

## **Performance Evaluation of Chickpea Varieties under Rainfed Condition of Dharmapuri District, Tamil Nadu, India**

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### **Authors' contributions**

*This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.*

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### **ABSTRACT**

Chickpea is an important pulse crop grown during rabi season in black soil areas of Dharmapuri District. Among the various biotic and abiotic factors, the drought stress and fusarium wilt disease incidence are the major problems that reduces the chickpea yield to a greater extent. To overcome the above problems, the varieties viz., JAKI 9218 and GBM 2 were studied in comparison with farmers practice i.e., CO 4 for identification of suitable drought and disease tolerant high yielding variety for prevailing rainfed condition. The results revealed that JAKI 9218 and GBM 2 were found promising under rainfed condition and recorded the grain yield of 1008 and 933 kg/ha as compared to 808 kg/ha in CO 4. The variety JAKI 9218 proved to be superior with a yield increase of 24.7 per cent over CO 4 and 8.04 per cent over GBM 2. The pod borer and fusarium wilt disease incidence were lower in the variety JAKI 9218. The highest net income of Rs. 22158 /- and benefit cost ratio of 2.16 was realized in JAKI 9218 and the lowest net income of Rs. 13958 /- and benefit cost ratio of 1.77 was realized in farmers practice i.e., CO 4. It is concluded from the study that the chickpea variety JAKI 9218 can be recommended for large scale cultivation under rainfed condition of Dharmapuri district for realizing higher return by the farmers.

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## 1. INTRODUCTION

Chickpea (*Cicer arietinum* L.) is an important rabi pulse crop cultivated in black soils of Dharmapuri district. Its grain contains 19.3 to 25.4 per cent protein and hence, it serves as major protein source to human beings and animals. Being a leguminous crop, it improves soil fertility by fixing atmospheric nitrogen in the root nodules from 100 to 140 kg/ha in a growing season by symbiotic association with rhizobium bacteria [1]. The fixed nitrogen can meet the nitrogen requirements of the chickpea for maximum grain formation and also available for use by subsequent crops. Hence, it is cultivated as fodder and green manure crop [2,3]. Also, it can be included as important component of cropping system as it improves soil health, reduce weed, pest and disease incidence [4].

In Dharmapuri district, chickpea is being cultivated in an area of about 4000 hectares. It is mainly grown in black soils under rainfed condition during rabi season. Generally, it is sown during 3<sup>rd</sup> week of October to 1<sup>st</sup> week of November. Often farmers take up the delayed sowing during 3<sup>rd</sup> week of November to 1<sup>st</sup> week of December due to late onset of rainfall. It leads to poor root and vegetative growth and low grain yield. Under rainfed condition, due to the uncertainty in rainfall occurrence of moisture stress at various crop growth stages leads to reduction in yield and in crop loss to some extent. It leads to poor plant population and there by low yield. Occurrence of drought stress during crop growth period severely reduced the yield in chickpea was reported by Davies et al. [5]. Maintenance of optimum plant population produce the maximum seed yield in chickpea was reported by Ayaz et al. [6] and Nawange et al. [7]. Besides, incidence of pod borer, *Helicoverpa armigera* and fusarium wilt disease in late sown chickpea crop is high and it causes 10 to 60 per cent yield loss depending upon the stage of the crop.

In chickpea, use of high yielding drought tolerant and wilt resistance varieties have major role in producing the maximum growth and yield. But the farmers used to sow their own seeds which are poor yielder and highly susceptible to pest and diseases. Knowledge on the use of high yielding, drought and wilt disease resistant chickpea varieties among the farmers is lacking. Hence, an on farm trial was proposed to identify

the high yielding, drought and disease tolerant chickpea variety suitable for rainfed condition of Dharmapuri district.

## 2. MATERIALS AND METHODS

### 2.1 Location of the Study

The study was taken up in five farmers holdings located in Dharmapuri district, Tamil Nadu. It is situated between 11°47' and 12° 33' North latitude and 77°02' and 78°40' East longitude with an altitude of 488 m above the mean sea level. The climatic conditions of the district is hot and dry in summer i.e., from March to May and in winter, it is very cold and misty i.e., from November to February. The maximum temperature ranges from 28.2 to 40.2°C and the minimum temperature varies from 15.6 to 24.7°C. The average annual rainfall of the district is 853 mm, which is mainly received through both south west monsoon and north east monsoon.

### 2.2 Details of the Technological Options

The following technological options were taken up for assessing the best suitable chickpea variety for rainfed conditions of Dharmapuri district.

Technological options (TO1) : Farmers practice i.e., cultivation of CO 4.

CO 4 variety is a short duration and high yielding variety released from Tamil Nadu Agricultural University during 1991.

Technological options (TO2) : JAKI 9218

Chickpea variety JAKI 9218 is a semi spreading and fusarium wilt and root rot disease resistant variety released from Jawaharlal Nehru Krishi Vishwa Vidyalaya (JNKVV), Jabalpur, Madhya Pradesh during 2007.

Technological options (TO3) : GBM 2

GBM 2 variety is suitable for mechanical harvesting, resistant to wilt and root rot disease was released from University of Agricultural Sciences, Raichur during 2014.

### 2.3 Field Experiment

To study the performance and suitability of chickpea varieties, an on farm trial was conducted in five farmers' holdings of Dharmapuri district. The trial was laid out during

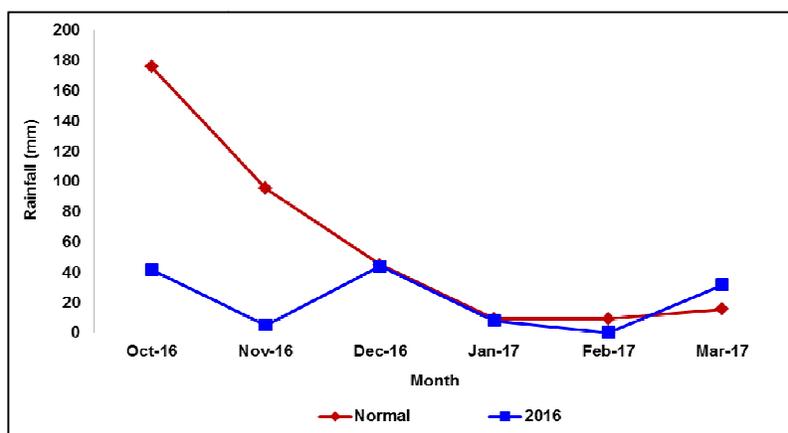


Fig. 1. Rainfall received during cropping period (October 2016 to March 2017)

Rabi season 2016 in black soil prevailing villages viz., Kadagathur, Sekkodi, Palavadi, Bommidi and Godlumarampatty of Dharmapuri district. The initial soil samples were collected and analysed for their physico-chemical properties. The characteristics of the experimental soil was clay loam in texture, non saline, neutral in reaction, low to medium in available nitrogen, medium in available phosphorus and high in available potassium status. The chickpea varieties JAKI 9218, GBM 2 were grown in comparison with the farmers practice i.e., cultivation of local variety CO4. Sowing of chickpea was taken up between the last week of October to first week of November 2016 by utilizing the residual soil moisture or rainfall received during that period. As per the technological options, the recommended quantity of seeds i.e., 75 kg/ha were sown in a spacing of 30 x 10 cm spacing by hand dibbling method. While sowing the seeds were treated with *Rhizobium* and *Phosphobacteria* each @ 25 g per kg of seed. The crop was raised by following the recommended package of practices including nutrient, pest and disease management practices as per the TNAU crop production guide 2014. The rainfall received during the cropping period is illustrated in Fig. 1.

#### 2.4 Data Collection and Analysis

Five plants were selected randomly for taking the observations on growth and yield parameters. At the time of harvest, growth parameters viz., plant population (number/m<sup>2</sup>), root length (cm), plant height (cm), number of branches per plant and yield parameters viz., number of pods per plant were recorded. During cropping period, per cent incidence of pod borer and fusarium wilt disease were recorded by counting the number of plants

showing the incidence in the total number of plants examined. Grain yield (kg/ha) was recorded after threshing and cleaning process. Based on the cost of inputs and market price of the produce, economic parameters such as net income (Rs/ha) and benefit cost ratio were worked out.

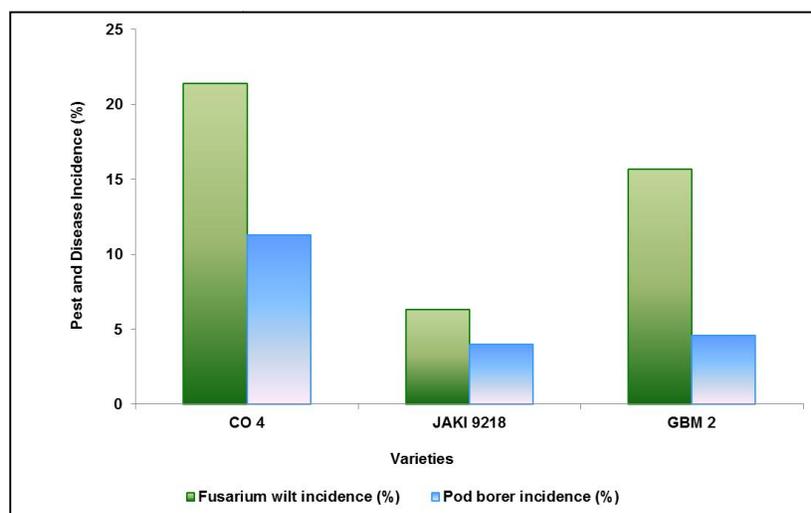
### 3. RESULTS AND DISCUSSION

The data on the growth and yield parameters of chickpea varieties is presented in Table 1. Results on the performance of chickpea varieties under rainfed conditions revealed that the varieties showed significant variation in growth and yield parameters. At harvest, higher plant population (32.3) was observed in JAKI 9218 variety and the lower plant population (23.1) was observed in CO 4. The root length was higher in JAKI 9218 variety (31.1 cm) followed by GBM 2 (29.8 cm) and lower in CO 4 (21.6 cm). Due to the higher root length and plant population, the performance of JAKI 9218 variety was better under rainfed condition compared to other two varieties. Similar studies on screening of chickpea varieties for drought tolerance based on plant population and root characteristics were reported by Miguez and Valenciano [8] and Neeraj et al. [9], respectively.

The per cent pest and disease incidence in chickpea varieties is illustrated in Fig. 2. It showed that per cent incidence of pod borer (4.0) and fusarium wilt disease (6.30) was lower in JAKI 9218 and it was followed by GBM 2. The per cent incidence of pod borer (11.3) and fusarium wilt disease (21.4) was higher in CO 4. Similar results of variation in chickpea varieties for incidence of pod borer were reported by Singh and Yadav [10] and fusarium wilt disease incidence were reported by Krishna and Krishnappa [11] and Javia et al. [12].

**Table 1. Growth, yield and economic parameters of chickpea varieties under rainfed condition**

Technological options	Plant population (Number/m <sup>2</sup> )	Root length (cm)	Plant height (cm)	Number of branches (Number/plant)	Number of pods (Number/plant)	Grain yield (kg/ha)	Per cent increase over farmers practice	Net income (Rs./ha)	Benefit cost ratio
Farmers practice –CO 4	23.1	21.6	25.5	2.67	18.4	808	-	13958	1.77
JAKI 9218	32.3	31.1	28.6	4.17	28.1	1008	24.7	22158	2.16
GBM 2	28.3	29.8	32.2	3.59	22.9	933	8.04	19083	2.00



**Fig. 2.** Per cent incidence of pest and disease in chickpea varieties

Results on the plant height indicated that the tallest plants were observed in GBM 2 variety (32.2 cm) and it was followed by JAKI 9218 (28.6 cm) and the shortest plants were observed in farmers practice i.e., CO 4 (25.5 cm). The number of branches per plant was maximum in JAKI 9218 (4.17) and it was followed by GBM 2 (3.59) and minimum number of branches per plant was recorded in CO 4 (2.67). The higher number of pods per plant was observed in JAKI 9218 (28.1) and it was followed by GBM 2 (22.9) and lower in CO 4 (18.4).

The data on grain yield revealed that JAKI 9218 and GBM 2 were found promising under rainfed condition and recorded the grain yield of 1008 and 933 kg/ha as compared to 808 kg/ha in CO 4. JAKI 9218 variety increased the grain yield by 24.7 per cent over CO 4 and 8.04 per cent over GBM 2. In JAKI 9218 variety, the plants were shorter in stature but the plant density, root length, number of branches per plant and number of pod per plant were higher. Hence, it recorded the highest grain yield compared to other varieties. The varieties showing drought tolerance recorded higher grain yield due to the production of more number of branches and pods per plant, maximum filling of pods and production of bold seeds. Similar variation in yield of pigeon pea and chickpea varieties under drought stress was reported by Rama and Rajamani [13] and Munirathnam et al. [14], respectively.

The data on economic parameters indicated that JAKI 9218 realised the highest net income of Rs. 22158/ha with benefit cost ratio of 2.16. The

lowest net income (Rs. 13958/ha) and benefit cost ratio (1.77) was recorded in CO 4. The reason for higher net income and benefit cost ratio might be due to higher grain yield obtained in JAKI 9218 variety. The similar findings were reported by Rajput and Rajput [15] in chickpea and [16] in groundnut.

#### 4. CONCLUSION

Based on the results, Chickpea variety JAKI 9218 proved to be the best in giving higher grain yield and showing drought and wilt tolerance compared to other varieties tested viz., GBM 2 and CO 4. Hence, the chickpea variety JAKI 9218 was recommended for cultivation under rainfed condition of Dharmapuri district for realizing higher return by the farmers.

#### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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