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Short Communication

Evaluation of chickpea (*Cicer arietinum* L.) cultivars with different crop geometries amenable to mechanical harvesting

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ABSTRACT

The present investigation on evaluation of chickpea (*Cicer arietinum* L.) cultivars suitable for mechanical harvesting under different plant geometries was conducted during rabi 2018-19 at the Research Farm of R.A.K. College of Agriculture Sehore (M.P.) under all India Co-ordinated Research Project on Chickpea. To compare the production potential and suitability of cultivars for mechanical harvesting, six chickpea cultivars (JG 16, NbeG 47, BG 30-62, Phule-G 08108, JG 2016-24 and GBM 2) were tried at two plant geometries 22.5×10 cm and 30×10 cm. The crop was shown on second week of and harvested on third week of March. Various growth and yield attributing characters were studied. Cultivar NbeG 47 and plant geometry 30×10 cm recorded significantly higher number of branches plant^{-1}, dry matter accumulation plant^{-1}, number of pods plant^{-1} and grain yield plant^{-1} while cultivar Nbeg 47 and plant geometry 22.5×10 cm recorded significantly higher values of plant height plant^{-1} (cm), height of lowest pod from base (cm), grain yield kg ha^{-1}. The interaction effect of cultivar Nbeg 47 with plant geometry 30×10 cm found significant for dry matter accumulation plant^{-1} (g), number of pods plant^{-1} and grain yield plant^{-1} (g) while the interaction effect of cultivar Nbeg 47 with plant geometry 22.5×10 cm found significant for plant height plant^{-1} (cm), height of lowest pod from base (cm), grain yield (kg ha^{-1}).

Key words: Chickpea, Cultivar, Grain yield, Plant geometry

India is the principal (or major) chickpea producing country in the world with a total production of 11.16 million tonnes, acreage of 10.76 million hectares with an average yield of 1037 kg ha^{-1}. M.P. is the highest total producer of Chickpea with annual production of 3.54 mt and it is cultivated in an area of 3.22 mha with an average yield of 1100 kg ha^{-1} (Anonymous, 2018). Currently chickpea farming is partially mechanized-the crop is cut manually and then fed into a threshing machine. The total mechanization of harvesting is cost effective and quicker, reducing the risk of the ripened crop's exposure to untimely rain or other extreme weather conditions. Chickpea is harvested manually as the existing cultivars possess inadequate height, semi-spreading growth habit and height of first pods from the ground is about 15-20 cm, thus these cultivars are not suitable for mechanical harvesting. Delay in harvesting due to unfavorable conditions at the time of harvesting may lead to pod drop and shattering.

Agricultural mechanization helps in increasing production, productivity and profitability in agriculture by achieving timeliness in farm operations, bringing precision in metering and placement of inputs, reducing available input losses, increasing utilization efficiency of costly inputs (seed, chemical, fertilizer, irrigation, water etc.), reducing unit cost of produce, enhancing profitability and competitiveness in the cost of operation. The effective mechanization contributes to increase production in two major ways: firstly the timeliness of operation and secondly the good quality of work. It also helps in the conservation of the produce and byproducts from qualitative and quantitative damages; enables value addition and establishment of agro processing enterprises for additional income and employment generation from farm produce.

The present investigation was carried out with six chickpea cultivars (JG 16, NBeG 47, BG 30-62, Phule-G 08108, JG 2016-24 and GBM 2) sown at two different plant geometry (30 x 10 cm and 22.5 x 10 cm) in split plot design replicated thrice during Rabi 2018-19 at the Research Farm of R.A.K. College of Agriculture Sehore (M.P.) under all India Co-ordinate Research Project on Chickpea. The experiment was laid out in Split Plot Design with three replication and 5.0m x 3.6 m plot size. The soil of the experimental field was medium clay loam (vertisol), low in available nitrogen, medium in phosphorus and medium in available potash with pH 6.9. All the recommended package of practices was adopted to raise the crop. Three randomly selected plants from each cultivar in each replication were used for recording the observations to estimate the genetic parameters among cultivars. The data were recorded on quantitative traits such as plant height (cm), height of lowest pod from base (cm), number of branches, Days to 50% flowering, number of pods per plant, grain yield plant^{-1} (g), grain yield (kgha^{-1}) and harvest index (%). The mean values of all the quantitative characters were subjected to statistical analysis by adopting Fisher's method of analysis of variance as outlined by Gomez and Gomez (1984). The level of significance used in 'F' test was at 5 percent.

The experimental finding in the previous chapter provided a detailed account of response of chickpea varieties to plant geometry in term of suitability of mechanical harvesting. In the present chapter an attempt has been made to highlight the experimental finding and to offer the possible explanation and evidence wherever, necessary with a view to determine the cause and relationship with regards to various characters and sort out the information of practical utility.

Growth characters

Plant height: The variety Nbeg 47 sown at 22.5×10 cm produced taller plant (60.40 cm) than 30×10 cm plant geometry (58.77cm). Plant height significantly influenced by varieties, variety Nbeg 47 retained higher plant height (59.58 cm). It may be due to genetic makeup of variety to retain more height. This result is conformity with the results of Stieller *et al.* (1994), Lather *et al*. (2000) Mamta *et al*. (2015) and Munirathnam *et al*. (2015). At harvest 22.5×10 cm planting geometry attained significantly higher plant height (54.63 cm) than 30×10 cm which might be due to more number of plants per unit area and also due to the reason that the sparsely sown crop spreads more than the closely spaced one which tends to grow in upright direction. This result is conformity with Parameshwarappa *et al*. (2012).

Number of branches: The variety Nbeg 47 produced more no. of branches than all other varieties (8.17). Syad *et al.* (2012) report, significant variations in number of primary and secondary branches per plant among the different varieties of chickpea. Significantly higher number of branches (6.75) was observed under plant geometry 30x10 cm (33 plants m^{-2}) when compared to plant geometry 22.5x10 cm (44 plants m^{-2}) (5.83). Increased plant density to an extent of 44 plants m^{-2} from 33 plants m^{-2} could not compete for sunlight due to its erect morphology. The increased number of branches under lower plant densities could be attributed to higher sunlight interception for photosynthesis. In contrast, the decreased number of branches in the narrower plant spacing might be due to the high competition for the resources and with the overlapped plant canopy, the crop might have been subjected to lower interception of sunlight which led to lower photo assimilation. This also indicated the plasticity response of plants to various plant spacing. Similar results were found for various characters studied in chickpea by Ramanappa *et al.* (2013).

Dry weight: Varieties and plant geometry were significant and various interactions between variety Nbeg47 and plant geometry 30×10cm were also significant for dry weight plant^{-1}. The variety NbeG 47 gave significantly higher dry weight plant^{-1} (41.14g at maturity). Variation in dry weight plant^{-1} in varieties may be due to variation in overall growth and development of individual variety as it is also evident from various growth observations like plant height and branches plant^{-1} discussed earlier in the chapter. Similar results of variation in dry matter production among chickpea varieties were reported by Deore *et al*. (1989) and Satish Kumar *et al.* (2006). The wider plant geometry 30×10 cm gave significantly higher dry weight plant^{-1} (35.67 g). The wider plant geometry gave sufficient space, nutrients, moisture and sunlight for better overall development of individual plant results is good branching and more dry weight. Similar results are reported by Pawar and Wasnik (1991)

Height of lowest pod from base: The Variety NbeG 47 sown at 22.5×10 cm plant geometry gave highest height (36.33 cm) of lowest pod from base. Muniratham *et al.* (2015). reported the effect of variety Nbeg47 and crop geometry (22.5×10cm) on lowest pod height from base, which lead to mechanical harvesting of chickpea.

Yield attributes: Variety NbeG 47 with plant geometry 30×10cm found best with respect to yield attributing characters *viz.,* pods plant^{-1} and seed yield plant^{-1}. Yield attributing characters *viz.* number of pods plant^{-1}, seed yield

Table 1. Growth parameters of chickpea as influenced cultivar and by planting geometry

Treatments	Plant height (cm)	Height of lowest pod bearing branch (cm)	Dry matter accumulation plant^{-1} (gm)	Branch/plant
A. Cultivars				
JG 16	46.58	22.06	32.41	6.35
NBeG 47	59.58	35.93	41.14	8.17
BG 30-60	53.25	30.31	32.40	5.30
Phule-G-08108	51.51	30.06	30.83	4.90
JG 2016-24	56.70	34.01	37.76	7.25
GBM 2	53.18	32.17	35.19	5.80
S.Em ±	0.67	0.20	0.49	0.23
CD at 5%	2.07	0.62	1.52	0.71
B. Plant Geometry				
22.5×10	54.63	31.51	34.24	5.83
30×10	52.3	30.00	35.67	6.75
S.Em ±	0.19	0.08	0.20	0.08
CD at 5%	0.59	0.26	0.63	0.26
C. Interaction				
S.Em ±	0.47	0.21	0.50	0.21
C.D. (p=0.05)	1.46	0.65	1.54	NS

plant^{-1}, seed index were significantly affected by varieties. The variety Nbeg 47 was the best as it produced significantly higher number of pods, seed yield plant^{-1} and seed index than rest of the varieties. More or less the same trend was observed in respect to seed index. Nbeg 47 produced larger seeds. Differential effect of varieties with respect to yield attributes was also reported by Reddy and Ahalawat (1998), Ali *et al*. (1999), Srinivas *et al*. (2005), Gallani (2005), Mukesh Kumar (2006) and Shamsi (2010).

The plant performance in terms of yield attributing characters such as number of pods per plant, seed yield per plant and seed index were significantly improved with increase in plant geometry from 22.5×10 cm to 30×10 cm. The maximum values were recorded at 30×10 cm plant geometry. This was ascribed mainly due to the increase in assimilate supply to the individual plant due to more free space, adequate nutrients and moisture availability in wide plant geometry (30×10cm). Similar results for wide row spacing were also reported by Parihar (1996) and Shamsi (2010).

Seed yield: When the variety Nbeg 47 sown at 22.5×10cm plant geometry gave higher seed yield (2082 kg ha^{-1}) then sown with other plant geometry (30×10cm). The seed yield is the combined effect of different factors contributing towards. It appears logical to assume that it is the function of yield attributing characters as increase in any one of these will result in increased yield. Variety NbeG 47 recorded higher seed yield of 1934 kg ha^{-1} and it was significantly superior to rest of the varieties. It may be due to significantly higher values of prime growth and yield attributing characters in NbeG 47. The variation in grain yield kgha^{-1} in varieties may be due to maximum number of root nodules per plant, pods per plant, grain yield per plant and better seed index. These favorable phenomenons resulted in highest yield. The finding on variation in grain yield of different varieties is in agreement with the result reported by Reddy and Ahalawat (1998), Shrivastav *et al.* (2000), Gallani *et al*. (2005), Mukesh Kumar *et al*. (2006), Shamsi (2010) and muniratham *et al.* (2015) reported the varietal differences in seed and straw yield.

The number of plants required per unit area is one of the prime considerations for higher biomass production which depends upon the nature of the crop, growth habit, branching and environment. This number can neither be too small, so that all the production potential will not be utilized, nor can it be too large so that excessive plant competition will reduce the overall efficiency of the crop. Manipulation of seed rate and spacing are the important factors in achieving required level of plant density, so that; plant makes efficient use of the resources. Reviews pertaining to influence of plant densities /seed rate/spacing on chickpea and related crops are summarized below.

Plant geometry had significant impact on seed yield ha^{-1}. Favorable effect of 22.5×10 cm plant geometry was well marked on seed yield and it resulted in higher yield than which obtained with 30×10cm plant geometry. The possible reason could be that, when plant geometry was decreased, number of plants per unit area increased, resulting in higher yield. The positive effect of row spacing was also observed by Veeranna *et al.* (1980), Pawar and Wasnik (1991), Mahapatra *et al.* (1995) and muniratham *et al.* (2015) they reported increased yield under closer row spacing.

Harvest index: The analysis for harvest index reveals that the effect of varieties and plant geometry was significant and interaction effect of varieties and plant geometry was non-significant on harvesting index. Significantly higher harvest index was recorded in variety JG 16 (52.2%). Harvest index is dependent on the ability of varieties to produce more grain yield than the straw accumulation. As such, higher grain yields than the straw would account for higher harvest index. These results were agreement with the results of Gallani *et al*. (2005) and Mukesh Kumar (2006).

Table 2. Yield parameters of chickpea as influenced cultivar and by planting geometry

Treatments	Pods/plant	Seed yield/ plant (g)	Seed yield (kg/ha)	Straw yield (kg/ha)	Harvest Index (%)
A. Cultivars					
V_1 : JG 16	43.5	16.1	1659	1536	52.18
V_2 : NBeG 47	45.6	20.0	1934	2048	48.72
V_3 : BG 30-60	40.4	15.6	1591	1775	47.32
V_4 : Phule-G- 08108	39.4	14.7	1452	1589	47.86
V_5 :JG 2016-24	42.5	18.2	1820	1801	50.58
V_6 : GBM 2	41.4	16.8	1747	1742	50.32
S.Em ±	0.0	0.7	7.03	53.38	0.79
CD at 5%	0.2	0.2	21.69	164.52	2.45
B. Plant Geometry					
G_1 : 22.5×10	41.1	16.5	1828	1969	48.16
G_2 : 30×10	43.1	17.2	1573	1527	50.83
S.Em ±	0.2	0.4	4.03	30.74	0.40
CD at 5%	0.8	0.2	12.44	94.74	1.25
C. Interaction					
S.Em ±	0.6	0.1	9.89	75.31	0.99
CD at 5%	0.2	0.4	30.48	NS	NS

Significantly Higher harvest index (50.83%) obtained with 30×10cm plant geometry. Lower harvest index (48.16%) was accrued with the narrow plant geometry, 22.5×10cm. This reduction in harvest index in narrower spacing might be due to the higher plant population per unit area which might have increased the flower abortion due to competition for nutrients, moisture and solar radiation. Similar result reported by other authors (khan *et al.* (2010)). They reported that maximum harvest index obtained from the wider row spacing of chickpea than narrow row spacing.

Straw yield: The increase in straw yield is directly related to an increase in the vegetative growth and to a negligible extent the increase in the production portion of the plant. It is revealed that the effect of varieties only was significant in case of straw yield ha^{-1}. The variety Nbeg 47 produced significantly higher straw yield (2048 $kgha^{-1}$) over rest of the varieties. Straw yield is function of vegetative growth which is governed by plant parameters like plant height, number of branches and plant population per unit area influenced these characters to a great extent. This favorable morphological phenomenon in this variety resulted significantly highest straw yield. The variation in straw yield of different varieties was also reported by Reddy and Ahalawat (1998), Plant geometey 22.5×10 cm produced higher straw yield (1969 $kgha^{-1}$) than the plant geometry 30×10 cm (1527 $kgha^{-1}$). It may be due to that the closer spacing has the more vegetative growth compare to reproductive growth, therefore the harvest index was less in 22.5×10 cm and straw yield was higher. The effect of raw spacing also reported by Mahapatra *et al.* (1995).

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