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# Effect of integrated nutrient management on productivity, nutrient uptake and economics of rainfed pigeon pea (*Cajanus cajan*) with sesame (*Sesamum indicum*) and sorghum (*Sorghum bicolor*) intercropping system

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**Abstract**
A field experiment was carried out during kharif season of 2017-18 to study the effect of integrated nutrition on productivity, nutrient uptake and economics of rainfed pigeon pea [*Cajanus cajan* (L.) Mill sp.] with sesame (*Sesamum indicum*) and sorghum (*Sorghum bicolor*) intercropping system. Total uptake of N, P and K by pigeon pea were highest recorded with the sole pigeon pea, which was comparable to normal intercropping system pigeon pea + sesame and significantly superior over paired intercropping system pigeon pea + sorghum. Further, data revealed that normal intercropping system pigeon pea + sorghum gave maximum values of net return (Rs. 84176 $ha^{-1}$) and B:C ratio (2.87) and which was at par with paired intercropping system pigeon pea + sesame and significantly superior to sole planting of pigeon pea. Application of 75% RDF + FYM @ 5 t $ha^{-1}$ + sulphur @ 40 kg $ha^{-1}$ + $ZnSo_4$ @ 25 kg $ha^{-1}$ + boron @ 1.5 kg $ha^{-1}$ gave significantly higher grain yield (1690.55 q $ha^{-1}$), stalk yield (64.49 q $ha^{-1}$) and harvest index (17.840%) of pigeon pea during the year.

**Keywords:** Economics, integrated nutrition, intercropping system, nutrient uptake, pigeon pea, yields

## Introduction
Pigeon pea [*Cajanus cajan* (L.) Millsp] is a multipurpose leguminous crop that can provide food, fuel, wood and fodder for the small-scale farmer in subsistence agriculture (Egbe and Kalu 2009) [4]. India accounts for 90% of world's pigeon pea growing area and 85% of world's production of pigeon pea. In India, it is grown in an area of 3.47 mha with a production of 2.26 mt and productivity of 711 kg $ha^{-1}$. The low productivity of pigeon pea has been attributed to the fact that large area is under rainfed situation grown in wider spacing. It is generally intercropped with sorghum, seasame, cotton and pulses. Under such situation, short duration pulse crop such as black gram/green gram can be grown as an intercrop to increase the productivity of the system. When pigeon pea is grown as a sole crop, it is relatively inefficient because of its slow initial growth rate and low harvest index; therefore, it is grown as intercrop, which helps in efficient utilization of available resources for enhancing the productivity and profit. To raise production on a sustainable basis, increased use of organic manures, management of nutrients through inter/mixed cropping is must both in rainfed and irrigated farming systems. Presently, organic sources of nutrients are preferred to synthetic chemicals but there is apprehension that the adequate quantity of organic material for the purpose may not be available. Therefore, there is a need for standardizing the mixed use of organic and inorganic sources of nutrition in order to increase the productivity and improving the soil health (Sharma *et al*. 2010) [17, 20]. The lack of information on these aspects under rainfed conditions made as impetus to undertake the present study.

## Materials and Methods
The field experiment was conducted during kharif season of 2017-18 at Agronomy Research Farm, Narendra Dev University of Agriculture and Technology, Kumarganj, Ayodhya, Uttar Pradesh, India situated in subtropical sub humid climate in indo-gangatic plains and lies between 26.47° North latitude and 81.12° East longitude with is an elevation of about 113 m. The treatments comprised of three intercropping systems (Pigeon pea sole, pigeon pea +

sesame and pigeon pea + sorghum) with five different integrated nutrient management's levels [RDF (20:40:0 kg NPK/ha for pigeon pea and 60:30:30 kg NPK/ha for sorghum & sesame); 75% RDF + FYM @ 5 t $ha^{-1}$; 75% RDF + FYM @ 5 t $ha^{-1}$ + sulphur @ 40 kg $ha^{-1}$; 75% RDF + FYM @ 5 t $ha^{-1}$ + sulphur @ 40 kg $ha^{-1}$ + $ZnSo_4$ @ 25 kg $ha^{-1}$ and 75% RDF + FYM @ 5 t $ha^{-1}$ + sulphur @ 40 kg $ha^{-1}$ + $ZnSo_4$ @ 25 kg $ha^{-1}$ + boron @ 1.5 kg $ha^{-1}$)] alone with sole cropping of pigeon-pea, sesame and sorghum. The experiment was laid out in Randomized Block Design with three replications. The experimental soil was silty loam in textural having low in organic carbon (0.33%), available N, P, and K was 158, 15.00 and 250 kg $ha^{-1}$, respectively with pH (8.0). The varieties namely Pigeon pea (Narendra Arhar-1), Sesame (T-12) and Sorghum (PKV-400) were sown in first week of July. Inter crops were harvested 90-110 days after sowing (sesame) and 110-120 days after sowing (sorghum) during 2017-18, respectively. Pigeon pea crop was harvested on 25th March in 2018. The Soil samples up to 15 cm depth were collected from individual plot after harvesting the pigeon pea crop. One soil sample of each plot was air dried; proceed to pass through 2 mm sieve. Soil samples was stored at low temperature in the deep freezer and used for estimation of different soil biological properties. The other cultural operations were done as per recommendation and crop requirement. Seed yield was computed by threshing pods from net plot, cleaned and the seeds weight was recorded. From this seed yield per hectare was computed. Net returns (Rs. $ha^{-1}$) were calculated by deducting cost of cultivation (Rs. $ha^{-1}$) from gross returns, while B:C ratio was worked out as ratio of gross returns (Rs. $ha^{-1}$) to cost of cultivation (Rs. $ha^{-1}$). The data was pooled for final statistical analysis as per the method suggested by (Gomez and Gomez 1984) [6]. Nutrient uptake in grain and stover of pigeon pea crop were calculated in kg $ha^{-1}$ in relation to dry matter production $ha^{-1}$ by using the formula.

$$\text{Nutrient uptake (kg ha}^{-1}) = \frac{\text{Nutrient content (\%)} \times \text{Yield (Grain/stover in kg ha}^{-1})}{100}$$

Pigeon pea equivalent yield (PEY) was calculated as follows:

$$\text{PEY (kg ha}^{-1}) = \frac{\text{Economic yield of a crop} \times \text{Per kg price of respective crop}}{\text{Price per kg of pigeon pea}}$$

## Results and Discussion

### Growth and development

Results on growth pattern of pigeon pea, sesame and sorghum are presented in Table 1. Among the intercropping systems the maximum plant height, total number of nodule (290.43 cm, 29.87 $plant^{-1}$) was recorded with pigeon pea sole which was significantly higher than pigeon pea + sorghum (259.28 cm, 26.67 $plant^{-1}$) and pigeon pea + sesame (255.22 cm, 26.25 $plant^{-1}$) respectively, during the year. Here it may be pointed out that, the competition between pigeon pea and sorghum for space, sunlight, nutrient water etc. was more as compared to sesame which resulted poor growth and development of pigeon pea under pigeon pea + sorghum intercropping system. Further, sesame crop also improve the fertility status and physical condition of soil which augmented growth and development of pigeon pea under pigeon pea + sesame the results collaborated with the finding of Kumar *et al.* (2003) [11] & Singh *et al.* (2013) [12]. The data revealed that amongst integrated nutrient management system, application of 75% RDF + FYM @ 5 t $ha^{-1}$ + sulphur @ 40 kg $ha^{-1}$ + $ZnSo_4$ @ 25 kg $ha^{-1}$ + boron @ 1.5 kg $ha^{-1}$ were recorded significantly maximum plant height (295.85 cm) and total number of nodule (30.43 $plant^{-1}$) during the experimentation.

### Yield attributes and yield

Number of pods was significantly influence by intercropping system during years of the experimentation is presented in Table 1. It is evidence from the data that maximum number of pods (145.05 $plant^{-1}$) were recorded with pigeon pea sole followed by pigeon pea + sorghum (129.49 $plant^{-1}$) and pigeon pea + sesame (127.46 $plant^{-1}$) intercropping system. Sizable reduction in pigeon pea yield under pigeon pea + sorghum intercropping system was due to more competition between sorghum and pigeon pea for space, nutrients, soil moisture and solar energy (Goud *et al*. 2010; Kantwa *et al*. 2005 and Kumawat *et al*. 2013) [7, 9, 12]. The data revealed that amongst integrated nutrient management system, the application of 75% RDF + FYM @ 5 t $ha^{-1}$ + sulphur @ 40 kg $ha^{-1}$ + $ZnSo_4$ @ 25 kg $ha^{-1}$ + boron @ 1.5 kg $ha^{-1}$ were recorded significantly maximum number of pods (147.75 $plant^{-1}$) during the experimentation. Inclusion of sesame and intercrop with pigeon pea attributed to less exhaustion of soil fertility reduced early stage of crop weed competition due to their smothering effect on weeds compared to sole pigeon pea and pigeon pea + sorghum intercropping, thereby increased the yield indices and finally the grains equivalent yield of pigeon pea (Laxminarayana *et al*. 2005; Mahto *et al*. 2007; Marer *et al*. 2007; Reddy *et al*. 2007 and Sharma *et al*. 2010) [13-15, 17, 20].

Intercropping system significantly influence grain yield and stalk yield of pigeon pea during the years. Grain yield, stalk yield and harvest index (16.59 q $ha^{-1}$, 84.66 q $ha^{-1}$ and 17.71%) were found significantly higher under pigeon pea sole intercropping system as compared to pigeon pea + sorghum (14.81 q $ha^{-1}$, 48.16 q $ha^{-1}$ and 17.33%) and pigeon pea + sesame (14.58 q $ha^{-1}$, 53.41 q $ha^{-1}$ and 17.20%) respectively, during 2017-18. Pigeon pea + sorghum (20.62 q $ha^{-1}$) intercropping system were recorded significantly higher pigeon pea equivalent yield as compared to pigeon pea sole (16.59 q $ha^{-1}$) as well as pigeon pea + sesame (19.52 q $ha^{-1}$) intercropping system. Here it may be elucidated that yield attributing characters were also maximum under pigeon pea + sesame as compared to rest other inter cropping system. On the other hand intercropping of pigeon pea + sorghum reduced the above yield attributes significantly which results the lowest yield of pigeon pea under pigeon pea + sorghum intercropping system. Further, the beneficial effect of sesame reflected on pigeon pea yield was probable due to addition of N in soil by decay of nodules and also due to non-significant crop competition resulted by sesame. Similar finding have also been reported by Srivastava *et al.* 2004 [25]; Tiwari *et al.* 2018 and Tiwari *et al.* 2018. Data revealed that amongst integrated nutrient management system, the application of 75% RDF + FYM @ 5 t $ha^{-1}$ + sulphur @ 40 kg $ha^{-1}$ + $ZnSO_4$

@ 25 kg ha$^{-1}$ + boron @ 1.5 kg ha$^{-1}$ recorded maximum grain yield, stalk yield and harvest index and pigeon pea equivalent yield (16.90 q ha$^{-1}$, 64.49 q ha$^{-1}$, 17.84% and 20.79 q ha$^{-1}$) and minimum (12.66 q ha$^{-1}$, 62.60 q ha$^{-1}$, 16.75% and 15.88 q ha$^{-1}$) respectively, with RDF during year of study. The higher value of growth parameters and dry matter production were recorded under pigeon pea + sesame intercropping system, caused enhancement in stalk yield as the function of growth parameter like plant height, number of branches, stalk weight, dry matter accumulation in sesame stalk being root system it harvests the nutrients from upper soil. However, pigeon pea is deep rooted crop which harvest the nutrient from deeper soil. The results were in close conformity with the work done by Kumar *et al.* 2012 [10]; Sharma *et al.* 2012 [18, 21]; Sharma, 2009 [19]; Sharma *et al.* 2010 [17, 20] and Shivran *et al.* 2000a [22].

**Soil pH, EC, OC and available NPK**

Data on pH and electric conductivity of soil as affected by different intercropping and integrated nutrient management system are presented in Table 1. Different treatments (intercropping and integrated nutrient management system) did not affect significantly the pH and EC (dSm$^{-1}$) of soil during the year. pH (7.98) and EC (0.31 dSm$^{-1}$) over slightly decreased with pigeon pea + sesame intercropping system. Application of nutrient system 75% RDF + FYM @ 5 t ha$^{-1}$ + sulphur @ 40 kg ha$^{-1}$ + $ZnSo_4$ @ 25 kg ha$^{-1}$ + boron @ 1.5 kg ha$^{-1}$. Maximum organic carbon and organic matter (%) of soil were recorded with pigeon pea + sesame while, minimum in pigeon pea sole during the year. At harvest stage of crop, OC of soil recorded in pigeon pea + sesame intercropping system was significantly higher than pigeon pea sole but it was at par with sole pigeon pea + sorghum during year. Available nitrogen, phosphorus and potassium content in soil were influenced significantly due to intercropping system during the years. Maximum available nitrogen (163.83 kg ha$^{-1}$) in soil was recorded under the pigeon pea sole which was significant superior over pigeon pea + sesame (163.66 kg ha$^{-1}$) and pigeon pea + sorghum (163.36 kg ha$^{-1}$) intercropping system during the year. Significantly maximum available phosphorus was observed under pigeon pea + sorghum (17.65 kg ha$^{-1}$) which was superior over pigeon pea sole (17.60 kg ha$^{-1}$) and pigeon pea + sesame (17.14 kg ha$^{-1}$). Maximum available potassium (269.63 kg ha$^{-1}$) in soil was recorded under the pigeon pea + sesame intercropping system which was significant superior over pigeon pea sole (268.25 kg ha$^{-1}$) and pigeon pea + sorghum (267.52 kg ha$^{-1}$) intercropping system during the year (Ahamad *et al*. 2017; Balaguraviah *et al*. 2005; Chaturvedi *et al*. 2010 and Garud *et al*. 2018) [1-3, 5].

**Nutrients uptake**

A close observation of the data revealed that intercropping system was influence significantly nitrogen, phosphorus and potassium content in grain as well as straw of pigeon pea during the year. Maximum nitrogen uptake was recorded with pigeon pea + sorghum (72.40 and 97.72 kg ha$^{-1}$) intercropping as well as grain and straw as compared to pigeon pea sole (61.66 and 79.94 kg ha$^{-1}$) and pigeon pea + sesame (49.86 and 68.26 kg ha$^{-1}$) intercropping system during the year. Total nitrogen uptake (grain + straw) of pigeon pea was recorded under pigeon pea + sorghum (170.12 kg ha$^{-1}$) which was significantly higher as compared to pigeon pea sole (141.60 kg ha$^{-1}$) and pigeon pea + sesame (118.12 kg ha$^{-1}$). Maximum phosphorus uptake was recorded with pigeon pea + sorghum (13.89 and 25.71 kg ha$^{-1}$) intercropping as well as grain and straw as compared to pigeon pea sole (7.52 and 11.73 kg ha$^{-1}$) and pigeon pea + sesame (8.18 and 12.62 kg ha$^{-1}$) intercropping system during the year. Total phosphorus uptake (grain + straw) of pigeon pea was recorded under pigeon pea + sorghum (39.60 kg ha$^{-1}$) which was significantly higher as compared to pigeon pea sole (19.25 kg ha$^{-1}$) and pigeon pea + sesame (20.80 kg ha$^{-1}$). Maximum potassium uptake was recorded with pigeon pea + sorghum (21.01 and 235.43 kg ha$^{-1}$) intercropping as well as grain and straw as compared to pigeon pea sole (13.56 and 140.72 kg ha$^{-1}$) and pigeon pea + sesame (10.92 and 99.15 kg ha$^{-1}$) intercropping system during the year. Total potassium uptake (grain + straw) of pigeon pea was recorded under pigeon pea + sorghum (256.43 kg ha$^{-1}$) which was significantly higher as compared to pigeon pea sole (154.28 kg ha$^{-1}$) and pigeon pea + sesame (110.70 kg ha$^{-1}$). The application of 75% RDF + FYM @ 5 t ha$^{-1}$ + sulphur @ 40 kg ha$^{-1}$ + $ZnSo_4$ @ 25 kg ha$^{-1}$ + boron @ 1.5 kg ha$^{-1}$ was found significantly higher nitrogen uptake in grain (66.80 kg ha$^{-1}$) and straw (88.06 kg ha$^{-1}$) as compared to RDF alone while statistically at par with 75% RDF + FYM @ 5 t ha$^{-1}$ + sulphur @ 40 kg ha$^{-1}$ + $ZnSo_4$ @ 25 kg ha$^{-1}$ during the year. The data revealed that amongst nutrient system, application of 75% RDF + FYM @ 5 t ha$^{-1}$ + sulphur @ 40 kg ha$^{-1}$ + $ZnSo_4$ @ 25 kg ha$^{-1}$ + boron @ 1.5 kg ha$^{-1}$ was recorded maximum total nitrogen uptake (154.85 kg ha$^{-1}$) as compared to RDF alone (144.31 kg ha$^{-1}$) which was statistically at par 75% RDF + FYM @ 5 t ha$^{-1}$ + sulphur @ 40 kg ha$^{-1}$ + $ZnSo_4$ @ 25 kg ha$^{-1}$ during 2017-18. It is also apparent from the data that various nutrients management had significant influence on total phosphorus uptake (grain + straw) during the year. The application of 75% RDF + FYM @ 5 t ha$^{-1}$ + sulphur @ 40 kg ha$^{-1}$ + $ZnSo_4$ @ 25 kg ha$^{-1}$ + boron @ 1.5 kg ha$^{-1}$ was found significantly higher phosphorus uptake in grain (10.82 kg ha$^{-1}$) and straw (18.11 kg ha$^{-1}$) as compared to RDF alone while statistically at par with 75% RDF + FYM @ 5 t ha$^{-1}$ + sulphur @ 40 kg ha$^{-1}$ + $ZnSo_4$ @ 25 kg ha$^{-1}$ during the year. The data revealed that amongst nutrient system, application of 75% RDF + FYM @ 5 t ha$^{-1}$ + sulphur @ 40 kg ha$^{-1}$ + $ZnSo_4$ @ 25 kg/ha + boron @ 1.5 kg ha$^{-1}$ was recorded maximum total phosphorus uptake (28.93 kg ha$^{-1}$) as compared to RDF alone (26.69 kg ha$^{-1}$) which was statistically at par 75% RDF + FYM @ 5 t ha$^{-1}$ + sulphur @ 40 kg ha$^{-1}$ + $ZnSo_4$ @ 25 kg ha$^{-1}$ during 2017-18. The application of 75% RDF + FYM @ 5 t ha$^{-1}$ + sulphur @ 40 kg ha$^{-1}$ + $ZnSo_4$ @ 25 kg ha$^{-1}$ + boron @ 1.5 kg ha$^{-1}$ was found significantly higher potassium uptake in grain (16.68 kg ha$^{-1}$) and straw (1698.20 kg ha$^{-1}$) as compared to RDF alone while statistically at par with 75% RDF + FYM @ 5 t ha$^{-1}$ + sulphur @ 40 kg ha$^{-1}$ + $ZnSo_4$ @ 25 kg ha$^{-1}$ during the year. The data revealed that amongst nutrient system, application of 75% RDF + FYM @ 5 t ha$^{-1}$ + sulphur @ 40 kg ha$^{-1}$ + $ZnSo_4$ @ 25 kg ha$^{-1}$ + boron @ 1.5 kg ha$^{-1}$ was recorded maximum total potassium uptake (185.88 kg ha$^{-1}$) as compared to RDF alone (174.87 kg ha$^{-1}$) which was statistically at par 75% RDF + FYM @ 5 t ha$^{-1}$ + sulphur @ 40 kg ha$^{-1}$ + $ZnSo_4$ @ 25 kg ha$^{-1}$ during the year.

**Economic studies**

Among the intercropping systems, maximum net returns (Rs. 84176 ha$^{-1}$) was found from pigeon pea + sorghum intercropping system, while the lowest net return (Rs. 25378 ha$^{-1}$) was recorded in pigeon pea sole crop during the year Table 1. The highest benefit: cost ratio (2.39) was recorded

with pigeon pea + sorghum intercropping system, while the lowest benefit: cost ratio (1.88) was recorded with pigeon pea sole during 2017-18, respectively. The maximum net return (Rs. 84583 ha$^{-1}$) was found 75% RDF + FYM @ 5 t ha$^{-1}$ + sulphur @ 40 kg ha$^{-1}$ + $ZnSo_4$ @ 25 kg ha$^{-1}$ + boron @ 1.5 kg ha$^{-1}$ as compared to other treatments. The minimum net return was recorded RDF (Rs. 62618 ha$^{-1}$). Application of 75% RDF + FYM @ 5 t ha$^{-1}$ + sulphur @ 40 kg ha$^{-1}$ + $ZnSo_4$ @ 25 kg ha$^{-1}$ + boron @ 1.5 kg ha$^{-1}$ recorded maximum benefit: cost ratio (2.84) followed by 75% RDF + FYM @ 5 t ha$^{-1}$ + sulphur @ 40 kg ha$^{-1}$ + $ZnSo_4$ @ 25 kg ha$^{-1}$ and RDF alone. Similar results were also reported by Singh *et al*. 2003 [11]; Srivastava *et al*. 2004 [25]. Tomar *et al*. 2004 [26], Yadav *et al*. 2005 [27].

**Table 1:** Growth, yield component and economics of pigeon pea as influenced by pigeon pea based intercropping and integrated nutrient management levels.

| Treatments | Plant height (cm) | Total number of nodule plant-1 | Number of pods plant-1 | Pigeon pea yield (q ha-1) | Intercrop yield (q ha-1) | | Stalk yield (q ha-1) | Harvest index (%) | Net return (Rs. ha-1) | Benefit : cost (Rs. ha-1) | Rain water-use efficiency (kg/ha-mm) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Sesame | Sorghum | | | | | |
| **Inter cropping system** | | | | | | | | | | | |
| Pigeon pea sole | 290.43 | 29.87 | 145.05 | 16.59 | - | - | 84.66 | 17.71 | 65867 | 2.59 | 1.88 |
| Pigeon pea + Sesame | 255.22 | 26.25 | 127.46 | 14.58 | 4.29 | - | 53.41 | 17.20 | 78314 | 2.69 | 2.26 |
| Pigeon pea + Sorghum | 259.28 | 26.67 | 129.49 | 14.81 | - | 12.78 | 48.16 | 17.33 | 84176 | 2.87 | 2.39 |
| S.Em± | 7.08 | 7.91 | 7.76 | 0.85 | - | - | 5.57 | 6.89 | - | - | - |
| CD (P = 0.05) | 14.20 | 1.63 | 8.00 | 9.82 | - | - | 2.58 | 0.89 | - | - | - |
| **Integrated nutrient management** | | | | | | | | | | | |
| RDF (20:40:0 kg NPK ha-1 for pigeon pea and 60:30:30 kg NPK ha-1 for sorghum & sesame) | 221.57 | 22.79 | 110.66 | 12.66 | 3.15 | 11.00 | 62.60 | 16.75 | 62618 | 2.52 | 1.84 |
| 75% RDF + FYM @ 5 t ha-1 | 260.67 | 26.81 | 130.19 | 14.89 | 4.00 | 12.42 | 58.61 | 17.33 | 72645 | 2.63 | 2.12 |
| 75% RDF + FYM @ 5 t ha-1 + sulphur @ 40 kg ha-1 | 274.98 | 28.28 | 137.33 | 15.71 | 4.55 | 13.00 | 61.75 | 17.50 | 78218 | 2.77 | 2.24 |
| 75% RDF + FYM @ 5 t ha-1 + sulphur @ 40 kg ha-1 + $ZnSO_4$ @ 25 kg ha-1 | 288.48 | 29.67 | 144.07 | 16.48 | 4.80 | 13.62 | 62.94 | 17.66 | 82530 | 2.82 | 2.36 |
| 75% RDF + FYM @ 5 t ha-1 + sulphur @ 40 kg ha-1 + $ZnSO_4$ @ 25 kg ha-1 + boron @ 1.5 kg ha-1 | 295.85 | 30.43 | 147.75 | 16.90 | 4.50 | 13.85 | 64.49 | 17.84 | 84583 | 2.84 | 2.41 |
| S.Em± | 7.08 | 7.91 | 7.76 | 0.85 | - | - | 5.57 | 6.89 | - | - | - |
| CD (P = 0.05) | 18.33 | 2.10 | 10.03 | 12.68 | - | - | 3.34 | 1.15 | - | - | - |

**Table 2:** Soil pH, EC, OC, available NPK and nutrients uptake of pigeon pea as influenced by pigeon pea based intercropping and integrated nutrient management levels.

| Treatments | pH | EC (dSm-1) | OC (%) | Av. nutrients (kg-1) | | | N uptake (kg-1) | | | P uptake (kg-1) | | | K uptake (kg-1) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | N | P | K | Grain | Straw | Total | Grain | Straw | Total | Grain | Straw | Total |
| **Inter cropping system** | | | | | | | | | | | | | | | |
| Pigeon pea sole | 7.97 | 0.31 | 0.33 | 163.83 | 17.60 | 268.25 | 61.66 | 79.94 | 141.60 | 7.52 | 11.73 | 19.25 | 13.56 | 140.72 | 154.28 |
| Pigeon pea + Sesame | 7.98 | 0.32 | 0.32 | 163.66 | 17.14 | 269.63 | 49.86 | 68.26 | 118.12 | 8.18 | 12.62 | 20.80 | 10.92 | 99.15 | 110.70 |
| Pigeon pea + Sorghum | 7.98 | 0.31 | 0.31 | 163.36 | 17.65 | 267.52 | 72.40 | 97.72 | 170.12 | 13.89 | 25.71 | 39.60 | 21.01 | 235.43 | 256.43 |
| S.Em± | 7.48 | 6.45 | 5.45 | 5.56 | 9.96 | 6.00 | 1.113 | 1.561 | 1.26 | 0.18 | 0.32 | 0.45 | 0.27 | 3.31 | 3.23 |
| CD (P = 0.05) | 0.44 | 0.01 | 0.01 | 4.56 | 1.30 | 5.32 | 3.224 | 4.52 | 3.67 | 0.54 | 0.93 | 1.32 | 0.80 | 9.59 | 9.36 |
| **Integrated nutrient management** | | | | | | | | | | | | | | | |
| RDF (20:40:0 kg NPK ha-1 for pigeon pea and 60:30:30 kg NPK ha-1 for sorghum & sesame) | 7.99 | 0.32 | 0.30 | 160.00 | 15.10 | 258.90 | 61.86 | 82.45 | 144.31 | 9.97 | 16.72 | 26.69 | 15.23 | 159.64 | 174.87 |
| 75% RDF + FYM @ 5 t ha-1 | 7.98 | 0.32 | 0.32 | 167.13 | 18.20 | 272.10 | 53.94 | 74.13 | 128.07 | 8.51 | 14.95 | 23.46 | 13.27 | 144.85 | 158.12 |
| 75% RDF + FYM @ 5 t ha-1 + sulphur @ 40 kg ha-1 | 7.96 | 0.31 | 0.33 | 163.38 | 17.80 | 269.70 | 60.47 | 80.82 | 141.30 | 9.72 | 16.34 | 26.06 | 15.82 | 162.81 | 178.62 |
| 75% RDF + FYM @ 5 t ha-1 + sulphur @ 40 kg ha-1 + $ZnSO_4$ @ 25 kg ha-1 | 7.97 | 0.31 | 0.32 | 164.56 | 18.52 | 271.50 | 63.47 | 84.40 | 147.87 | 10.30 | 17.29 | 27.59 | 14.83 | 155.66 | 170.49 |
| 75% RDF + FYM @ 5 t ha-1 + sulphur @ 40 kg ha-1 + $ZnSO_4$ @ 25 kg ha-1 + boron @ 1.5 kg ha-1 | 7.98 | 0.31 | 0.33 | 163.02 | 17.67 | 270.13 | 66.80 | 88.06 | 154.85 | 10.82 | 18.11 | 28.93 | 16.68 | 169.20 | 185.88 |
| S.Em± | 7.48 | 6.45 | 0.02 | 5.56 | 9.96 | 6.00 | 1.43 | 2.01 | 1.63 | 0.24 | 0.41 | 0.59 | 0.36 | 4.274 | 4.17 |
| CD (P = 0.05) | 0.57 | 0.01 | 0.04 | 4.38 | 1.68 | 6.87 | 4.16 | 5.83 | 4.74 | 0.69 | 1.20 | 1.70 | 1.04 | 12.38 | 12.09 |

## Conclusion

Combined application of 75% RDF + FYM @ 5 t ha$^{-1}$ + sulphur @ 40 kg ha$^{-1}$ + $ZnSo_4$ @ 25 kg ha$^{-1}$ + boron @ 1.5 kg ha$^{-1}$ was found economically beneficial for obtaining higher productivity and economic return of pigeon pea + sesamum intercropping over sole pigeon pea and pigeon pea + sorghum under rainfed condition during the year.

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