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## Effect of integrated nutrient management on growth and yield of late sown chickpea (*Cicer arietinum* L.)

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### Abstract

The new appraisal entitled "Effect of integrated nutrient management on growth and yield of late sown chickpea (*Cicer arietinum* L.)" variety RVG (Raj Vijay Gram -202) was carried out at research farm of College of Agriculture and Research Station, Janjgir - Champa during the *rabi* season of 2022. The soil of the experimental site was a black soil. Field experiment was laid out in Randomized Block Design with three replications. Twelve treatments were tested *viz.* T<sub>1</sub> - 100% RDF through Inorganic fertilizer, T<sub>2</sub> - 100% RDF + Vermicompost @ 2 tons ha<sup>-1</sup>, T<sub>3</sub> - 100% RDF + NPK Consortia, T<sub>4</sub> - 100% RDF + Rhizobium culture, T<sub>5</sub> - 100% RDF + PSB, T<sub>6</sub> - 75% RDF + Vermicompost @ 2 tons ha<sup>-1</sup> + NPK Consortia, T<sub>7</sub> - 75% RDF + Vermicompost @ 2 tons ha<sup>-1</sup> + Rhizobium culture, T<sub>8</sub> - 75% RDF + Vermicompost @ 2 tons ha<sup>-1</sup> + PSB, T<sub>9</sub> 50% RDF + Vermicompost @ 2 tons ha<sup>-1</sup> + NPK Consortia, T<sub>10</sub> 50% RDN + Vermicompost @ 2 tons ha<sup>-1</sup> + Rhizobium culture, T<sub>11</sub> - 50% RDF + Vermicompost @ 2 tons ha<sup>-1</sup> + PSB, T<sub>12</sub> - 75% RDF + 25% Vermicompost @ 2 tons ha<sup>-1</sup> + PSB + Rhizobium culture. Application of T<sub>12</sub> - 75% RDF + 25% Vermicompost @ 2 tons ha<sup>-1</sup> + PSB + Rhizobium culture, recorded significantly higher almost all the growth and yield attributes *viz.* plant height, number of branches plant<sup>-1</sup>, dry matter accumulation plant<sup>-1</sup> number of pods plant<sup>-1</sup>, Number of seeds pod<sup>-1</sup>, 100 seed weight, seed yield. The least value of these parameters was recorded under the treatment T<sub>9</sub> - 50% RDF + Vermicompost @ 2 tons ha<sup>-1</sup> + NPK consortia which were at par with, T<sub>4</sub> - 100% RDF + Vermicompost @ 2 tons ha<sup>-1</sup>, T<sub>5</sub> - 100% RDF + PSB. Based on the experimental results, it could be concluded that, 75% RDF + 25% Vermicompost @ 2 tons ha<sup>-1</sup> + PSB + Rhizobium culture was found to be an ideal for late sown chickpea.

**Keywords:** Chickpea, integrated nutrient management, PSB, rhizobium culture, vermicompost, growth and yield parameter

### Introduction

Chickpea (*Cicer arietinum* L.) is a popular pulse crop that is grown in tropical, subtropical, and temperate climates. Chickpea is high in protein (20-22%). It's also high in fiber, carbohydrates (40-50%) fat, (4-5%) minerals, (47%) starch, (8%) curde fibre, and (3.6%) ash. The content of all the essential amino acids including lysine is adequate, but sulphur-containing amino acids, methionine and cysteine are limiting. It is also rich in minerals such as (Phosphorus, calcium, magnesium, iron, and zinc), and beta-carotene. Chickpeas are the second most popular legume crop after pigeonpea in the world for human diet and other use. Chickpeas are grown India, Pakistan, Turkey, Iran, Myanmar, Australia, Ethiopia, Canada, Mexico, and Iraq are some of the other main chickpea-producing countries. On the global basis production exceeds 11.5 million tons per year. The majority of the manufacturing took place in India. Most of the production centered in India. India is sharing 9.70 m ha area, 11.078 tons production and 11.42 kg ha<sup>-1</sup> productivity during 2020. (Source: Ministry of Agriculture & Farmers Welfare, Govt. of India). Chickpeas are farmed on around 10 million hectares of land worldwide, with an annual production of around 8.5 million metric tons.

The basic concept of integrated nutrient management is the maintenance of soil fertility and to supply the plant nutrients at an optimum level for sustaining the desired crop productivity through optimization of the benefits from all possible sources of plant nutrients in an integrated manner. Application of Farmyard manure (FYM) and vermicompost (VC) also improves soil health by improving nutrient availability, soil physical properties and microbial activity. Further, both Rhizobium and PSB are low-cost ecofriendly bio-fertilizer input is an integral component of integrated nutrient management (INM) for pulse production, considering this an experiment was planned and conducted. To increase agricultural productivity, biofertilizers and inorganic fertilizers must be used. Rhizobium has huge potential for nitrogen fixation in the atmosphere.

Phosphate solubilizing bacteria (PSB) solubilize the soil's inaccessible bound phosphates and make them available to plants, increasing total plant growth and production by 10 to 15% increasing in yield.

### Materials and Method

The experiment was carried out during *rabi* season 2021-22 conducted at Instructional Farm of College of Agriculture and Research Station, Janjgir - Champa (C.G.), which is situated at 21.99° North latitude and 82.61° East longitude and at an altitude of 294.40 meters above from mean sea level (MSL). The general climate condition of Surguja (Chhattisgarh) is Eastern Plateau and Hilly region with average annual rainfall is about 1200 mm, of which about 80% is, received a short span of four month i.e., between June to September. The experiment was carried out in Randomized Block Design (RBD) with 3 replication and 12 treatments, integrated nutrient management used as a treatment *viz.*, T<sub>1</sub> - 100% RDF through Inorganic fertilizer, T<sub>2</sub> - 100% RDF + Vermicompost @ 2 tons ha<sup>-1</sup>, T<sub>3</sub> - 100% RDF + NPK Consortia, T<sub>4</sub> - 100% RDF + Rhizobium culture, T<sub>5</sub> - 100% RDF + PSB, T<sub>6</sub> - 75% RDF + Vermicompost @ 2 tons ha<sup>-1</sup> + NPK Consortia, T<sub>7</sub> - 75% RDF + Vermicompost @ 2 tons ha<sup>-1</sup> + Rhizobium culture, T<sub>8</sub> - 75% RDF + Vermicompost @ 2 tons ha<sup>-1</sup> + PSB, T<sub>9</sub> 50% RDF + Vermicompost @ 2 tons ha<sup>-1</sup> + NPK Consortia, T<sub>10</sub> - 50% RDN + Vermicompost @ 2 tons ha<sup>-1</sup> + Rhizobium culture, T<sub>11</sub> - 50% RDF + Vermicompost @ 2 tons ha<sup>-1</sup> + PSB, T<sub>12</sub> - 75% RDF + 25% Vermicompost @ 2 tons ha<sup>-1</sup> + PSB + Rhizobium culture. The soil of the experimental site was a black soil. The crop variety "RVG - 202 (Raj Vijay Gram - 202)" was sown on 13 December 2021 at a spacing of 30 cm x 10 cm with fertilizer dose of 20:60:40 N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O kg<sup>-1</sup>. The crop was harvested at full maturity on 15 April 2022.

### Result and Discussion

The data pertaining to varietal performance on growth parameters are presented in table 1.

#### Plant height

Integrated nutrient management had significantly influenced on plant height of chickpea at 90 DAS stage of observation. Application of 75% RDF + 25% Vermicompost @ 2 tons ha<sup>-1</sup> + PSB + Rhizobium culture (T<sub>12</sub>) recorded significantly taller plant height at 90 DAS 41.52 cm, respectively over other treatments, but at par with 100% RDF + Vermicompost @ 2 tons ha<sup>-1</sup> (T<sub>2</sub>), 100% RDF + NPK consortia (T<sub>3</sub>), 100% RDF + Rhizobium culture (T<sub>4</sub>) and 100% RDF + PSB (T<sub>5</sub>). The lower plant height 35.85 cm was observed under the application of 50% RDF + Vermicompost @ 2 tons ha<sup>-1</sup> + NPK consortia (T<sub>9</sub>). The integrated nutrient management showed positive response on influencing the height of chickpea crop. These results confirm the finding of Jakhar *et al.* (2020)<sup>[6]</sup>.

#### Number of branches plant<sup>-1</sup>

The number of branches plant<sup>-1</sup> gradually increase under all the treatments at all growth stages of chickpea. Application of 75% RDF + 25% Vermicompost @ 2 tons ha<sup>-1</sup> + PSB + Rhizobium culture (T<sub>12</sub>) recorded significantly maximum number of branches plant<sup>-1</sup> 9.83 respectively which were at par with 100% RDF + Rhizobium culture (T<sub>4</sub>) and 100% RDF + PSB (T<sub>5</sub>) Whereas, the lowest number of branches plant<sup>-1</sup>

7.83 respectively was recorded at 90 DAS of observation. Similar findings were reported by Hussain *et al.* (2011), Jakhar *et al.* (2020)<sup>[6]</sup> and application of 100% RDF + Rhizobium culture + PSB is reported by Patel and Thanki (2020)<sup>[8]</sup>.

#### Leaf area (cm<sup>2</sup>)

The value of Leaf area increased with the inoculation of Rhizobium culture + PSB with inorganic fertilizer and was recorded to have higher value 71.01 (cm<sup>2</sup>) respectively in application of 75% RDF + 25% Vermicompost @ 2 tons ha<sup>-1</sup> + PSB + Rhizobium culture (T<sub>12</sub>) which were at par with 100% RDF + Rhizobium culture (T<sub>4</sub>), 100% RDF + PSB (T<sub>5</sub>), 100% RDF + Vermicompost @ 2 tons ha<sup>-1</sup> (T<sub>2</sub>), 100% RDF + NPK consortia (T<sub>3</sub>) Whereas, the least value of leaf area observed 60.93 (cm<sup>2</sup>) under 50% RDF + Vermicompost @ 2 tons ha<sup>-1</sup> + NPK consortia (T<sub>9</sub>). Similar result was observed by Sinha *et al.* (2018)<sup>[11]</sup>.

#### Performance on yield attributes and yield

The varietal performance for yield attributes and yield is discussed in following sub heads and the data presented in table 2.

#### Number of pods plant<sup>-1</sup>

Number of pods plant<sup>-1</sup> was increased significantly under those treatments where bio-fertilizers sources used with inorganic fertilizers. The maximum number of pods plant<sup>-1</sup> 40.79 was recorded with application of 75% RDF + 25% Vermicompost @ 2 tons ha<sup>-1</sup> + PSB + Rhizobium culture (T<sub>12</sub>) which was significantly higher over all the treatments but at par with 100% RDF + Rhizobium culture (T<sub>4</sub>), 100% RDF + PSB (T<sub>5</sub>), whereas the minimum number of pods plant<sup>-1</sup> was recorded with 50% RDF + Vermicompost @ 2 tons ha<sup>-1</sup> + NPK consortia (T<sub>9</sub>). It may be due to increase in availability of nutrient by vermicompost and Bio-fertilizer, resulted better growth and yield attribute the similar results was also reported by Ashoka *et al.* (2008)<sup>[3]</sup>.

#### No. of seeds pod<sup>-1</sup>

Number of seeds pod<sup>-1</sup> was showed non-significant among the other treatments. The maximum number of seeds pod<sup>-1</sup> 2.13 was recorded under the application of 75% RDF + 25% Vermicompost @ 2 tons ha<sup>-1</sup> + PSB + Rhizobium culture (T<sub>12</sub>) as compared to other treatments but the minimum number of seeds pod<sup>-1</sup> 1.67 was recorded with 50% RDF + Vermicompost @ 2 tons ha<sup>-1</sup> + NPK consortia (T<sub>9</sub>). The variation found might be due to higher availability of nutrient and favourable condition for producing a greater number of branches and pods. Similar result was conformity with Singh *et al.* (2008)<sup>[10]</sup>.

#### 100 seed weight (g)

The data pertaining to 100 seed weight have been presented in Table- 4.7. The 100 seed weight of chickpea were show to be non-significant among the other treatments. The higher 100 seed weight 24.49 (g) was recorded under application of 75% RDF + 25% Vermicompost @ 2 tons ha<sup>-1</sup> + PSB + Rhizobium culture (T<sub>12</sub>) as compare to other treatments but the lower 100 seed weight 21.22 (g) were recorded with 50% RDF + Vermicompost @ 2 tons ha<sup>-1</sup> + NPK consortia (T<sub>9</sub>). Similar results were reported by Ali *et al.* (2010), Patel and Thanki (2020)<sup>[8]</sup>.

**Seed yield (q ha<sup>-1</sup>)**

The higher seed yield of chickpea increased linearly with the application of Vermicompost + PSB + Rhizobium culture along with inorganic fertilizer and the significantly higher seed yield 18.85 q ha<sup>-1</sup> respectively was noticed with application of 75% RDF + 25% Vermicompost @ 2 tons ha<sup>-1</sup> + PSB + Rhizobium culture (T<sub>12</sub>) which were at par with 100% RDF + Rhizobium culture (T<sub>4</sub>), 100% RDF + PSB (T<sub>5</sub>). However, the minimum seed yield 13.55 q ha<sup>-1</sup> was observed with application of 50% RDF + Vermicompost @ 2 tons ha<sup>-1</sup> + NPK consortia (T<sub>9</sub>).

**Harvest index (%)**

Among the difference treatment showed non-significant

variation to each other but the maximum HI (38.16%) was recorded in Application of 75% RDF + 25% vermicompost @ 2 tons ha<sup>-1</sup> + PSB + Rhizobium (T<sub>12</sub>) and followed by 100% RDF + Rhizobium culture (T<sub>4</sub>), 100% RDF + PSB (T<sub>5</sub>), 75% RDF + Vermicompost @ 2 tons ha<sup>-1</sup> + NPK consortia (T<sub>6</sub>), 75% RDF + @ 2 tons ha<sup>-1</sup> Vermicompost + Rhizobium culture (T<sub>7</sub>), 75% RDF + @ 2 tons ha<sup>-1</sup> Vermicompost + PSB (T<sub>8</sub>), 100% RDF + Vermicompost @ 2 tons ha<sup>-1</sup> (T<sub>2</sub>), 100% RDF through inorganic fertilizer (T<sub>1</sub>) and 100% RDF + NPK consortia (T<sub>3</sub>). Whereas the lowest HI (35.00%) was recorded in application of 50% RDF + Vermicompost @ 2 tons ha<sup>-1</sup> + NPK consortia (T<sub>9</sub>). Similar result were observed with Patel and Thanki (2020)<sup>[8]</sup>.

**Table 1:** Effect of integrated nutrient management on growth attributes of late sown chickpea

Treatments	Plant height (cm)	Number of branches (plant <sup>-1</sup> )	Leaf area (cm <sup>2</sup> )
T <sub>1</sub> : 100% RDF through inorganic fertilizer	38.13	8.60	66.70
T <sub>2</sub> : 100% RDF + Vermicompost @ 2 tons ha <sup>-1</sup>	39.34	8.67	68.20
T <sub>3</sub> : 100% RDF + NPK Consortia	39.62	8.73	67.00
T <sub>4</sub> : 100% RDF + Rhizobium culture	40.07	9.20	69.40
T <sub>5</sub> : 100% RDF + PSB	40.12	8.87	68.50
T <sub>6</sub> : 75% RDF + Vermicompost @ 2 tons ha <sup>-1</sup> + NPK Consortia	36.97	8.20	65.20
T <sub>7</sub> : 75% RDF + Vermicompost @ 2 tons ha <sup>-1</sup> + Rhizobium culture	38.64	8.53	66.70
T <sub>8</sub> : 75% RDF + Vermicompost @ 2 tons ha <sup>-1</sup> + PSB	38.37	8.47	65.80
T <sub>9</sub> : 50% RDF + Vermicompost @ 2 tons ha <sup>-1</sup> + NPK Consortia	35.85	7.83	60.93
T <sub>10</sub> : 50% RDF + Vermicompost @ 2 tons ha <sup>-1</sup> + Rhizobium culture	36.59	7.87	64.60
T <sub>11</sub> : 50% RDF + Vermicompost @ 2 tons ha <sup>-1</sup> + PSB	36.38	8.17	64.60
T <sub>12</sub> : 75% RDF + 25% Vermicompost @ 2 tons ha <sup>-1</sup> + PSB + Rhizobium culture	41.52	9.83	71.01
S.Em±	0.89	0.35	1.03
CD (p=0.05)	2.61	1.02	3.02

**Table 2:** Effect of integrated nutrient management on yield attributes of late sown chickpea

Treatment	Number of pods plant <sup>-1</sup>	Number of seeds plant <sup>-1</sup>	100 seed weight	Seed yield (q ha <sup>-1</sup> )	Harvest index (%)
T <sub>1</sub> : 100% RDF through inorganic fertilizer	36.60	1.73	23.68	16.20	37.32
T <sub>2</sub> : 100% RDF + Vermicompost @ 2 tons ha <sup>-1</sup>	36.65	1.77	23.73	16.47	37.37
T <sub>3</sub> : 100% RDF + NPK Consortia	36.23	1.83	23.59	16.21	37.15
T <sub>4</sub> : 100% RDF + Rhizobium culture	38.14	2.06	24.09	17.65	37.81
T <sub>5</sub> : 100% RDF + PSB	37.55	1.87	23.76	17.38	37.57
T <sub>6</sub> : 75% RDF + Vermicompost @ 2 tons ha <sup>-1</sup> + NPK Consortia	34.71	1.87	23.84	15.57	37.52
T <sub>7</sub> : 75% RDF + Vermicompost @ 2 tons ha <sup>-1</sup> + Rhizobium culture	35.20	2.10	22.77	15.87	37.49
T <sub>8</sub> : 75% RDF + Vermicompost @ 2 tons ha <sup>-1</sup> + PSB	35.45	2.07	22.64	15.82	37.47
T <sub>9</sub> : 50% RDF + Vermicompost @ 2 tons ha <sup>-1</sup> + NPK Consortia	33.43	1.67	21.22	13.55	35.00
T <sub>10</sub> : 50% RDF + Vermicompost @ 2 tons ha <sup>-1</sup> + Rhizobium culture	34.66	1.93	22.16	14.80	36.61
T <sub>11</sub> : 50% RDF + Vermicompost @ 2 tons ha <sup>-1</sup> + PSB	34.22	2.07	23.16	14.50	36.50
T <sub>12</sub> : 75% RDF + 25% Vermicompost @ 2 tons ha <sup>-1</sup> + PSB + Rhizobium culture	40.79	2.13	24.49	18.85	38.16
S.Em±	1.13	0.14	0.63	0.51	0.84
CD (p=0.05)	3.32	NS	NS	1.5	NS

**Conclusion**

From these results it can be concluded that the application of inorganic fertilizer with the organic fertilizer 75% RDF + 25% Vermicompost @ 2 tons ha<sup>-1</sup> + PSB + Rhizobium culture (T<sub>12</sub>) is best nutrient management combination for late sown chickpea. Among the integrated nutrient management practice 75% RDF + 25% Vermicompost @ 2 tons ha<sup>-1</sup> + PSB + Rhizobium culture gave excellent value for growth and yield parameters as well as productivity where seed yield 18.85 respectively was noticed with application of 75% RDF + 25% Vermicompost @ 2 tons ha<sup>-1</sup> + PSB + Rhizobium culture which were at par with 100% RDF + Rhizobium and 100% RDF + PSB. However, the minimum seed yield 13.55 q ha<sup>-1</sup>

was observed with application of 50% RDF + @ 2 tons ha<sup>-1</sup> Vermicompost + NPK consortia.

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