International Journal of Plant & Soil Science

34(9): 19-28, 2022; Article no.IJPSS.84190
ISSN: 2320-7035

Effect of Seed Rate and Spacing on Nutrient Uptake in Chickpea

Kajal Loria [a], Manju Kumari [b*], Yachna Sood [b], Vikas [b], Lalita [b], Saroj Rani [b] and Himangini [b]

[a] Department of Agriculture, Maharishi Markandeshwar University, Sadopur (Ambala) Haryana, India.
[b] Department of Agriculture, Maharishi Markandeshwar (Deemed to be) University, Mullana (Ambala) Haryana, India.

Authors' contributions

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

Article Information

DOI: 10.9734/IJPSS/2022/v34i930909

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/84190

Original Research Article

Received 05 January 2022
Accepted 08 March 2022
Published 15 March 2022

ABSTRACT

The research experiment comprising of three levels of seed rate, *i.e.*, 60, 75 and 90 kg/ha and three line spacing, *i.e.*, 20, 30 and 40 cm was conducted at Research Farm of the Department of Agriculture, Maharishi Markandeshwar University, Sadopur, Ambala during winter season of 2020-21 to study the effect of seed rate and spacing on uptake of nitrogen, phosphorus and potash in chickpea. The seed rate was kept in main plot and spacing in sub-plot. The total nine treatment combinations of seed rate and line spacing were laid out in Split Plot Design (SPD) and replicated thrice. The interaction between seed rate and line spacing significantly influenced the uptake of N, P and K in plants and their status in soil. The maximum available NPK was registered with seed rate 75 kg/ha. Irrespective of the seed rate, the maximum NPK content was recorded under line spacing of 30 cm. Similar observations were also recorded for NPK content (%) in seed and straw of chickpea. The maximum NPK uptake and protein content was also observed when the crop was sown at row spacing of 30 cm using a seed rate 75 kg/ha.

Keywords: Chickpea; protein content; available NPK; nutrient uptake.

**Corresponding author: E-mail: mkmanjuthakur@gmail.com;*

1. INTRODUCTION

Chickpea (*Cicer arietinum* L.) is one of the most important legume crop which belongs to the family Fabaceae. Globally, chickpea is grown over an area of 131.1 million hectare with the total production 127.3 million tonnes and yield of 970 kg/ha [1]. Around the world, it is found to be the second most cultivated legume crop by small holder farmers of the semi-arid regions [2]. It is a high value crop suitable for deep black soils in the cool semi arid areas of the tropics, sub-tropics as well as temperate areas [3]. India ranks first in area and production but not in terms of productivity [4]. It is winter season pulse crop cultivated in different parts of the country, grown successfully in Madhya Pradesh, Rajasthan, Maharashtra, Karnataka, Andhra Pradesh and Uttar Pradesh [5].

In Chickpea (*Cicer arietinum* L.) the main reason of low yield is too low and high plant population beyond a certain limit often adversely affects the crop yield. Number of plants per unit area influences plant parameters, yield components and ultimately the seed yield [6-11]. Plant spacing is also very important to facilitate aeration and light penetration in to plant canopy for optimizing rate of photosynthesis. There is very little information available on the relative contribution of various plant spacing towards yield and also their interaction [12-15].

The seed rate impacts a lot in overall growth and production of Chickpea [16-18]. Moreover, recommended seed rate differs for cultivar to cultivar along with seed size, location, soil moisture and environmental conditions such as rainfall and temperature [19]. The emergence count per meter row length was influenced by the seed rate because of presence of abundant seeds, which absorbs moisture present in soil thus creating the competition for soil moisture [20]. It was also found that increase in seed rate also increase the height of plant, as there was competition among the plants for sunlight (Cokkizgin, 2012).The use of low seed rate, poor quality seed, inadequate moisture level at time of sowing, plant mortality due to various disease or salinity or moisture stress could affect plant stand [21-24]. To maintain sufficient plant population, the requirement of optimum seed rate of good quality is recommended [20]. The effect of seed rate showed an increasing trend of N uptake with increase in plant population. When plants are sown at optimum level (60 kg/ha seed rate), they get adequate levels of nitrogen that results in increased level of protein. Moreover, increase in the seed rate causes decrease in the protein content of the seeds [25].

When environmental resources are used most effectively yield can be maximized. Therefore, plant row spacing is an important crop management factor. 45 cm row spacing of increase chickpea yield compared to 30 and 50 cm spacing.

2. MATERIALS AND METHODS

Experiment was conducted at Research Farm, Department of Agriculture, Maharishi Markandeshwar University, Sadopur Ambala (Haryana) during *Rabi* season 2020-2021. The experiment was laid out in split plot design where nine treatments and three replications were designed in of November 2020. The fertilizer application of Nitrogen, Phosphorus, Potassium at the rate of 20kg/ha, 40kg/ha and 17 kg/ha, respectively, were broadcasted at the time of sowing in the form of Urea, DAP and MOP. In the beginning, before conducting the experiment in the field, the soil samples were collected randomly from different plots upto depth of 0-15cm and composite soil samples were prepared. The samples of crop produce (Seed and Straw) were collected from each treatment at harvest, dried in an oven at 60^0C for 72 hours, than processed and analyzed for N, P, K and protein content in seed and straw. Table 2 indicated the details of method employed for estimating different treatments.The NPK uptake by seed and straw in each plot was obtained by multiplying the nutrient content (%) with crop yield. The total nutrient uptake of N, P, K at harvest was calculated as under:

$$\text{Nutrient uptake by seed (kg/ha)} = \frac{\text{Nutrient content (\%)} \times \text{Seed yield (kg/ha)}}{100}$$

$$\text{Nutrient uptake by straw (kg ha}^{-1}\text{)} = \frac{\text{Nutrient content (\%)} \times \text{Straw yield (kg ha}^{-1}\text{)}100}{100}$$

2.1 Protein Content in Chickpea Seeds and Straw

The protein content (%) of seed and straw was determined by multiplying the N content (%) of seed and straw with 6.25 to obtain crude protein content.

2.2 Statistical Analysis

The obtained data from the experimental field and laboratory studies were subjected to appropriate statistical analysis on the basis of procedure recommended by Gomez and Gomez [26]. For parameters the F value of significance will be checked at 5% level of significance and also the Critical difference (CD) were calculated. The critical difference was used to compare different treatments.

3. RESULTS AND DISCUSSION

3.1 NPK Status in Soil (kg/ha)

The data regarding nitrogen, phosphorus and potassium status in soil have been embodied in Table 1. The N availability (133.84 kg/ha), P (22.44 kg/ha) and K (101.56 kg/ha) in soil was observed in 75 kg/ha seed rate with row spacing of 30cm. The N availibility (125.36 kg/ha), P (16.43 kg/ha) and K (91.60 kg/ha) status in soil was recorded with the seed rate of 90 kg/ha and row spacing of 20cm.

In case of seed rate, the overall highest N (131.85 kg/ha) and K (99.84 kg/ha) in soil was recorded under 75 kg/ha seed rate, and was followed by 60 kg/ha and 90 kg/ha seed rate, respectively. The maximum value of available P (20.17 kg ha^{-1}) was found when seed was sown at 75 kg/ha seed rate and at par with 60 kg/ha seed rate.

In case of inter row spacing, the overall highest N (132.22 kg/ha), P (21.23 kg/ha) and K (100.72 kg/ha)in soil was observed under 30cm row spacing, which was followed by 40cm and 20 cm row spacing, respectively. The similar results were declared by Kumar et al. [27].

3.2 N Content in Seed and Straw (%)

Highest N content in seed (3.68%) and straw (0.98%) was found superior with the use of 75 kg/ha seed rate and row spacing of 30cm. The reduction in N content in seed (3.21%) and straw (0.82%) was at 90 kg/ha seed rate and row spacing of 20 cm where as the interaction effect of 90 kg/ha seed rate and 40 cm row spacing showed minimum N content in straw (0.82%).

Table 1. Effect of seed rate and spacing on available N, P and K (kg/ha) in soil

N(kg/ha)				
Treatments	**20cm**	**30cm**	**40cm**	**Mean**
60 kg ha^{-1}	127.57	132.44	130.78	130.26
75 kg ha^{-1}	129.48	133.84	132.22	131.85
90 kg ha^{-1}	125.36	130.39	125.62	127.12
Mean	127.47	132.22	129.54	

C.D.(5%)(Seed rate)=1.35, C.D.(5%)(Spacing)= 0.64, C.D.(5%)(Seed rate × Spacing)= 1.10, SEm± (Seed rate)= 0.33, SEm± (Spacing)= 0.20, SEm± (Seed rate × Spacing)= 0.35

P(kg/ha)				
Treatments	**20cm**	**30cm**	**40cm**	**Mean**
60 kg ha^{-1}	17.78	21.18	18.87	19.28
75 kg ha^{-1}	18.95	22.44	20.17	20.17
90 kg ha^{-1}	16.43	20.07	18.07	18.19
Mean	17.72	21.23	19.04	

C.D.(5%)(Seed rate)=0.91, C.D.(5%)(Spacing)=0.48, C.D.(5%)(Seed rate × Spacing)= 0.82, SEm± (Seed rate)=0.22, SEm± (Spacing)=0.15, SEm± (Seed rate × Spacing)= 0.26

K(kg/ha)				
Treatments	**20cm**	**30cm**	**40cm**	**Mean**
60 kg ha^{-1}	92.53	101.16	96.60	96.76
75 kg ha^{-1}	97.33	101.56	100.63	99.84
90 kg ha^{-1}	91.60	99.43	48.46	96.50
Mean	93.82	100.72	98.56	

C.D.(5%)(Seed rate)=1.46, C.D.(5%) (Spacing)=0.66, C.D.(5%)(Seed rate × Spacing)= 1.13, SEm± (Seed rate)=0.36, SEm± (Spacing)=0.21, SEm± (Seed rate × Spacing)= 0.36

Table 2. Effect of seed rate and spacing on N content (%) in seed and straw

N content in seed (%)				
Treatments	**20cm**	**30cm**	**40cm**	**Mean**
60 kg ha^{-1}	3.53	3.66	3.60	3.59
75 kg ha^{-1}	3.57	3.68	3.63	3.63
90 kg ha^{-1}	3.26	3.54	3.21	3.34
Mean	3.45	3.63	3.21	

C.D.(5%)(Seed rate)=0.21, C.D.(5%)(Spacing)= 0.08, C.D.(5%)(Seed rate × Spacing)= 0.14, SEm± (Seed rate)= 0.05, SEm± (Spacing)= 0.03, SEm± (Seed rate × Spacing)= 0.04

N content in straw (%)				
Treatments	**20cm**	**30cm**	**40cm**	**Mean**
60 kg ha^{-1}	0.86	0.93	0.90	0.90
75 kg ha^{-1}	0.92	0.98	0.92	0.94
90 kg ha^{-1}	0.82	0.92	0.90	0.88
Mean	0.87	0.94	0.91	

C.D.(5%)(Seed rate)=0.03, C.D.(5%)(Spacing)= 0.03, C.D.(5%)(Seed rate × Spacing)= 0.03, SEm± (Seed rate)=0.008, SEm± (Spacing)=0.009, SEm±(Seed rate × Spacing)= 0.011

Regarding different seed rate, average highest N content in seed (3.63%) under 75 kg/ha seed rate, which was statistically at par with seed rate of 60 kg/ha .On the other side, highest N content in straw (0.94%) was observed in case of 75 kg/ha seed rate.

Regarding different row spacing, average highest N content in seed (3.63%) was obtained under 30cm row spacing as compared to other treatments while highest N content in straw (0.94%) was recorded under 30 cm row spacing and it was at par with 40 cm row spacing. It is due to improvement in nodulation in case of wider-row spacing. The similar research was observed by Chauhan [28].

3.3 N uptake by Seed and Straw (kg/ha)

The result showed that maximum N uptake by seed (85.77 kg/ha) and by straw (25.57 kg/ha) was noticed from the plots with seed rate of 75 kg/ha and row spacing of 30 cm. Likewise, minimum N uptake by seed (66.54 kg/ha) and by straw (19.37 kg/ha) was recorded in plot having seed rate of 90 kg/ha and row spacing of 20cm.

On the basis of seed rate, the mean N uptake was highest in seed (79.90 kg/ha) and straw (23.41 kg/ha) when seed was sown at 75 kg/ha seed rate, which was followed by seed rate of 60 kg/ha and 90 kg/ha, respectively. Lone et al. [29] reported that in soyabean crop, the impact of seed rate on nitrogen uptake was found to be more, when the plant population was increased. Therefore, the uptake of nutrients (Nitrogen) increased by increased in seed rate.

On the basis of row spacing, the overall highest N uptake by seed (78.74 kg/ha) was recorded when the crop was sown at 30cm row spacing and it was at par with 40 cm spacing while maximum N uptake by straw (24.06 kg/ha) was observed at row spacing of 30 cm. The similar result was quoted by Chauhan [28] and Patel [30]. Therefore, they concluded that N uptake depends on the nitrogen content and yield of the crop. The maximum yield was obtained from the same treatment that is 30 cm row spacing.

Table 3. Effect of seed rate and spacing on N uptake (kg/ha) by seed and straw

N uptake by seed (kg/ha)				
Treatments	**20cm**	**30cm**	**40cm**	**Mean**
60 kg ha^{-1}	66.54	76.31	74.53	72.46
75 kg ha^{-1}	72.25	85.77	81.69	79.90
90 kg ha^{-1}	67.72	74.14	68.20	70.02
Mean	68.83	78.74	74.81	

C.D.(5%)(Seed rate)=4.14, C.D.(5%)(Spacing)= 4.37, C.D.(5%)(Seed rate × Spacing)= 7.47, SEm±(Seed rate)= 1.02, SE m± (Spacing)= 1.40, SEm± (Seed rate × Spacing)= 2.43

N uptake by straw (kg/ha)				
Treatments	**20cm**	**30cm**	**40cm**	**Mean**
60 kg ha^{-1}	19.37	22.30	21.80	21.16
75 kg ha^{-1}	21.37	25.57	23.30	23.41
90 kg ha^{-1}	19.84	22.60	20.04	20.83
Mean	20.01	24.06	22.04	

C.D.(5%)(Seed rate)=1.07, C.D.(5%)(Spacing)=1.36, C.D.(5%)(Seed rate × Spacing)= 2.33, SEm± (Seed rate)=0.26,SEm± (Spacing)=0.43, SEm± (Seed rate × Spacing)= 0.75

Table 4. Effect of seed rate and spacing on P content (%) in seed and straw

P content in seed (%)				
Treatments	**20cm**	**30cm**	**40cm**	**Mean**
60 kg ha^{-1}	0.220	0.450	0.382	0.351
75 kg ha^{-1}	0.379	0.576	0.416	0.457
90 kg ha^{-1}	0.213	0.477	0.310	0.334
Mean	0.271	0.501	0.369	

C.D.(5%)(Seed rate)=0.038, C.D.(5%)(Spacing)=0.032, C.D.(5%)(Seed rate × Spacing)=0.052, SEm± (Seed rate)=0.008, SEm± (Spacing)=0.009, SEm± (Seed rate × Spacing)=0.017

P content in straw (%)				
Treatments	**20cm**	**30cm**	**40cm**	**Mean**
60 kg ha^{-1}	0.465	0.530	0.312	0.502
75 kg ha^{-1}	0.520	0.537	0.512	0.526
90 kg ha^{-1}	0.428	0.524	0.521	0.485
Mean	0.471	0.530	0.502	

C.D.(5%)(Seed rate)=0.031, C.D.(5%)(Spacing)=0.028, C.D.(5%)(Seed rate × Spacing)= 0.052, SEm± (Seed rate)=0.008,SEm±(Spacing)=0.009, SE m± (Seed rate × Spacing)= 0.017

3.4 Phosphorus Content in Seed and Straw (%)

Maximum Phosphorus content in seed (0.576%) and straw (0.537%) was recorded with the treatment combination of 75 **kg/ha** seed rate and row spacing of 30cm. The seed sown at 90 kg/ha seed rate and row spacing of 20 cm reported minimum Phosphorus content in seed (0.213%) and straw (0.312%).

Among different seed rates, phosphorus content was highest in seed (0.457%) under 75 kg/ha seed rate, which was followed by seed rate of 60 kg/ha and 90 kg/ha, respectively. The maximum phosphorus content in straw (0.526%) was noticed under 75 kg/ha seed rate. However, it was at par with 60 kg/ha seed rate.

Among different row spacing, phosphorus content was highest in seed (0.501%) under 30cm row spacing which was significantly higher as compared to other treatments. In case of straw, the maximum phosphorus content (0.530%) was recorded from the plots of 30 cm row spacing and it was at par with 40 cm row spacing. The accumulation of nitrogen and phosphorus in grain and straw was observed higher in row spacing of 30 cm than 20 cm row spacing [27].

3.5 P uptake by Seed and Straw (kg/ha)

The data presented in Table 5 indicates that highest P uptake by seed (13.41 kg/ha) and straw (13.95 kg/ha) was obtained by the interaction of 75 kg/ha seed rate and row spacing of 30cm. On the other side, the seed rate of 60 kg/ha with 20 cm row spacing showed minimum effect of P uptake by seed (4.12 kg/ha) and lowest value of straw (9.95 kg/ha) was found in case of 90 kg/ha seed rate at 20 cm row spacing.

Table 5. Effect of seed rate and spacing on P uptake (kg/ha) by seed and straw

P uptake by seed (kg/ha)				
Treatments	**20cm**	**30cm**	**40cm**	**Mean**
60 kg ha^{-1}	4.12	9.41	7.90	7.14
75 kg ha^{-1}	7.64	13.41	9.36	10.13
90 kg ha^{-1}	4.13	9.95	6.06	6.71
Mean	5.30	10.92	7.74	

C.D.(5%)(Seed rate)=0.68, C.D.(5%)(Spacing)=0.84, C.D.(5%)(Seed rate × Spacing)= 1.45 SEm± (Seed rate)=0.16, SEm± (Spacing)= 0.27, SEm± (Seed rate × Spacing)= 0.46

P uptake by straw (kg/ha)				
Treatments	**20cm**	**30cm**	**40cm**	**Mean**
60 kg ha^{-1}	10.41	12.70	12.17	11.76
75 kg ha^{-1}	12.03	13.95	13.17	13.05
90 kg ha^{-1}	9.95	12.81	11.69	11.48
Mean	10.79	13.15	12.37	

C.D.(5%)(Seed rate)= 0.73, C.D.(5%)(Spacing)= 1.12, C.D.(5%)(Seed rate × Spacing)= 1.91, SEm± (Seed rate)= 0.18, SEm± (Spacing)= 0.36, SEm± (Seed rate × Spacing)= 0.62

On the basis of seed rate, the overall P uptake was highest in seed (10.13 kg/ha) and straw (13.05 kg/ha) from the treatment in which 75 kg/ha seed rate was used, which was followed by seed rate of 60 kg/ha and 90 kg/ha seed rate, respectively. The similar result was observed by Sethi et al. [25] and Lone et al. [29] in which they proved that impact of seed rate on nitrogen uptake is found to be more when plant population is increased. Therefore, uptake of phosphorus is more whenhigh seed rates was used (Jatindar and Badiyala, 2004).

On the basis of row spacing, the overall P uptake was highest in seed (10.92 kg/ha) and straw (13.15 kg/ha) was observed in the treatment in which 30cm row spacing was kept, where as maximum value of straw was at par with 40 cm row spacing. Chauhan [28] and Patel [30] suggested that N uptake depends on the nitrogen content and yield of the crop, thus the maximum yield was obtained from the same treatment that is 30 cm row spacing.

3.6 K Content in Seed and Straw (%)

The presented data of Table 6 showed that interaction effect of 75 kg/ha seed rate and inter row spacing of 20 cm resulted in highest K content in seed (0.639%) and straw (1.717%). Likewise, the minimum K content in seed (0.293%) and straw (1.213%) was observed when plot was sown at 90 kg/ha seed rate and spacing of 20cm between the rows.

In case of seed rate, the overall K content was highest in seed (0.552%) with the application of 75 kg/ha seed rate, which was followed by seed rate of 60 kg/ha and 90 kg/ha respectively. While highest K content in straw (1.594%) was observed in case of 75 kg/ha seed rate and was at par with 60 kg/ha seed rate. The accumulation of nitrogen and phosphorus in grain and straw was observed higher in row spacing of 30 cm than 20 cm row spacing [27].

Table 6. Effect of seed rate and spacing on K content (%) in seed and straw

K content in seed (%)				
Treatments	**20cm**	**30cm**	**40cm**	**Mean**
60 kg ha^{-1}	0.347	0.484	0.421	0.417
75 kg ha^{-1}	0.451	0.639	0.566	0.552
90 kg ha^{-1}	0.293	0.528	0.383	0.401
Mean	0.364	0.550	0.457	

C.D.(5%)(Seed rate)=0.033, C.D.(5%)(Spacing)=0.044, C.D.(5%)(Seed rate × Spacing)= 0.078, SEm± (Seed rate)=0.008,SEm± (Spacing)= 0.014, SEm± (Seed rate × Spacing)=0.024

K content in straw (%)				
Treatments	**20cm**	**30cm**	**40cm**	**Mean**
60 kg ha^{-1}	1.467	1.623	1.583	1.558
75 kg ha^{-1}	1.537	1.717	1.530	1.594
90 kg ha^{-1}	1.213	1.597	1.377	1.396
Mean	1.406	1.646	1.497	

C.D.(5%)(Seed rate)=0.071, C.D.(5%)(Spacing)=0.090, C.D.(5%)(Seed rate × Spacing)= 0.156, SEm± (Seed rate)=0.018,SEm± (Spacing)=0.029,SEm± (Seed rate × Spacing)=0.040

Table 7. Effect of seed rate and spacing on K uptake (kg/ha) by seed and straw

K uptake by seed (kg/ha)				
Treatments	**20cm**	**30cm**	**40cm**	**Mean**
60 kg ha^{-1}	6.51	10.06	8.72	8.43
75 kg ha^{-1}	9.11	14.85	13.08	12.34
90 kg ha^{-1}	5.97	10.82	7.47	8.08
Mean	7.19	11.91	9.75	

C.D.(5%)(Seed rate)=0.99, C.D.(5%)(Spacing)=0.95, C.D.(5%)(Seed rate × Spacing)= 1.63 SEm± (Seed rate)=0.24, SEm± (Spacing)=0.30, SEm± (Seed rate × Spacing)= 0.53

K uptake by straw (kg/ha)				
Treatments	**20cm**	**30cm**	**40cm**	**Mean**
60 kg ha^{-1}	32.87	38.92	37.84	36.54
75 kg ha^{-1}	35.56	44.62	38.73	39.64
90 kg ha^{-1}	28.19	39.06	32.14	33.13
Mean	32.20	40.87	36.24	

C.D.(5%)(Seed rate)=1.94, C.D.(5%)(Spacing)=3.38, C.D.(5%)(Seed rate × Spacing)= 5.79 SEm± (Seed rate)=0.48, SEm± (Spacing)=1.08, SEm± (Seed rate × Spacing)=1.88

Table 8. Effect of seed rate and spacing on Protein content (%) in seed and straw

Protein content in seed (%)				
Treatments	**20cm**	**30cm**	**40cm**	**Mean**
60 kg ha^{-1}	22.08	22.87	22.49	22.48
75 kg ha^{-1}	22.35	23.04	22.72	22.70
90 kg ha^{-1}	20.22	22.16	20.24	22.87
Mean	21.55	22.69	21.82	

C.D.(5%)(Seed rate)=1.31, C.D.(5%)(Spacing)=0.54, C.D. (5%)(Seed rate × Spacing)= 0.93, SEm± (Seed rate)= 0.33, SEm± (Spacing)=0.17, SEm± (Seed rate × Spacing)=0.30

Protein content in straw (%)				
Treatments	**20cm**	**30cm**	**40cm**	**Mean**
60 kg ha^{-1}	5.40	5.80	5.69	5.63
75 kg ha^{-1}	6.76	6.14	5.75	5.88
90 kg ha^{-1}	5.15	5.77	5.63	5.52
Mean	5.44	5.90	5.69	

C.D.(5%)(Seed rate)=0.17, C.D.(5%)(Spacing)= 0.18, C.D.(5%)(Seed rate × Spacing)= 0.31 SEm± (Seed rate)=0.04, SEm± (Spacing)= 0.06, SEm± (Seed rate × Spacing)= 0.10

In case of row spacing, the overall maximum K content in seed (0.550%) and straw (1.646%) was observed at a spacing of 30cm between the rows, which was followed by row spacing of 40 and 20 cm, respectively.

3.7 K uptake by Seed and Straw (kg/ha)

The data represented in Table 7 summarized the effect of seed rate and spacing on K uptake by seed and straw. The data indicated that

significantly maximum K uptake by seed (14.85 kg/ha) and straw (44.62 kg/ha) was taken when 75 kg/ha seed rate was used with row spacing of 30cm. On the other side, plots of 90 kg/ha seed rate with row spacing of 20 cm showed minimum K uptake by seed and straw with respective values of 5.97 kg/ha and 28.19 kg/ha.

With respect to seed rate, the average increase in K uptake by seed (12.34 kg/ha) and straw (39.64 kg/ha) was examined with the use of 75 kg/ha, which was followed by 60 and 90 kg/ha seed rate, respectively. Jatinder and Kumar [31] on his study reported that when sowing rate increases, the uptake of nutrients (Potassium) also increased. The similar result was also quoted by Lone et al [29].

With respect to row spacing, the average increase in K uptake by seed (11.91 kg/ha) and straw (40.87 kg/ha) was recorded with the use of 30cm, which was followed by 40 and 20 cm row spacing, respectively.

3.8 Protein Content in Seed and Straw (%)

Protein content in seed and straw recorded under different treatments have been presented in Table 8, which clearly indicates that plots sown at seed rate of 75 kg/ha with row spacing of 30 cm resulted insignificantly higher protein content in case of seed (23.04%) and straw (6.14%). The lowest protein content in seed (20.22%) and straw (5.15%) was obtained with the seed rate of 90 kg/ha and row spacing of 20cm. The similar result was quoted by Kumar et al. [27].

Regarding different seed rate, maximum protein content in seed (22.70%) was obtained from the treatment of 75 kg/ha seed rate but was at par with seed rate of 60 kg/ha and 90 kg/ha, respectively. The maximum protein content in straw (5.88%) was obtained from the treatment of 75 kg/ha seed rate.

Regarding different row spacing, maximum protein content in seed (22.69%) and straw (5.90%) was obtained at 30cm row spacing, which was followed by row spacing of 40 cm and 20 cm, respectively. The above findings was in accordance with Ray et al. [32]. Higher values of proteins are obtained in the cases where N content is more as the protein content directly depends upon the value of N (Protein content= N content % × 6.25). The similar resultswas undertaken by Chauhan [28].

4. CONCLUSION

On the basis of present study, the research concluded that interaction effect between 75 kg/ha seed rate and row spacing of 30 cm in chickpea crop provided superior result under different soil parameters such as available NPK and protein content. On the basis of above observations, it was concluded that 75 kg/ha seed rate with 30 cm row spacing is the optimum planting geometry improves soil physco-chemical status of soil. The maximum effect of N, P, K content in seed and straw was observed in plot having75 kg seed per hectare with row spacing of 30cm.Among seed rate and spacing, the spacing caused higher N, P, K content and uptake both in case of seed and straw as compared to seed rate. Preferably,75 kg/ha seed rate and inter row spacing of 30 cm are positively recommended to the farmers, as it is beneficial to provide better yield and results under given environmental condition.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Anonymous. Global Scenario of Agriculture Pulses. In: All India Pulses and Grains Association Publication. 2019a;4(2): 4-9.
2. Thudi M, Gaur PM, Krishnamurthy L, Mir RR, Kudapa H, Fikre A, Varshney RK. Genomics-assisted breeding for drought tolerance in chickpea. Functional Plant Biology. 2014;41(11):1178.
3. Agajie. Effect of spacing on yield components and yield of chickpea (*Cicerarietinum* L.) at Assosa, Western Ethiopia. Agriculture, Forestry and Fisheries. 2018;7(2):39-51.
4. Samriti Sharma S, Sharma R, Pathania A. Trands in Area, Production and Productivity and Trade of Chickpea in India. Economics Affairs. 2020;65(2):261-265.
5. Kumar N, Singh MK, Praharaj CS, Singh SS. Performance of chickpea under different planting method, seed rate and irrigation level in Indo-Gangetic Plains of India. Journal of Food Legumes. 2015;28(1):40-44.
6. Anonymous. Agricultural Statistics at a Glance.Directorate of Economics and Statistics, Ministry of Agriculture and

Farmers Welfare Department of Agriculture Cooperation and Farmers Welfare, Government of India. 2019b:62-63.

7. Anonymous. Directorated of Pulses Development, Bhopal,Ministry of Agriculture and Farmers Welfare Department of Agriculture Cooperation and Farmers Welfare, Government of India. 2018:8.
8. Deb AC, Khaleque MA. Nature of gene action of some quantitative traits in chickpea (*Cicerarietinum* L.). World Journal of Agriculture Science. 2009;5(3):361-368.
9. Flowers TJ, Gaur PM, Laxmipathigowda CLL, Krishnamurthy L, Samineni S, Siddique KHM, Turner NC, Vadez V, Varshney RK, Colmer TD. Salt Sensitivity in chickpea. Plant Cell Environment. 2010;33:490-509.
10. Hama SJ. Correlation and path coefficient analysis for seed yield and yield components in chickpea under rainfedcondition. Journal of Kerbala Agriculture Science. 2019;6(1):26-35.
11. Hirdyani H. Nutritional composition of chickpea (*Cicerarietinum* L.) and value added products. Indian Journal of Community Health. 2014;26(02):199-201.
12. Jackson ML. Soil Chemical Analysis. Prentice Hall of India Pvt. Ltd, New Delhi. 1973:111-126.
13. Jackson ML. Soil Chemical Analysis. Prentice Hall of India Pvt. Ltd, New Delhi. 2005:112-127.
14. Kousar S, Sohaib M, Ahmed RT, Sana, Ahmed B, Khan HA. Genetic diversity analysis of morpho-genetic traits and micro-nutrient concentration in chickpea genotypes. International Journal of Agronomy Agriculture. 2019;14(5): 1-8.
15. Machado S, Humphrays C, Tuck B, Corp M. Seeding date, plant density and cultivars effect on chickpea yield and seed size in eastern Oregon. Online, Crop Mgt. 2006:1094.
16. Singh S, Singh I, Kapoor K, Gaur PM, Chaturvedi SK, Singh NP, Sandhu JS. Broadening the genetic Base of Grain Legumes. 2014:51-73.
17. Varshney KR, Thudi M, Nayak SN, Gaur PM, kashiwagi J, Krishnamurthy L, Jaganathan D, Koppolu J, Bohra A, Tripathi S, Rathore A, Jukanti AK, Jayalakshmi V, Vemula A, Singh SJ, Yasin M, Sheshshayee MS, Viswanatha KP. Genetic dissection of drought tolerance in Chickpea (*Cicerarietinum* L.).Theoretical and Applied Genetics. 2013;127(2):445-462.
18. Yadav PK, Jal MK, Singh B, Kaushik N, Singh JKR, Kumar A. Enhancement of productivity and profitability of chickpea (*Cicerarietinum* L.) as well as soil fertility of coarse textured potassium fertilization. International journal of Agriculture Statistics Science. 2020;16:1053-1058.
19. Chang KF, Ahmed HU, Hwang SF, Gossen BD, Howard RJ, Warkentin TD, Strelkov SE, Blade SF. Impact of cultivar, row spacing and seeding rate on ascochyta blight severity and yield of chickpea Canadian Journal of Plant Science. 2006;87:395-403.
20. Singh G, Ram H, Aggarwal N. Growth, Productivity and Economics of Kabuli Chickpea (*Cicerarietinum* L.)Genotypes in Response to Seed rate in Northern India. International Journal of Current Microbiology and Applied Sciences. 2017;6(7):3917-3930.
21. Maya M, Maphosa M. Current status of chickpea production: Opportunities for promoting, adoption and adapting the crop in Zimbabwe: A review. Journal of Dryland Agriculture. 2020;6(1): 1-9.
22. Patel TB. Studies on growth, yield and quality of chickpea (*Cicerarietinum* L.); 1992.
23. Rasool S, Latef AAHA, Ahmad. Chickpea: Role and responses under abiotic and biotic stress. Legumes under Environmental Stress. 2014:67-79.
24. Siddique KH, Johansen C, Kumar RJVDK, Ali M. Role of legumes in sustainable cropping system. In: Abstracts, Fourth International food legume Research conference- Food legumes for Nutritional Security and Sustainable Agriculture. 2005;10:18-22.
25. Sethi IB, Sewhag M, Jajoria M. Relative performance of Chickpea cultivars: A Review. Trendsin Biosciences. 2017;10 (3):974-979.
26. Gomez KA, Gomez AA. Statistical Procedure for Agricultural Research second Edition Wiley Inter Science, New York, USA; 1984.
27. Kumar M, Singh RC, Kumar R. Effect of genotypes, sowing date and row spacing on nutrient concentration, uptake and protein of chickpea. Haryana Journal of Agronomy. 2003;19(1): 120-122.

28. Chauhan CN. Effect of spacing, weeds and phosphorus management on chickpea (*Cicerarietinum* L.).M.Sc. Thesis, Department of Agronomy Gujarat Agriculture University, Navsari. 2000: 1-129.
29. Lone BA, Hasan B, Ansar S, Khanday BA. Effect of seed rate, row spacing and fertility levels on growth and nutrient uptake of soybean (Glycine max, L.) under temperate conditions. Journal of Agriculture and Biological Science. 2009;4(3):1990-6145.
30. Patel TB. Studies on growth, yield and quality of chickpea (*Cicerarietinum* L.) genotypes as influenced by irrigation and row spacing. Ph.D. thesis submitted to IARI, New Delhi;1992.
31. Jatinder K, Badiyala D. Studies on the effect of seed rate, row spacing and sowing time on dry matter accumulation and nutrient uptake in soyabean (Glycine max L.). Journal of Oilseed Research. 2004;21(2):290-292.
32. Ray K, Singh D, Laljat B. Effect of sowing time and seed rate on growth and yield of chickpea cultivars. Advance Research Journal of Crop Improvement. 2017;8(1): 1-16.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/84190