Indian Journal of Agronomy **61** (2): 161–167 (June 2016)

**Research Paper**

# Productivity, profitability and nutrient uptake in groundnut (*Arachis hypogaea*)-based cropping systems under different nutrient-management practices

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Received : December 2015; Revised accepted : April 2016

## ABSTRACT

A field experiment was carried out during 2011–12 to 2012–13 at Rahuri, Maharashtra, on sandy clay-loam soil, to evaluate the groundnut (*Arachis hypogaea* L.)-based diversified cropping systems, viz. groundnut–onion (*Allium cepa* L), groundnut–wheat [*Triticum aestivum* (L.) emend. Fiori & Paol.) and groundnut–chickpea (*Cicer arietinum* L.), under 4 nutrient-management practices, viz. recommended dose of fertilizer (RDF), fertilizer dose as per soil test, fertilizer dose as per soil–test crop response (STCR) equations and control (main-plots), and 3 fertilizer levels, viz. 100% RDF, 75% RDF and 50% RDF as sub-plot treatments. This semi-arid tract with an annual rainfall received 527.8 mm and 424.0 mm during both years, respectively. The altitude varies from 495 to 569 m above mean sea-level. The yield target of 2.5 t/ha was achieved in rainy-season (*kharif*) groundnut by application of fertilizer as per STCR equation with less than 10% variation (–5.8%) on pooled mean basis. Among the cropping systems, groundnut–onion cropping system recorded significantly maximum total system productivity (7.82 t/ha), production efficiency (35.1 kg/ha/day) and economic efficiency (₹842.5/ha/day) than rest of the cropping systems. Similarly, groundnut–onion cropping system obtained significantly maximum net monetary returns (₹188.0 × $10^3$/ha) and benefit: cost ratio (2.98 ) than rest of cropping systems. At the end of the 2 years cropping cycles, application of fertilizer as per STCR equation (2.5 t/ha) to *kharif* groundnut, followed by 75% RDF (75, 37.5, 37.5 N, $P_2O_5$, $K_2O$ kg/ha) to onion during the winter (*rabi*) season found most remunerative proposition to achieve the maximum yield and monetary benefits in groundnut–*rabi* onion cropping system.

***Key words* :** Cropping systems, Nutrient management, Productivity, Profitability, Soil health

In the climate change, agriculture in India has to face new challenges to compete at the global level in many agricultural commodities. Now in India, farmers are practicing mostly monocropping which can decrease system productivity, reduce profitability and decline soil health. It is clear that, continuous use of chemical fertilizers in intensive cropping system is leading to imbalance of nutrients in soil, which has an adverse effect on soil health and also on crop yields (Hashim *et al.,* 2015). Inclusion of legume and oilseeds in cropping system has advantages beyond N addition through biological nitrogen fixation which includes recycling from soil layers, minimizing soil compaction, protecting soil from erosion, increasing soil organic matter through root biomass and leaf fall and minimizing any harmful allopathic effects (Jain *et al.,* 2015). Groundnut (*Arachis hypogaea* L.) is the premier oilseed crop of India, occupying an area of 6.7 million/ha, contributes 7.3 million tonnes towards oilseed production. India stands first in area and second in production and fifth in productivity (995 kg/ha). The challenge of producing 58.56 million tonnes of oilseeds to meet the requirement of 1.13 billion Indian populations. A gap of about 33.82 million tonnes of oilseeds needs the growth rate of 5.56% per annum in the production. Area under oilseeds is not likely to increase in the near future and meeting this gap is the most important problem in India today. Groundnut is an unpredictable legume since its response to nutrient application is always not optimistic, excessive application of nitrogen and potassium often resulted in excessive vegetative growth considering the availability of the major elements in the soil and quantum of losses due to leaching or fixation of the individual elements. The research is aimed to have better understanding of different nutrient-management treatments on optimizing the nutrient requirement and uptake in increasing the pod yield of groundnut and benefits of interaction between the organic, inorganic manures which can be helpful for increasing the produc-

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tion of rainy season (*kharif*) groundnut and their residual effects on succeeding crops. In nutrient management, the targeted yield concept has proved to be superior to others whose theoretical basis and proof was demonstrated by Ramamoorthy *et al.* (2009). So, it is essential to increase the production potential of legume based cropping system and effort was been made to carried out an experiment for 2 consecutive years with yield maximization in groundnut-based cropping systems under different nutrient-management treatments.

## MATERIALS AND METHODS

A field experiment was conducted during 2011–12 to 2012–13 at Post-graduate Institute, Research Farm, Mahatma Phule Krishi Vidyapeeth, Rahuri (19° 48' N and 74° 32' E 495 m above mean sea-level). The average maximum and minimum atmospheric temperatures were 32.4°C and 15.5°C respectively. The average relative humidity was 62% in morning and 42.5% in the evening. Rainfall received during 2011–12 and 2012–13 was 527.8 and 424.0 mm respectively (average 520.0 mm). The soil is sandy clay loam (clay–44.45%, Silt–33.20% and Sand–21.42%), having *p*H 8.2 and electrical conductivity 0.29 dS/m and organic carbon 0.54% in top of 15 cm soil. The available nitrogen, phosphorus and potassium were 172.11, 18.02, 427.0 kg/ha and moderate in Fe, Mn, Zn and Cu, being 6.89, 9.51, 0.62 and 3.41 µg/g of soil. The field capacity, bulk density and permanent wilting point of the surface (0–15 cm) soil were 32.23% on volume basis, 1.32 Mg/m$^3$ and 16.21% respectively.

The experiment was laid out in randomized block design during *kharif* season with 9 replications and strip-plot design in *rabi* season with 3 replications. The treatment tested include 3 cropping systems viz. groundnut–onion, groundnut–wheat and groundnut–chickpea, with 4 nutrient-management practices, viz. recommended dose of fertilizer, fertilizer dose as per soil test, fertilizer dose as per soil-test crop response (STCR) equations and control as main-plot treatment, whereas 3 fertilizer levels, viz. 100% RDF, 75% RDF and 50% RDF as sub plot treatments. The crop varieties, viz. groundnut 'JL 501' and chickpea 'Digvijay' were dibbled at 30 cm × 10 cm, onion 'N 2-4-1' was transplanted at 15 cm × 10 cm spacing and wheat 'Trimbak' was sown in 22.5 cm line spacing respectively. The recommended dose of N, P and K (kg/ha) for groundnut 25–50 and 0, onion 100–50 and 50, wheat 120–60 and 40 and chickpea 25–50 and 0 was applied. The yield-target equation was used for *kharif* groundnut as prescribed by Ramamoorthy *et al.* (1967). Targeted yield-equations for $F_N$ (kg/ha) = 4.16 T – 0.37 $S_N$; $FP_2O_5$ (kg/ha) = 4.96 T– 4.36 SP; $FK_2O$ (kg/ha) = 3.14 T–0.16 SK; where FN, $FP_2O_5$ and $FK_2O$ = Fertilizer in kg/ha; T is target yield (t/ha), SN is soil available nitrogen (kg/ha); SP, soil available phosphorus (kg/ha); SK, soil available potassium (kg/ha). Groundnut was sown in the third week of June and harvested in the second week of October. The winter crops, viz. onion, durum wheat and chickpea, were sown in the second week of November and harvested in the third and fourth week of onion. The intercultural operations, seed rate, protective irrigation as per critical growth stages and plant-protection measures were carried out as per the recommendations of respective crops. In experimental plot, 5 plants were selected randomly from the second row of each plot in *kharif* groundnut, *rabi* onion, chickpea and per m$^2$ area of wheat was selected after leaving the first row of the each plot for measurement of growth and yield attributes. The economic yield of the component crops was taken into account over the years and then expressed as productivity (t/ha) of different cropping sequences. The cost of cultivation was calculated by taking into account the prevailing prices of inputs. To compare different crop sequences, the yields of all crops were converted into groundnut equivalents (GEs) on market price basis. Production efficiency (PE) in terms of kg/ha/day was worked out by total economic yield in terms of PE in a crop rotation divided by total duration of crops in a system (Tomar and Tiwari, 1990). Economic efficiency in terms of ₹/ha/day was worked out by dividing the net returns of the sequence by total duration of crops in an agricultural year (Patil *et al.,* 1995). Net returns were the difference between the gross and net returns of the system total cost of cultivation of the component crops. Soil (0–15 cm) and plant samples were collected at the end of cropping cycle and analyzed for standard procedures and fertilizer dose of N, $P_2O_5$ and $K_2O$ was given as per soil test. Statistical analysis of the data was carried out using standard analysis of variance.

## RESULTS AND DISCUSSION

### *Yield and yield attributes of kharif groundnut*

The growth and yield attributes of *kharif* groundnut were influenced significantly due to different nutrient-management treatments during both the years. Application of fertilizer as per soil-test-crop response (STCR) equation (40, 50, 20 kg NPK/ha) to *kharif* groundnut exhibited significantly higher growth and yield attributes, *viz.* plant height, number of branches, number of pods and pod weight/plant, over the control. Similarly, the higher growth and yield attributes were reflected in significantly higher dry pod yield than rest of treatments during both the years and on pooled mean. The yield target of 2.5 t/ha was achieved by STCR equation with less than 10% variation (–5.8%). The fertilizer dose as per soil test was found the second best treatment (1.93 t/ha) during on pooled mean

(Table 1). This is because of balanced nutrition through yield target approach increases the photosynthetic rate and translocation of photosynthates towards reproductive parts (pods). Dudhatra *et al*. (2002) and Varalakshmi *et al*. (2005) reported similar findings.

### *Yield and yield attributes of rabi crops*

*Onion:* The residual effect of nutrient management significantly influenced the growth, yield attributes and yields of onion, wheat and chickpea during the period of experiment. The growth and yield attributes like plant height (cm), number of leaves, neck thickness (mm) and average weight of onion bulb (g) were significantly higher with application of fertilizer as per STCR equation to *kharif* groundnut and at par with fertilizer as per soil test and recommended dose of fertilizer in respect of weight of onion bulb during pooled mean. Application of fertilizer as per STCR equation to preceeding crop *kharif* groundnut resulted in the maximum and significantly higher yield of onion bulb and it was 9.75% higher than recommended dose of fertilizer on pooled mean. Application of 100% recommended dose fertilizer (RDF: 100, 50, 50 kg N, $P_2O_5$ and $K_2O$/ha) to succeeding onion crop preceded by *kharif* groundnut resulted in significantly higher bulb yield, being 4.46% higher than 75% RDF and 16.65% higher than 50% RDF on pooled mean (Table 2). This might be because of the residual effect of preceding crop maintaining soil organic matter, major and micronutrients, which increases the uptake of these nutrients and accelerating the physiological activities in crop for improving growth attributes. Similarly, it also increases the translocation of photosynthates towards onion bulb, resulting in increased weight of bulb. These results confirm the findings of Konde (2002), Reddy and Suresh (2009) and Jat *et al.* (2011).

*Wheat:* The growth and yield attributes of wheat were influenced significantly due to residual effect of *kharif* groundnut and fertilizer levels on pooled mean. Application of fertilizer as per STCR equation to preceding crop *kharif* groundnut registered significantly maximum growth and yield attributes, viz. plant height (cm), number of tillers/plant, number of spikelets/panicle, weight of grains/panicle than the control treatment. Similarly, application of fertilizer as per STCR equation to preceding crop *kharif* groundnut recorded significantly higher grain yield of wheat, being higher than recommended dose of fertilizer on pooled mean basis (Table 2).

An application of 100% RDF (120, 60 and 40 kg N, $P_2O_5$ and $K_2O$/ha) to wheat crop during the *rabi* season recorded significantly more plant height, tillers/plant, spikelets/panicle, weight of grains/panicle than 50% RDF and at par with 75% RDF. The effect reflected on significantly maximum grain yield (3.64 t/ha) and it was 14.9% higher in pooled mean than reduced level of fertilizer, i.e. 50% RDF but at par with 75% RDF on pooled mean ( Table 2). This indicate that growing of wheat crop after *kharif* groundnut saves 25% RDF because of balanced nutrition to *kharif* groundnut through STCR equation creates favourable environment in the root rhizosphere of wheat crop to absorb more nutrients and moisture by improving the nutrient-use efficiency. These results confirm findings of Verma *et al*. (2005), Ramesh *et al*. (2009) and Mubarak and Singh (2011).

*Chickpea:* Growing of chickpea during the *rabi* season preceded by *kharif* groundnut showed the favourable response for increasing the growth and yield attributes. The fertilizer management as per STCR equation revealed the maximum increase in growth and yield attributes, viz. plant height (cm), branches/plant, pods/plant and weight of grains/plant. The fertilizer application as per STCR equation increases the nutrient pool in soil which favourably increased nutrient availability to the succeeding crop because of that maximum and significantly higher grain yield (2.89 t/ha) of chickpea was achieved and it was 11.38% higher than recommended dose of fertilizer (Table 2).

The 100% RDF (25, 50 and 0 kg N, $P_2O_5$ and $K_2O$/ha) exhibited significantly maximum growth and yield at-

**Table 1.** Growth and yield attributes of rainy season groundnut as influenced by different nutrient management treatments (pooled mean of 2 years)

| Treatment | Plant height (cm) | Branches/ plant | Pods/plant | Weight of pods/plant (g) | Groundnut yield (t/ha) |
|---|---|---|---|---|---|
| *Nutrient management* | | | | | |
| Recommended dose of fertilizer | 28.1 | 6.4 | 25.5 | 19.3 | 1.71 |
| Fertilizer dose as per soil test | 29.1 | 6.8 | 28.4 | 21.7 | 1.92 |
| Fertilizer dose as per STCR equation (2.5 t/ha) | 30.1 | 6.8 | 30.6 | 24.3 | 2.35 |
| Control (no fertilizer) | 23.0 | 4.8 | 12.5 | 8.3 | 0.73 |
| SEm± | 0.92 | 0.35 | 0.92 | 0.75 | 0.05 |
| CD (P=0.5) | 2.26 | 1.02 | 2.67 | 2.20 | 0.14 |

**Table 2.** Growth, yield attributes and yield of winter crops as influenced by nutrient-management treatments (pooled mean of 2 years)

| Treatment | Onion | | | | | Wheat | | | | | Chickpea | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Plant height (cm) | Functional leaves/ plant | Neck thickness (mm) | Weight of bulb (g) | Onion bulb yield (t/ha) | Plant height (cm) | Tillers (/m$^2$) | Grains/ panicle | Weight of grains/ panicle (g) | Wheat grain yield (t/ha) | Plant height (cm) | Branches/ plant | Pods/ plant | Weight of grains/ plant (g) | Chickpea grain yield (t/ha) |
| *Nutrient management* | | | | | | | | | | | | | | | |
| Recommended dose of fertilizer | 55.8 | 9.3 | 14.9 | 117.0 | 54.5 | 96.0 | 473.1 | 42.5 | 2.16 | 3.94 | 45.9 | 10.5 | 37.0 | 11.0 | 2.60 |
| Fertilizer dose as per soil test | 56.1 | 9.5 | 15.2 | 121.4 | 55.6 | 97.6 | 517.2 | 46.1 | 2.21 | 4.08 | 46.8 | 10.8 | 39.8 | 11.4 | 2.69 |
| Fertilizer dose as per STCR equation (2.5 t/ha) | 57.5 | 9.6 | 16.0 | 125.0 | 59.7 | 99.7 | 553.6 | 49.1 | 2.43 | 4.26 | 48.8 | 11.4 | 43.3 | 12.6 | 2.89 |
| Control (no fertilizer) | 32.1 | 5.3 | 9.7 | 53.6 | 13.4 | 64.0 | 293.7 | 14.4 | 0.81 | 1.31 | 34.1 | 11.5 | 26.9 | 8.43 | 1.35 |
| SEm± | 0.96 | 0.14 | 0.36 | 1.24 | 0.90 | 1.35 | 21.34 | 0.92 | 0.04 | 0.04 | 1.94 | 0.20 | 0.83 | 0.35 | 0.07 |
| CD (P=0.5) | 2.73 | 0.43 | 1.25 | 3.69 | 2.72 | 4.67 | NS | 2.78 | 0.12 | 0.14 | 3.59 | 0.60 | 2.51 | 1.04 | 0.20 |
| *Fertilizer level* | | | | | | | | | | | | | | | |
| 100% of RDF | 53.3 | 9.1 | 14.6 | 115.0 | 48.8 | 92.2 | 481.9 | 42.5 | 2.24 | 3.64 | 46.0 | 11.0 | 41.3 | 12.0 | 2.64 |
| 75% of RDF | 51.6 | 8.8 | 14.0 | 107.0 | 46.8 | 89.9 | 467.4 | 40.0 | 1.95 | 3.48 | 45.1 | 10.6 | 38.1 | 11.1 | 2.43 |
| 50% of RDF | 46.2 | 7.3 | 13.2 | 90.7 | 41.9 | 85.9 | 427.5 | 31.6 | 1.51 | 3.17 | 40.7 | 9.4 | 30.9 | 9.6 | 2.08 |
| SEm± | 0.78 | 0.17 | 0.33 | 2.16 | 0.96 | 1.41 | 11.31 | 1.08 | 0.06 | 0.07 | 1.06 | 0.16 | 1.04 | 0.24 | 0.08 |
| CD (P=0.5) | 2.30 | 0.48 | 0.92 | 6.51 | 2.79 | 4.35 | NS | 3.46 | 0.17 | 0.23 | 3.17 | 0.47 | 3.12 | 0.71 | 0.26 |

RDF, Recommended dose of fertilizer

tributes like plant height (cm), branches/plant, pods/plant, weight of pods/plant and weight of grains/plant (Table 2). These effects on growth and yield attributes were directly reflected on grain yield of chickpea and resulted in significantly higher grain yield of 2.65 t/ha and at par with 75% RDF on pooled mean (Table 2). This indicates saving of 25% fertilizer, when chickpea was grown after the *kharif* groundnut. These results are in accordance with Rao and Shakatwat (2002), Ramesh *et al*. (2009) and Singh *et al.* (2010).

*System productivity:* The total system productivity of cropping systems was assessed based on groundnut-equivalent yield in groundnut–onion, groundnut–wheat and groundnut–chickpea cropping systems. Among the cropping systems, groundnut–onion cropping system showed significantly maximum total system productivity, being 138.9% higher than groundnut–wheat and 92.7% higher than groundnut–chickpea on pooled mean basis. The nutrient management as per STCR equation proved its superiority by recording maximum total system productivity of 6.69 t/ha and 19.3% higher than recommended dose of fertilizer on pooled mean basis. The total system productivity was significantly higher with 100% RDF to succeeding crop during the *rabi* season than 50% and at par with 75% RDF on pooled mean basis (Table 3).

*Production efficiency:* Among the cropping systems, groundnut–onion cropping system registered significantly higher production efficiency than groundnut–wheat and groundnut–chickpea cropping systems. The nutrient-management treatments as per STCR equation registered significantly higher production efficiency (30.3 kg/ha/day), being it was 17.2% higher than recommended dose of fertilizer during on pooled mean basis. Application of 100% RDF to succeeding crop during the *rabi* season revealed significantly higher production efficiency than 50% RDF and at par with 75% RDF on pooled mean (Table 3).

*Economic efficiency:* The groundnut–onion cropping system recorded significantly higher economic efficiency than groundnut–wheat and groundnut–chickpea cropping systems. Application of fertilizer as per STCR equation to *kharif* groundnut recorded significantly higher economic efficiency than rest of the nutrient management and the control treatment. Different fertilizer levels also influenced the economic efficiency of different cropping systems. Application of 100% RDF to succeeding crop during the *rabi* season recorded significantly higher economic efficiency than 50% RDF level and it was at par with 75% RDF on pooled mean (Table 3). This is because of higher yield and biomass production with higher level of fertilizer.

*Nutrient uptake and soil fertility*: Among the cropping systems, groundnut–chickpea recorded highest uptake of

**Table 3.** Total system productivity, production efficiency, economic efficiency and economics (pooled mean of 2 years)

| Treatment | Total system productivity (t/ha) | Production efficiency (kg/ha/day) | Economic efficiency (₹/ha/day) | Cost of cultivation ($\times 10^3$ ₹/ha) | Net monetary returns ($\times 10^3$ ₹/ha) | Benefit: cost ratio |
|---|---|---|---|---|---|---|
| *Cropping system* | | | | | | |
| Groundnut–onion | 7.82 | 35.0 | 842.4 | 95.0 | 188.0 | 2.98 |
| Groundnut–wheat | 3.27 | 15.0 | 209.3 | 72.0 | 46.0 | 1.64 |
| Groundnut–chickpea | 4.06 | 19.2 | 363.4 | 69.0 | 77.2 | 2.11 |
| SEm± | 0.06 | 0.15 | 5.95 | - | 1.2 | - |
| CD ( P=0.05) | 0.19 | 0.45 | 17.45 | - | 3.6 | - |
| *Nutrient-management* | | | | | | |
| Recommended dose of fertilizer | 5.61 | 25.8 | 552.3 | 82.2 | 120.5 | 2.47 |
| Fertilizer dose as per soil test | 5.93 | 27.0 | 598.1 | 82.8 | 131.5 | 2.59 |
| Fertilizer dose as per STCR equation (2.5 t/ha) | 6.69 | 30.2 | 713.3 | 83.2 | 158.1 | 2.90 |
| Control (no fertilizers) | 1.97 | 9.31 | 23.2 | 66.1 | 4.8 | 1.07 |
| SEm± | 0.08 | 0.18 | 6.87 | - | 1.4 | - |
| CD ( P=0.05) | 0.24 | 0.53 | 20.15 | - | 4.2 | - |
| *Fertilizer level* | | | | | | |
| 100% of RDF | 5.24 | 24.1 | 499.7 | 79.5 | 109.8 | 2.38 |
| 75% of RDF | 5.18 | 23.5 | 492.3 | 78.7 | 108.3 | 2.37 |
| 50% of RDF | 4.73 | 21.6 | 423.2 | 77.8 | 93.0 | 2.20 |
| SEm± | 0.05 | 0.21 | 3.76 | - | 1.2 | - |
| CD ( P=0.05) | 0.14 | 0.60 | 10.69 | - | 3.8 | - |

Market price: 2011–12: groundnut 34,500₹/t, onion 3,600₹/t, wheat 14,000₹/t, chickpea 33,000₹/t
2012–13: groundnut 37,500₹/t, onion 6,000₹/t, wheat 18,000₹/t, chickpea 36,000₹/t.

N (437.3 kg/ha) but groundnut–wheat recorded the maximum uptake of P (70.9 kg/ha) and K (338.4 kg/ha) nutrients as compared to the groundnut–chickpea cropping system. Application of fertilizer dose as per STCR equation (2.5 t/ha) to the *kharif* groundnut recorded the highest uptake of nutrients, followed by recommended dose of fertilizer, fertilizer dose as per soil test and the control treatments. The fertilizer dose when applied as per soil test recorded higher soil organic carbon, lower the *p*H and electrical conductivity, while the recommended dose of fertilizer resulted in higher soil available N, P and K and soil available nutrients on pooled mean. At the end of 2 years cropping cycle, application of 100% RDF to succeeding crop during the *rabi* season recorded higher nutrient uptake of N, P and K than 50 and 75% RDF (Table 4).

*Economics:* Among the cropping systems, groundnut–onion cropping system resulted in significantly higher net monetary returns and benefit: cost ratio than groundnut–wheat and groundnut–chickpea cropping systems. The groundnut–chickpea cropping system was second in respect of net monetary returns on pooled mean. Application of fertilizer as per STCR equation to *kharif* groundnut revealed significantly maximum net monetary returns and benefit: cost ratio than rest of the nutrient management treatments on pooled mean. Application of 100% RDF to succeeding crop during the *rabi* season obtained significantly more net monetary returns and benefit: cost ratio than 50% RDF and at par with 75% RDF in respect of net monetary returns and benefit: cost ratio on pooled mean (Table 3).

Thus, application of fertilizer as per soil test crop response (STCR) equation (2.5 t/ha yield target) to *kharif* groundnut, followed by 75% RDF (75, 37.5, 37.5 N, $P_2O_5$, $K_2O$ kg/ha) to succeeding onion during the *rabi* season found most remunerative option to achieve the maximum productivity, monetary benefit and sustainability in groundnut–*rabi* onion cropping system.

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**Table 4.** Total uptake of nutrients, soil chemical properties and soil-available nutrients at the end of cropping systems

| Treatment | Total nutrient uptake (kg/ha/annum) | | | Soil chemical properties | | | Soil available nutrients (kg/ha) | | |
|---|---|---|---|---|---|---|---|---|---|
| | N | P | K | *p*H | EC (dS/m) | Soil organic carbon (%) | N | P | K |
| *Cropping system* | | | | | | | | | |
| Groundnut–onion | 288.5 | 65.8 | 192.5 | 8.09 | 0.34 | 0.58 | 186.9 | 17.8 | 309.7 |
| Groundnut–wheat | 350.3 | 70.9 | 338.3 | 8.11 | 0.31 | 0.55 | 185.3 | 17.7 | 262.0 |
| Groundnut–chickpea | 437.2 | 64.8 | 248.3 | 7.92 | 0.27 | 0.59 | 192.0 | 18.0 | 270.2 |
| SEm± | - | - | - | 0.03 | 0.03 | 0.02 | - | - | - |
| CD (P=0.05) | - | - | | 0.09 | NS | NS | - | - | - |
| *Nutrient management* | | | | | | | | | |
| Recommended dose of fertilizer | 384.5 | 70.4 | 281.9 | 8.08 | 0.31 | 0.56 | 204.8 | 19.8 | 302.7 |
| Fertilizer dose as per soil test | 421.5 | 78.6 | 301.8 | 8.03 | 0.27 | 0.59 | 194.4 | 19.7 | 285.1 |
| Fertilizer dose as per STCR equation (2.5 t/ha) | 480.3 | 93.4 | 338.4 | 8.06 | 0.26 | 0.58 | 186.4 | 18.9 | 279.9 |
| Control (no fertilizers) | 148.8 | 26.2 | 116.7 | 7.99 | 0.30 | 0.53 | 166.4 | 12.8 | 268.8 |
| SEm± | - | - | - | 0.02 | 0.02 | 0.03 | - | - | - |
| CD (P=0.05) | - | - | - | 0.06 | NS | NS | - | - | - |
| *Fertilizer level* | | | | | | | | | |
| 100% of RDF | 386.0 | 73.4 | 276.6 | 8.10 | 0.33 | 0.58 | 195.7 | 19.1 | 291.3 |
| 75% of RDF | 368.7 | 68.1 | 264.8 | 8.07 | 0.31 | 0.55 | 186.9 | 18.0 | 281.9 |
| 50% of RDF | 321.6 | 59.8 | 237.6 | 7.95 | 0.28 | 0.54 | 181.6 | 16.3 | 272.6 |
| SEm± | - | - | - | 0.03 | 0.02 | 0.02 | - | - | - |
| CD ( P=0.05) | - | - | - | 0.08 | NS | NS | - | - | - |
| Initial status | – | – | – | 8.2 | 0.29 | 0.54 | 172.11 | 18.02 | 427.0 |

RDF, Recommended dose of fertilizer

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