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Agronomic Practices Enhancing the Productivity of Chickpea *(Cicer arietinum* L.) – A Review

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ABSTRACT

Chickpea (*Cicer arietinum* L.) is grown in rabi (post-rainy season) following kharif (rainy season) crop or kharif fallow. Late sowing (December-January) should be avoided as the late-sown crop may experience moisture stress and high temperatures at the critical stage of pod-filling, leading to reduced yield and seed quality. A pre-sowing irrigation may be needed, if the available soil moisture is not adequate for germination. Kabuli chickpea should never be irrigated immediately after sowing, particularly in deep black soils. Desi varieties are sown at plant geometry of 30 cm x 10 cm whereas wider row spacing (45–60 cm) can be used in large seeded kabuli chickpea and irrigated crops (both desi and kabuli types). Total quantities of N, P and K should be given as a basal dose. Foliar spray of 2% urea at flowering has been found beneficial in rainfed crops. Pre-emergence application of Pendimethalin 30% EC @ 0.75 – 1.0 kg a.i. ha^{-1} and one hand weeding or interculture operations at 25-30 days after sowing is economical. Two irrigations (30 mm each), one each at branching and pod filling stages, are recommended for higher yield. Machine harvesting of chickpea will reduce production cost. Tall and non spreading plant varieties are available with suitable mechanization package.

Key words: *Chickpea, Sowing time, Nutrient management, Irrigation, Weed management, Mechanization.*

Introduction

Chickpea (*Cicer arietinum* L.) is an important legume crop cultivated and consumed across the world. Among the different countries in the world, India is the largest producer and consumer of chickpea. It is grown in an area of about 9.85 Mha with a production of 10.32 Mt and productivity of 1048 kg ha^{-1} (http: //www. agricoop.nic.in). Chickpea is *rabi* crop generally cultivated under conditions of residual soil moisture and often subjected to deficit moisture after sowing. Under late sown conditions, the growth of chickpea is affected resulting in low yield. The higher productivity in chickpea could be achieved through manipulation in plant population depending on variety, its growth habit and agro climatic condition (Kumar *et al.,* 2015).

Crop season and sowing time

Chickpea is grown in rabi (postrainy season) following a kharif (rainy season) crop or kharif fallow. The sowing is done in the month of October or November. Late sowing (December-January) should be avoided as the late-sown crop may experience moisture stress and high temperatures at the critical stage of pod-filling, leading to reduced yield and seed quality. In sub-tropical region, the climate is temperate with winter rainfall, chickpea is conventionally seeded in spring; therefore, the crop faces high temperature and water stress towards maturity which resulted in low and variable yields. However, with new cultivars, winter seeding of chickpea in subtropical environments has recently been augmented, since winter sowing provides higher and more

stable yield and growth (Pacuacci *et al.,* 2006).

Flower development is a crucial stage because fluctuation in environment affects it which ultimately influence on crop production. Flowering in chickpea is dependent on photothermal reaction, which is the main determinant (Basu *et al.,* 2009). Higher grain yield of chickpea from 2nd FN of October sown crop from different agro-climatic conditions are reported by Mansur *et al.* (2010). Early sowing of chickpea can expose it to heavy rainfall which results in lodging, diseases occurrence, and moisture deficit during grain fill stage. Late sowing can effect on plant height which may reduce vegetative cover and water use efficiency and increase the incidence of insects (Matthews and Mc-Caffery, 2011). Significantly higher number of pods per plant (46.2), 100 seed weight (32.4) and seed yield (1833 kg/ha) were obtained with irrigation at 35 and 55 days in 2nd fortnight of October. This study has clearly indicated that partitioning efficiency will be maximum at 2nd fortnight of October and with advancing sowing dates i.e. to November and December, partitioning efficiency was reduced due to receding soil moisture which affects Source and Sink partitioning (Raghavendra *et al.,* 2017).

The pooled yield of 1660 kg ha^{-1} was recorded with crop sown during November first fortnight followed by that of November second fortnight sowing treatment. Seed yields followed increased trend up to November sowings and decreased beyond November month (Prabhakar *et al.,* 2021). The optimum sowing date results in timely initiation of flowering by minimizing threats of cold temperatures which can retard the growth of chickpea. Adjustments in sowing date can be used as a strategy to increase chickpea production to overcome the effect of cold temperature.

Suitable soil type

Chickpea can be successfully grown in a variety of soil types including coarse-textured sandy to fine-textured deep black soils (vertisols). However, the best suited soils are deep loams or silty clay loams with a pH ranging from 6.0 to 8.0. Saline soil and fields with a high water table are not suitable for chickpea.

Field preparation and varieties

Chickpea plants are highly sensitive to poor aeration in the soil. Seedling emergence and plant growth are hindered if field surface is compact. Therefore, the field should have loose tilth and good drainage. The stubble and debris from the previous crop should be removed as these can harbor the pathogens that cause root diseases, such as collar rot. State wise recommended desi or kabuli varieties could be cultivated for chickpea for higher productivity.

Seed rate

It differs from variety to variety, depending on seed size. For initial seed multiplication of a new variety, the multiplication rate (yield per plant) is more important than yield per unit area. The following guidelines may be used for seed rate:

Seed size (100-seed weight)	Seed rate (kg ha^{-1})
Small (less than 20 g), eg, JG 315	50 – 60
Medium (20 – 30 g), eg, JG 11, JG 130, JAKI 9218	60 – 90
Large (30 – 40 g), eg, KAK 2, Vihar, LBeG 7	90 – 120
Extra-large (more than 40 g), eg, JGK 3	120 – 150

Sowing

Sowing is usually done on conserved soil moisture. A pre-sowing irrigation may be needed, if the available soil moisture is not adequate for germination. Kabuli chickpea should never be irrigated immediately after sowing, particularly in deep black soils. This is because the kabuli chickpea seeds have thin seed coat and deteriorate faster as compared to desi type and are also more susceptible to seed rot and seedling damping off. Seed should be sown deeply enough to make contact with moist soil. A depth of 5-8 cm seems to be ideal for the emergence of chickpea.

Spacing

Line sowing is a must in the crop grown for seed production as it facilitates interculture operations, rouging and field inspection. Row-to-row spacing of 30 cm and plant-to-plant spacing of 10 cm are generally used, which give a plant population of about 33 plants per m^2 (330,000 plants ha^{-1}). Wider row spacing (45–60 cm) can be used in large seeded kabuli chickpea and irrigated crops (both desi and kabuli types), which are expected to have greater plant width. Broad bed and furrow system or ridge and furrow system are very useful for irrigation, drainage and interculture operations.

Fertilizer application

Fertilizer requirements depend on the nutrient status of the field, and thus, vary from field to field. Therefore, the doses of fertilizers should be determined based on the results of soil test. The generally recommended doses for chickpea include 20–30 kg nitrogen (N) and 40–60 kg phosphorus (P) ha^{-1}. If soils are low in potassium (K), an application of 17 to 25 kg K ha^{-1} is recommended. There will be no response to application of K in soils with high levels of available K. Total quantities of N, P and K should be given as a basal dose. Foliar application of 2% urea at 75 DAS significantly increased the seed size, leaf and seed nitrogen content and also protein content of the seeds in chickpea (Venkatesh and Basu, 2011).

Higher chickpea yield and net return could be obtained by the application of 20 kg N/ha as basal + *Rhizobium* + PSB + PGPR seed inoculation + 2% urea spray at flowering and 10 days thereafter under rainfed conditions in black soils (Gupta *et al.*, 2011). Urea spray at 2% at flowering as well as at flowering+pod formation stages also improved the Zn and Fe content in the grain of chickpea (Pal *et al.*, 2019). Application of 20 Kg K2O ha^{-1} in Chickpea is recommended in coarse textured low to medium potash status soils (Yadav *et al.*, 2020).

Weed management

Chickpea competes poorly with weeds and therefore good weed management is critical for high yields. As post-emergence chemical weed control in chickpea is not possible, it is essential to check weeds in the previous crop and before sowing. Pre-emergence application of Pendimethalin 30% EC @ 0.75 – 1.0 kg a.i. ha^{-1} was found effective in controlling the early flush of weeds to check the weed growth for 20-25 days (use immediately after sowing or the next day). one hand weeding or interculture operations at 25-30 days after sowing is economical. Application of Pendimethalin 38% CS 0.75 kg a.i ha-1 PE + HW at 30-35 DAS or Pendimethalin 30% EC + Imazethapyr 2% 1.0 kg ha-1 PE + one hoeing at 30-35 DAS were the most effective alternative for controlling weeds and in obtaining optimum seed yield in chickpea under rainfed conditions of Karnataka state (Rathod *et al.*,2017). Application of 1.0 kg ha^{-1} of s-metolachlor and Pendimethalin each integrated with one hand weeding at 5 WAE are the most appropriate methods for effective weed management and economic benefit of Chickpea (Merga and Alemu, 2019)

Irrigation

The Chickpea crop is a very water sensitive crop. The Chickpea crop requires about 25 cm of water. Watering should be done as per the soil conditions and requirements. Sowing is usually done on conserved soil moisture. A pre-sowing irrigation may be needed, if the available soil moisture is not adequate for germination. Kabuli Chickpea should never be irrigated immediately after sowing, particularly in deep black soils as seeds have thin seed coat and also more susceptible to seed rot and seedling damping off. Don't let the ground get too big cracks. Mild irrigation at the time of root rot and collor rot disease incidence under stress condition to minimize the soil temperature is helpful to manage these diseases. Chickpea is generally grown as a rainfed crop, but two irrigations, one each at branching and pod filling stages, are recommended for higher yield. Higher number of irrigations may lead to excessive vegetative growth in heavy soils. If winter rains fail, give one irrigation at pre-flowering stage and one at pod development stage. In no case first irrigation should be given at flowering time of Chickpea crop., Irrigation at branching and pod development stage with all furrows irrigated was beneficial for remunerative cultivation of Chickpea and also achieving higher production. Irrigation of Chickpea crop by sprinkler irrigation method and cultivation of improved varieties gives a big increase in yield.

Irrigation influenced the crop growth and increased the seed yield of chickpea by 29.6 per cent. The result is in confirmation with Palled *et al.* (1995), where they reported that the number of branches $plant^{-1}$ increased due to irrigation in blackgram. Similarly El-Waraky and Koliey, (2000) investigated that Irrigation at branching and pod development stages resulted with the highest number of pods per plant. Significantly higher number of pods $plant^{-1}$ and 100 seed weight with irrigation at pod development stage over irrigation at flowering and no irrigation might be due to better translocation of absorbed nutrients coupled with supply of soil moisture which coincided with peak pod and seed development stages (Fallah *et al.*, 2005).

The results indicated that number of branches $plant^{-1}$ increased with increasing soil moisture con-

tent. Reduced number of branches plant-1 might be due to inhibition of cell division and cell enlargement under water stress (Mariam *et al.,* 2014). Possibility of supplemental irrigation twice to chickpea is better option to irrigate at pre-flowering and pod setting stage which is agreeing with findings of Satyabhan (2017). When possibility of supplemental irrigation is only for one time, it was greater advantage to give irrigation at pod development stage then pre flowering. Similar results were reported by Kirnak *et al.* (2017). Irrigation at 35 and 55 DAS recorded higher pod per plant (46.2) than no irrigation and irrigation at 35 DAS (Raghavendra *et al.,* 2017). Bakhsh *et al,* (2007) noted that on average basis 48% increase in number of pods per plant was recorded due to irrigation. Most of the morphological and yield attributes such as plant height, pods plant^{-1}, test weight, seed yield were enhanced significantly due to application of irrigation. Cultivation of desi variety NBeG 49 with application of 50 kg P_2O_5 ha^{-1} with one light irrigation (30 mm) at branching stage/pre flowering enhanced the productivity of chickpea under moisture deficit condition in vertisols (Basha *et al.,* 2020 b)

Conservational Agricultural Practices

The management of crop residues can have direct and indirect effects on crop yield (Pittelkow *et al.,* 2015). Crop residues that cover the soil act as physical barriers, making it less susceptible to the erosive action of raindrops and wind (Johnson *et al.,* 2016). Moreover, the maintenance of crop residues favors infiltration (Valim *et al.,* 2016) and the storage of water in the soil (Tormena *et al.,* 2017). In a climate change scenario, the maintenance of crop residues on the soil might increase the conservation of soil moisture and decrease the effects of droughts. Conventional tillage with crop residue retention (@ 2.5 t ha^{-1}) of foxtail millet could be effective for soil moisture conservation and higher seed yield and net returns in Foxtailmillet-Chickpea cropping system (Basha *et al.,* 2020 a) . Zero tillage practice could be implemented in the high and medium high land for chickpea cultivation in rice fallows. Low income farmers may practice the zero tillage technology (Quddus *et al.,* 2020).

Mechanized harvesting

Machine harvesting of chickpea will reduce production cost and reduce the chances of damage to the crop due to rains, winds, etc. that may occur during the additional period required in manual harvesting. This will become more attractive and remunerating to farmers. Mechanical harvesting requires tall stature and branches non spreading i.e. erect in nature. Chickpea variety NBeG-47 was suitable for mechanical harvesting and perform well at a plant density 55/m^2 with the recommended dose of nitrogen 20 kg/ha (Munirathnam *et al.,* 2015).

First machine suitable for harvesting of taller variety of chickpea NBeG 47 was released for Andhra Pradesh region after number of feasibility trials. A wide scale demonstration in harvesting of this variety was carried out in Kurnool and Anantapuramu districts of Andhra Pradesh. The NBeG 47 variety out performed as compared to popular variety of JG11 in respect of yield as well as disease and drought tolerance (ICRISAT, 2016). Tall and non spreading plant varieties are needed for mechanical harvesting with proper row geometry and plant population density. It is required to make available these types of cultivar all over the country along with suitable mechanization package from seedbed preparation to harvesting and threshing for profitable chickpea cultivation (Dhimate *et al.,* 2018). Chickpea varieties, i.e. GBM 2, Dheera, Phule G08108 and BRC1 could be suitable for mechanical harvesting due to their plant stature, height of the lowest pod bearing branches and seed yield (Basha *et al.,* 2020)

Conclusion

It is inferred that the suitable agronomic practices could be beneficial to enhance the productivity of chickpea under prevailing environmental conditions. The yield potentials of chickpea may not be realized without synergistic combination of improved management practices and adequate nutrient use.

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