the positive influence of these treatments through immediate supply of nutrients from inorganic sources especially at the early stage of the crop and slow and steady supply of nutrients from FYM and vermicompost throughout the crop growth period improved adequate biomass production and improvement in yield parameters resulting in higher pod yield [12,13]. Any acceptance of technology is dependent on economic feasibility of the treatment in this experiment natural farming significantly recorded higher recorded higher gross returns (Rs. 1,62,458 $ha^{-1}$), net returns (Rs.1,14,063) and B:C ratio (3.36) as compared to other nutrient management practices this is due to higher non premium price and lower the cost of cultivation these findings were accordance with Saurabh et al. [14].

In the present study, all the yield attributing parameters were significantly higher with recommended package of practices which might be due to favorable effects of chemical fertilizers and also it provides nutrition in early stage with available form. The increase in economic and biological yield of groundnut due to application chemical fertilizers could be due to better availability of nutrients throughout the crop growth which might be the result of improved microbial activity in the soil. These findings are in accordance with Kasbe et al. [15] and Dekhane et al. [16] who reported that higher nutrient availability resulted in profused growth in the form of higher dry matter accumulation and yield parameters. Whenever nutrients are applied at regular they act as a stimulus in the plant system and in turn increase the production of growth regulators in the cell system and growth hormones which might have improvement in soil biomass, thereby sustaining the availability and uptake of applied as well as native soil nutrients which ultimately have resulted in better growth and yield of crops.

## 3.2 Growth Attributes

Pooled analysis on growth components were significantly influenced by different nutrient management (Table 5). Significantly higher plant height (48.9 cm), number of functional leaflets (50.2plant$^{-1}$), number of branches (6.6plant$^{-1}$) and dry matter (68.5gplant$^{-1}$) were recorded with recommended package of practice. The results confirm the findings of Sabale [17], Karunakaran et al. [13] and Gagare et al. [17]. The lowest values of growth components were observed under the control plot. The increase in plant height with recommended package of practice may be attributed to ready availability of nitrogen through inorganic fertilizers and vermicompost during the vegetative crop growth. These findings are in close conformity with Karunakaran et al. [13] and Gagare et al. [18]. Application of 100 %

**Table 1. Normal and actual rainfall distribution at ZAHRS, Hiriyur**

| Months | Normal rainfall | Rainfall (mm) | | Rainy days | |
|---|---|---|---|---|---|
| | | 2019 | 2020 | 2019 | 2020 |
| Jan | 3.35 | 4.8 | 0.0 | 1 | 0 |
| Feb | 3.93 | 0.2 | 0.0 | 0 | 0 |
| Mar | 6.23 | 0.0 | 0.0 | 0 | 0 |
| Apr | 26.8 | 0.0 | 23.0 | 0 | 0 |
| May | 79.8 | 51.6 | 60.8 | 6 | 6 |
| Jun | 54.8 | 45.6 | 83.3 | 3 | 7 |
| Jul | 46.2 | 24.6 | 93.4 | 3 | 7 |
| Aug | 57.8 | 76.4 | 22.0 | 9 | 4 |
| Total | 278.9 | 203.2 | 282.5 | 22 | 24 |

**Table 2. Initial physico-chemical properties of experimental site**

| **A. Particle size composition** | | |
|---|---|---|
| **Particulars** | **Value** | **Method** |
| Sand (%) | 22.40 | International pipette method [7] |
| Silt (%) | 34.20 | |
| Clay (%) | 43.40 | |
| Texture | Clay | |
| **B. Chemical properties** | | |
| **Particulars** | **Value** | **Method** |
| pH (1:2.5 Soil :Water) | 8.80 | Potentiometric method [8] |
| Electrical Conductivity (dSm$^{-1}$) | 0.45 | Conductometric method [8] |
| Organic Carbon (%) | 0.43 | Wet oxidation method [9] |
| Available Nitrogen (kg ha$^{-1}$) | 230.6 | Alkaline Potassium Permanganate Method [10] |
| Available Phosphorus (kg ha$^{-1}$) | 29.82 | Olsen's extract method (1954) |
| Available Potassium (kg ha$^{-1}$) | 334 | Neutral Normal Ammonium Acetate Method [8] |
| Fe (mg kg$^{-1}$) | 4.54 | DTPA Extract Method [11] |
| Cu (mg kg$^{-1}$) | 1.42 | |
| Zn (mg kg$^{-1}$) | 0.52 | |
| Mn (mg kg$^{-1}$) | 14.93 | |

**Table 3. Pod, Haulm and Kernel yield (kgha$^{-1}$) of groundnut as influenced by different nutrient management practices at harvest under irrigated conditions at ZAHRS, Hiriyur (Pooled over two years)**

| Treatment | Pod yield (kg/ha) | | | Haulm yield (kg/ha) | | | Kernel yield (kg/ha) | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2019 | 2020 | Pooled | 2019 | 2020 | Pooled | 2019 | 2020 | Pooled |
| $T_1$: NF | 1592 | 1799 | 1696 | 2812 | 3178 | 2995 | 1184 | 1338 | 1261 |
| $T_2$: OPS | 1694 | 1966 | 1830 | 3004 | 3485 | 3244 | 1277 | 1481 | 1379 |
| $T_3$: RPP | 1799 | 2140 | 1969 | 3378 | 4019 | 3699 | 1384 | 1647 | 1516 |
| $T_4$: Control | 1294 | 1312 | 1303 | 2716 | 2754 | 2735 | 973 | 987 | 980 |
| S.Em+ | 91 | 107 | 99 | 67 | 89 | 77 | 36 | 38 | 37 |
| CD(P=0.05) | 280 | 329 | 304 | 205 | 273 | 237 | 109 | 118 | 113 |

**Table 4. Yield parameters of groundnut as influenced by different nutrient management practices at harvest under irrigated conditions at ZAHRS, Hiriyur (Pooled over two years)**

| Treatment | Yield parameters | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Pod weight (g/plant) | | | 100 seed weight (g) | | | Pod yield (kg/plot) | | | Shelling % | | |
| | 2019 | 2020 | Pooled | 2019 | 2020 | Pooled | 2019 | 2020 | Pooled | 2019 | 2020 | Pooled |
| $T_1$: NF | 47.3 | 53.4 | 50.4 | 27.7 | 31.3 | 29.5 | 29.3 | 33.2 | 31.2 | 75.4 | 76.4 | 75.9 |
| $T_2$: OPS | 49.4 | 57.3 | 53.4 | 30.5 | 35.3 | 32.9 | 31.2 | 36.2 | 33.7 | 77.5 | 78.7 | 78.1 |
| $T_3$: RPP | 56.3 | 67.0 | 61.6 | 28.2 | 33.5 | 30.8 | 33.1 | 39.4 | 36.3 | 79.2 | 80.7 | 79.9 |
| $T_4$: Control | 43.5 | 44.1 | 43.8 | 24.3 | 24.6 | 24.5 | 23.8 | 24.2 | 24.0 | 74.6 | 75.7 | 75.2 |
| S.Em + | 3.2 | 3.7 | 3.5 | 1.2 | 1.3 | 1.2 | 1.7 | 2.0 | 1.8 | 6.5 | 6.6 | 6.6 |
| CD(P=0.05) | 9.9 | 11.5 | 10.7 | 3.6 | 4.0 | 3.8 | 5.1 | 6.1 | 5.6 | 20.1 | 20.4 | 20.3 |

| *Treatment* | *Details* |
|---|---|
| $T_1$ : *Natural Farming* | *Jeevamrtha 200 lit /15 days + Ghanajevamrutha 400 kg/ acre + Beejamrutha (Seed treatment )* |
| $T_2$ : *Organic Production System* | *Vermicompost (P Equivalent ) and Rhizobium 150 g/Acre + PSB 400g/acre (Seed treatment)* |
| $T_3$ : *Recommended Package of Practice (RPP)* | *FYM 4 ton /acre, NPK 10:20:15 kg/acre and Rhizobium 150 g/Acre + PSB 400g/acre(Seed treatment)* |
| $T_4$ : *Absolute Control* | *Only sowing* |

**Table 5. Growth parameters at harvest of groundnut as influenced by different nutrient management practices at different growth stages under irrigated conditions at ZAHRS, Babbur farm, Hiriyur (Pooled over two years)**

| Treatment | Total dry matter production (g/plant) | | | Number of Branches (plant$^{-1}$) | | | Number of leaf lets (plant$^{-1}$) | | | Plant Height (cm) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2019 | 2020 | Pooled | 2019 | 2020 | Pooled | 2019 | 2020 | Pooled | 2019 | 2020 | Pooled |
| $T_1$: NF | 51.8 | 54.4 | 53.1 | 5.9 | 6.0 | 5.9 | 47.2 | 49.6 | 48.4 | 41.0 | 43.1 | 42.1 |
| $T_2$: OPS | 55.3 | 62.0 | 58.7 | 6.2 | 6.3 | 6.2 | 42.6 | 47.7 | 45.2 | 43.4 | 45.6 | 44.5 |
| $T_3$: RPP | 62.2 | 74.7 | 68.5 | 6.1 | 7.1 | 6.6 | 45.6 | 54.8 | 50.2 | 47.8 | 50.1 | 48.9 |
| $T_4$: Control | 50.0 | 52.5 | 51.3 | 5.9 | 6.0 | 5.9 | 50.8 | 53.4 | 52.1 | 34.3 | 36.0 | 35.1 |
| S.Em ± | 1.2 | 1.7 | 1.4 | 0.1 | 0.2 | 0.1 | 2.4 | 2.7 | 2.6 | 0.1 | 0.1 | 0.1 |
| CD(P=0.05) | 3.8 | 5.2 | 4.4 | 0.5 | 0.5 | 0.5 | 7.4 | 8.3 | 7.9 | 0.2 | 0.2 | 0.2 |

**Table 6. Major nutrient uptake in groundnutas influenced by different nutrient management practices at harvest under irrigated conditions at ZAHRS, Babbur farm, Hiriyur (Pooled over two years)**

| Treatment | N Uptake (kg ha$^{-1}$) | | | P Uptake (kg ha$^{-1}$) | | | K Uptake (kg ha$^{-1}$) | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2019 | 2020 | Pooled | 2019 | 2020 | Pooled | 2019 | 2020 | Pooled |
| $T_1$: NF | 78.64 | 79.37 | 79.01 | 21.12 | 22.41 | 21.77 | 74.22 | 75.31 | 74.76 |
| $T_2$: OPS | 86.32 | 87.77 | 87.04 | 23.76 | 25.01 | 24.38 | 80.94 | 81.91 | 81.42 |
| $T_3$: RPP | 101.32 | 102.17 | 101.75 | 27.78 | 29.05 | 28.41 | 94.08 | 94.99 | 94.54 |
| $T_4$: Control | 56.93 | 56.97 | 56.95 | 15.74 | 15.94 | 15.84 | 54.58 | 55.77 | 55.18 |
| S.Em± | 1.09 | 1.15 | 1.04 | 0.51 | 0.67 | 0.40 | 1.17 | 1.17 | 1.14 |
| CD(P=0.05) | 3.35 | 3.56 | 3.21 | 1.56 | 2.06 | 1.22 | 3.59 | 3.61 | 3.50 |

| *Treatment* | *Details* |
|---|---|
| *$T_1$: Natural Farming* | *Jeevamrtha 200 lit /15 days + Ghanajevamrutha 400 kg/ acre + Beejamrutha (Seed treatment )* |
| *$T_2$: Organic Production System* | *Vermicompost (P Equivalent ) and Rhizobium 150 g/Acre + PSB 400g/acre(Seed treatment)* |
| *$T_3$: Recommended Package of Practice (RPP)* | *FYM 4 ton /acre, NPK 10:20:15 kg/acre and Rhizobium 150 g/Acre + PSB 400g/acre(Seed treatment)* |
| *$T_4$: Absolute Control* | *Only sowing* |

**Table 7. Gross, Net returns and B:C ratio groundnut as influenced by different nutrient management practices at harvest under irrigated conditions at ZAHRS, Babbur farm, Hiriyur (Pooled over two years)**

| Treatment | Gross returns | | | Net returns | | | B:C ratio | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2019 | 2020 | Pooled | 2019 | 2020 | Pooled | 2019 | 2020 | Pooled |
| $T_1$: NF | 153810 | 171106 | 162458 | 105830 | 122296 | 114063 | 3.21 | 3.51 | 3.36 |
| $T_2$: OPS | 163677 | 115666 | 139672 | 107537 | 58546 | 83042 | 2.92 | 2.02 | 2.47 |
| $T_3$: RPP | 90987 | 112555 | 101771 | 35867 | 56645 | 46256 | 1.65 | 2.01 | 1.83 |
| $T_4$: Control | 65717 | 69261 | 67489 | 24607 | 27521 | 26064 | 1.60 | 1.66 | 1.63 |
| S.Em± | 7298 | 7321 | 5942 | 7298 | 7321 | 5942 | 0.13 | 0.14 | 0.11 |
| CD(P=0.05) | 22487 | 22559 | 18310 | 22487 | 22559 | 18310 | 0.41 | 0.43 | 0.35 |

| *Treatment* | *Details* |
|---|---|
| *$T_1$: Natural Farming* | *Jeevamrtha 200 lit /15 days + Ghanajevamrutha 400 kg/ acre + Beejamrutha (Seed treatment )* |
| *$T_2$: Organic Production System* | *Vermicompost (P Equivalent ) and Rhizobium 150 g/Acre + PSB 400g/acre(Seed treatment)* |
| *$T_3$: Recommended Package of Practice (RPP)* | *FYM 4 ton /acre, NPK 10:20:15 kg/acre and Rhizobium 150 g/Acre + PSB 400g/acre(Seed treatment)* |
| *$T_4$: Absolute Control* | *Only sowing* |

*** Organic price is considered under natural and organic production system treatment*

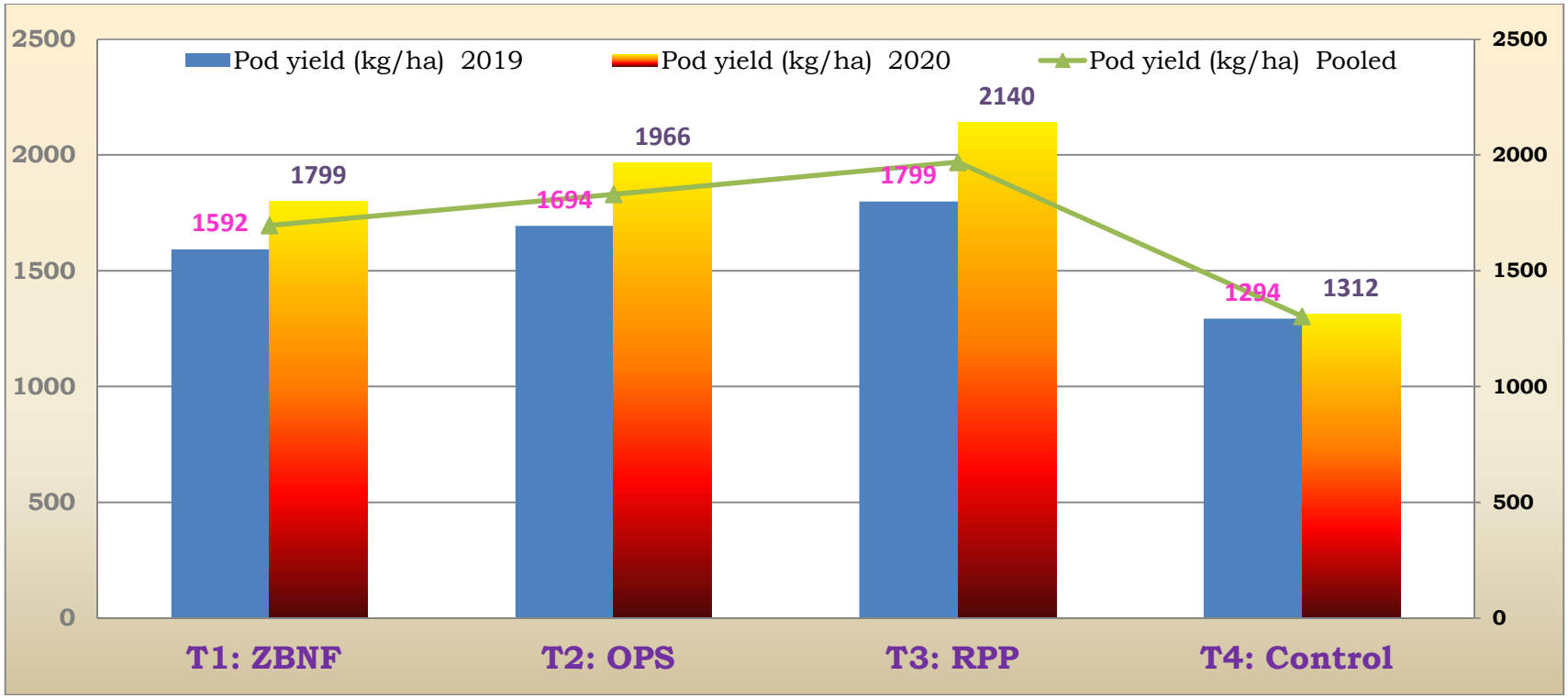


**Fig. 1. Yield (kg/ha) of Groundnut as influenced by different nutrient management practices at harvest (Pooled over two years)**

RDF (RPP) through inorganic fertilizer recorded significantly higher number of functional leaves during all growth stages. It was due to increase in assimilation rate, cell division and metabolic activities in plant because of faster release of nutrients in soils.These findings are collaborative with earlier reported by Sabale [17] and Karun akaran et al. [13]. The increase in number of branches with recommended package of practice was mainly due to its influence on the vegetative growth resulting in higher number of branches these findings was supportedby works of Gagare et al. [18]. The maximum dry matter production (68.5 g plant$^{-1}$) was recorded under nutrient management treatments due to increased plant height, functional leaves, of maximum nutrient availability it was reported by Karunakaran et al. [13].

### 3.3 Nutrient Uptake

Improvement in yield and yield attributes might be due to stimulation in root growth by inorganic nutrients as well better absorption of water and nutrients due to soil application of nutrients which further also supported the synergistic and complementary effect of applied nutrients which favour the higher yield. These findings are in line with those reported by Kumar et al. (2011). Further nutrient uptake studies revealed that application of nutrients increased the uptake of major nutrients by groundnut. The treatment receiving recommended package of practice recorded higher uptake of nutrients (N, P and K) by groundnut as compared to other treatments (Table 5). Combined application of FYM 4 ton /acre with NPK 10:20:15 kg/acre brought about significant improvement in N, P and K uptake by groundnut to the extent of 77.97, 76.49, 72.37 and 79.34, 82.24 and 70.32 per cent, respect tively during 2019 and 2020 over absolute control. Increased nutrient uptake with combined application of FYM might be due to consistent supply of nutrients and reduced rate of loss of releasing nutrients during the process of decomposition of FYM and also due to improved root growth and its functional activity which helped in greater extraction of nutrient. The application recommended dose of FYM coupled with fertilizers reduces N losses and conserves soil N by mineralization, thus maintaining a continuous availability of major nutrients in the entire life cycle of groundnut plant which would result in the increase of total nutrient uptake. Further, application of farm yard manure help the cropto the greater extent of availability of phosphorus which enhanced the cambial activity of root hairs involved in root cell development and enhanced the root proliferation and root biomass. It helps to allowing the plants to absorb higher quantity of essential nutrients such as N, P and K from rhizosphere soil. This is unfailing with the observations of Bholanth Saha et al. [19]. The uptake of major nutrients by groundnut is also mainly due to greater availability of N, $P_2O_5$ and $K_2O$.The major nutrients are also involved in aspects of cell division, nitrogen metabolism, carbohydrate metabolism, active salt absorption and hormone movement in groun dnut crop. It involved in cambial activity of root hairs, root proliferation and cell development on root resulted in increased plant height, number of leaves, leaf area and maximum biological yield and ultimately uptake of N, $P_2O_5$ and $K_2O$. The results are in agreement with the findings of Peter [20] and Nadaf and Chidanadappa [21].

## 4. CONCLUSION

Application of recommended package of practice resulted in better growth and yield attributes and contributed for improved fertility status of soil. It has resulted in 33.82 percent increased pod yield (1969 kg ha$^{-1}$ over 1303 absolute control kg ha$^{-1}$). Hence, these readily available efficient chemical substitutes and they can be applied along with organic manures in an integrated approach for obtaining higher crop yield besides improving the nutrient status of the soil. It can be concluded from the present study that summer groundnut crop though had higher yield and yield attributes due to the application of recommended package of practice.

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## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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