ABSTRACT

Chickpea has been well known for its nutritional values, it provides a good amount of energy, protein, soluble and insoluble fibre. It is an important crop for Bundelkhand Region. In this article improved chickpea cultivation technologies in Bundelkhand region has been highlighted.

Chickpea is an important Rabi season legume crop cultivated in wide agro-geographical area across India. It contributes 39 per cent to the total production of pulses in the country. The major chickpea producing states are Madhya Pradesh, Uttar Pradesh, Rajasthan, Maharashtra, Andhra Pradesh, Gujarat, Karnataka, Haryana, Bihar and West Bengal. The total area in Uttar Pradesh under chickpea cultivation is about 5.7 lakh hectare, out of which the UP Bundelkhand region is cultivating about 85 percent of the state area. The seven districts of Bundelkhand (UP) accounting 3.90 lakh hectares with a production of 4.86 lakh tones and average per hectare productivity 1324 kg that is higher than the average productivity among major chickpea producing states of India. The Jalaun district average productivity is highest 1412 Kg/ha, which show potential of the crop. Thus, data indicates this region has enormous possibility to increase the present productivity level. However, the abiotic stresses, lack of awareness new technologies and inadequate availability of quality seeds are responsible for the huge gap between average and potential yield in the region.

A cumulative effort has to be made by the breeders, agronomists and extension functionaries together to harness potentiality of chickpea cultivation in the region. The present article emphasizing improves production technologies of chickpea considering the agro-climatic condition of the Bundelkhand region.

Chickpea has been well known for its nutritional values, it provides a good amount of energy, protein, soluble and insoluble fiber. The protein found in chickpea contains essential amino acids like lysine, methionine, threonine, valine, isoleucine and leucine. On an average, the 100g of chickpea seed contains Protein – 14.5g, Carbohydrate – 45g, Fat – 4.2g, Sugar – 7.9g, Dietary Fiber - 12.5g, Phosphorus – 447 mg, Iron – 12.3 mg, Calcium – 280 mg and Calorific value – 268 Kcal. The Recommended Dietary Allowances (RDA) of chickpea seed for adult male and female is 60 g and 55 g per day, respectively, or per capita availability is 42 g per day. Chickpea is rich in fiber, minerals (phosphorus, calcium, magnesium, iron and zinc) and β-carotene. Chickpea is a vegetative plant, its height generally 30-70 cm, and its deep root system which perforates soil very deeply. The minute nodules are found in its roots, in which rhizobium bacteria are found which fixed the environmental nitrogen in root nodules and provide to the plants and increase the soil fertility.

In India two types of chickpea are grow in (i) Desi - the seed colour is yellow to deep brown and size is small and (ii) Kabuli-the seed and the flower colour is white, the Kabuli plant having erect, long, architecture with a short period.

Climatic Requirements:

Chickpea is grown in winter season in low rainfall area but gives good results in irrigated and sandy loam to slightly clay soils. The 30-35°C temperature is best for good plant growth and yields, while the crop adversely affected by temperature more than 35°C and less than
15°C in the reproductive stage. The flowers development and pod setting is adversely affected by very high as well as low temperature. The productivity affected by various abiotic factors like aerial temperature, photoperiod and moisture in the flowering stage. Generally, low temperature and low photoperiod are responsible for delayed flowering.

Soil Type:
Chickpea is grown on light to medium textured, sandy loam to deep black and well-drained soils. Furthermore, the deep loamy or clay loamy soil with pH 5.5 to 6.0 is suitable for chickpea cultivation. Saline and alkaline soils are not suitable for plant development. The Bundelkhand soil red, black, mar, tendency, and rakad with good water drainage is very advantageous and suitable soil for chickpea cultivation.

Crop Rotation:
In Bundelkhand region chickpea is sown in fallow land of kharif season. It can rotate after harvesting of kharif or rainy season crops such as moong, urd, maize, sorghum, bajra, sesame etc. The crop may be taken as single crop, intercropping and riley cropping. In the present time, generally, farmers sow single crop but intercropping increase farmer income. The intercropping systems for Bundelkhand region are as follows;

i. Chickpea + Linseed (4:1)
ii. Chickpea + Mustard (4:1)

Thus, the sowing of chickpea with mustard or linseed is very common in this region. Chickpea, rotation with cereal crops helps in controlling soil-borne diseases. The common crop rotations are (rainfed based) are as follows:

i. Jowar-Chickpea
ii. Maize-Chickpea
iii. Rice-Chickpea-Summer Moong
iv. Jowar-Urd-Chickpea
v. Soybean-Chickpea
vi. Bajra-Chickpea
vii. Sesame-Chickpea
viii. Moong-Chickpea
ix. Urd-Chickpea

Improved Varieties:
The selections of quality seeds depend on various factors such as crop rotation, time of sowing time, availability of irrigation water etc. The All India Coordinated Research Project on Chickpea (AICRP) recommended a number of the high yielding varieties for cultivation in the Bundelkhand region. The varieties carry a number of useful traits like wilt resistance, dry root rot-tolerance, short duration, large and medium seed size, low vegetative growth, tolerant to salinity and drought tolerance. The improved varieties recommended for this region are summarized below with major attributes.

<table>
<thead>
<tr>
<th>Tab 1: Less than 10-Year-old varieties recommended for Bundelkhand Region</th>
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<tbody>
<tr>
<td>Variety</td>
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<tr>
<td>IPCK 2002-29</td>
</tr>
<tr>
<td>IPCK 2004-29</td>
</tr>
<tr>
<td>JSC 55 (RVG 202)</td>
</tr>
<tr>
<td>JSC 56 (RVG 203)</td>
</tr>
<tr>
<td>JG 12</td>
</tr>
<tr>
<td>JG 36</td>
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<tr>
<td>Phule G 0405</td>
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</tbody>
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Agronomical Practices:

Sowing Time:
The recommended sowing time of chickpea in Bundelkhand region is 15 October to 15 November. Sowing time under two different situations:

i. Rainfed cultivation- Last of the week of September to 1st week of October
ii. Irrigated cultivation- 2nd fortnight of October to 1st week of November

With late sown varieties sowing may extend to last week of November or first week of December where the good irrigation facility is available but late sowing affect yield decline is as follows:
1. Lack of soil moisture during pod formation, less developed seed due to high temperature and reduce quality. In this situation, the selection of early varieties should be done.

2. The large outbreak of pod borer occurred. For this condition, short term varieties may be grown.

**Land Preparation:**
Chickpea plant are very sensitive to low aeration in soil. Therefore, ploughing is necessary for good aeration. Ploughing with the cultivator or harrow in the opposite direction after a deep ploughing with mold bold plough and planking is sufficient. The proper management of water drainage is necessary. Chickpea is grown on the saved moisture after harvesting of kharif crops due to scarce of irrigation resources therefore; it may adopt the management of soil moisture conservation in this region.

**Seed and Sowing:**
The seed should be planted in line sowing with the row to row distance 30-45cm with 10 cm plant to plant spacing. The 75-100 kg seed is required for sowing in a hectare area. The shallow sowing causes the wilt disease occurrence therefore depths sowing at 5-6 cm are good for plant establishment.

**Seed treatment:**
The seed should be treated with Rhizobium culture to increase the number of root nodules in the legume crops as well as for nitrogen fixation in the soil. The 10 kg seed should be treated with 200 gm quantity of Rhizobium culture. The seeds should be soaked well in clean water before treatment with culture whereby a thin film of culture formed on seed coat and dried in shade for 2:30 hours after that sowing should be done. It should be kept in mind that the seed doesn’t dry in sunlight directly. For the protection of seed from seed-borne disease, the fungicide treatment is very important. The seed treatment with 2.5gm thirum or 2.0gm bavistin per kg would be beneficial to protect from the wilt and root rot of chickpea. Even if termites have occurred in soil then 1.0 liter chlorpyriphos per quantal of seed would be beneficial. The seed treatment steps is as follows:

- Seed priming (soaking of seed for 4-5 hours in water)
- Seed treatment with Trichoderma (6g/kg) and Vitavex (Carboxin) (1g/kg)
- Seed treatment with Rhizobium culture one packet (200g)/10 kg seed

**Manures and fertilizers:**

<table>
<thead>
<tr>
<th>Crop</th>
<th>Ecology</th>
<th>Time of sowing</th>
<th>Quantity of fertilizer, NPK kg/ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Desi gram</td>
<td>Rainfed</td>
<td>Normal</td>
<td>20-40-00</td>
</tr>
<tr>
<td></td>
<td>Irrigated</td>
<td>Normal</td>
<td>20-60-20</td>
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<tr>
<td></td>
<td></td>
<td>Late</td>
<td>40-40-20</td>
</tr>
<tr>
<td>Kabuli gram</td>
<td>Irrigated</td>
<td>Normal</td>
<td>30-60-30</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Late</td>
<td>40-60-30</td>
</tr>
</tbody>
</table>

**Table 2: Fertilizer requirement of Desi and Kabuli Gram**

The recommended quantity of fertilizers and the total quantity of NPK should be used during sowing. Note: Spray of 2% urea at flowering stage (70 DAS) and 10 days thereafter will enhance yield.

The water management is essential for batter growth of chickpea crop. Hence, the various tools such as contour band, deep ploughing in summer, mulching, water harvesting etc. should be adopted for water conservation by proper channelizing during the last rainfall. The first irrigation during branching and second during pod formation is beneficial for chickpea crop and avoids irrigation during the flowering stage because flowers can drop in this stage. The proper arrangement of drainage may be done in heavy rainy conditions and crops may be grown on the ridges whereby water could not stagnate in the root zone.

**Weed Control:**
One or two hand-hoeing with grub-hoe are sufficient for control of weeds at 30 and 60 days after sowing.

**Herbicide application: pre-emergence spray of Pendimethlin @ 1.0-1.25 at kg/ha.**

**Diseases and Insect-Pest of Chickpea:**

**Major Diseases:**
Chickpea crop production hampered by hundreds of plant pathogens, among them Fusarium wilt, collar rot, ascochyta blight and dry root rot caused major yield loss under Bundelkhand region.
1. **Wilt Disease:** It is the major soil-borne disease of chickpea which is caused by fungus namely *Fusarium oxysporium* var. *ciceri*. The treatment of the disease is very difficult after the infection occurred. The resting spores of fungus in soil living a long time and infect plants when the crop is grown in the field.

Symptoms: The leaves and stalk of upper parts in the plant turn down and plant starts dry and finally shows die symptoms. The most characteristic symptom of this disease is vascular dis-colouration of roots which is dark brown to black. Sometimes, only one sided branches are affected resulting in partial wilting. It can be prevented by improved crop management practices.

**Management:**
- Deep ploughing in summer
- Timely sowing (last week of Oct. to the first week of Nov.)
- Apply crop rotation as cultural practice
- Large quantity of carbon added into the soil for increasing beneficial microorganisms which create competition for food and reduced pathogen population
- Seed treatment with Carbendazim+Thirum (1:2) @ 3.0 per kg. of seed or seed treated with Trichoderma @ 4.0-10 g per kg of seed.

2. **Dry Root Rot:** This is a soil-borne disease which is caused by fungus *Rhizoctonia* btaticola. This disease boosts in low soil moisture and at 30°C temperature.

Symptoms: The infection of fungus occurred during flowering and pod formation in which the roots of the plant turns black and breaks easily. Slowly, all the leaves turn yellow and later become straw coloured. The plants are dried in heavy infection.

**Management**
- Good crop rotation
- Timely sowing
- Reduced infection by irrigation
- Seed treatment with Carbendazim+Thirum (1:2) @ 3.0 per kg. of seed or seed treated with Trichoderma @ 4.0-10 g per kg of seed.

3. **Coller rot:** It is also caused by a fungus namely *Sclerotinia sclerotium*. The various conditions increase diseases such as high moisture in the soil, partially decomposed organic matter on the soil surface, low pH and 25-30°C temperature.

Symptoms: The part of root nod and stem near to soil become thin and brown. Light brown to dark-brown lesions appears on the collar region of the plants. Later, these lesions become black and affect the basal tap root. This disease affects the seedling stage (1-1.5 months) in which plants dry by yellowing.

**Management:**
- Adopts good crop rotation
- Partially decayed residue drop off from the field during sowing
- Avoids high moisture in the field during sowing to seedling stage
- Seed treatment with fungicides like carbendazim 50% (2gm/kg seed)
- Seed treatment with Carbendazim+Thirum (1:2) @ 3.0 per kg. of seed or seed treated with Trichoderma @ 4.0-10 g per kg of seed.

4. **Ascochyta Blight:** This disease spreads by a fungus *Ascochyta rabiei*. This disease has negligible effects in the Bundelkhand region because this is found in the area which has high humidity and low temperature. But during Rabi 2019-20 in some parts of Bundelkhand region (Jhansi) this disease was noticed.

Symptoms: Dark-brown spots studded with black dot-like bodies are produced on the stem, branches, leaflets and pods. The lesions are elongated on stems, branches and twigs. On pods and leaves, these black dot-like bodies are concentrically arranged in the spots. Shoot terminals are especially liable to attack. Even the seeds in the pods are infected.

**Management**
- Used disease free Seed
- Seed treatment with Carbendazim+Thirum (1:2) @ 3.0 per kg. of seed or seed treated with Trichoderma @ 4.0-10 g per kg of seed.
- Spray of mixture fungicide Carbendazim+mancozeb@0.2%.
Harmful Insect-Pest:

1. **Pod Borer:** This is very common insect pest of chickpea and occurred all chickpea growing region of India. The insect scientifically known as *Helicoverpa armigera* which is polyphagous in nature. The larvae damage the chickpea crop by feeding on leaves, flower buds, flowers, pods and seeds in the pods.

Management:
- Selection of earlier varieties
- Timely sowing
- Expose the insect pupas in direct sunshine with help of deep ploughing in summer
- Use of sex pheromones which regards the number of the insect population in the field according to this can be used spray
- Sprays of 5% solution of the extract of neem kernel
- 80 g Proclaim 5 SG (emamectin benzoate) or 160 ml Rimon 10 EC (novaluron*) in 80-100 litres of water per acre on appearance of pest at the start of pod formation and repeat after two weeks, if necessary.

2. **Cutworm:** This insect has smoothy and dark brown colour. Its length is 1-1.5 inch which hides under clods and comes out in the night. The plants are cut near to the ground.

Management:
- The small dump of dry grass should be taken in various place in the field in which insects hide and collect this dump in the morning and destroyed
- Strew with 25kg chlorpyriphos 1.5% powder per hectare before the last ploughing

3. **Termites:** The pest can generally be observed feeding on roots or near the root zone of the damaged plants. Termites attack the crop especially at the seedling stage and also near maturity. The affected plants dry up and can be pulled out easily. The incidence of pests is more in light soils.

Management:
- Seed treatment with 1.0 liter chlorpyriphos 20EC per 100 kg of seed and use 2.50 liter per hectare with irrigation water

4. **Semilooper insect:** The larva is a greenish colour and runs with making a loop. They eat leaves and soft parts of plants.

Management:
- Anyone spray in the following
  - Dichlorvos 1ml/liter
  - Amamectin benzoate 0.2gm/liter
  - Spinosad0.25gm/liter