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Research Communication

Influence of seed rate and nipping practice on yield, nutrient uptake and quality of chickpea (*Cicer arietinum*) varieties in Irrigated Arid Western Plains Zone

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ABSTRACT

A field experiment was conducted during winter season 2016–17 and 2017–18 at Bikaner, Rajasthan, to study the effect of seed rates and nipping on yield, nutrient uptake and quality of chickpea (*Cicer arietinum* L.) varieties. Among varieties, 'GNG 1581' recorded significantly higher seed yield (2,142 kg/ha), net returns and benefit: cost (B : C) ratio followed by 'GNG 1958' and 'GNG 2171'. 'GNG 1958' chickpea gave significantly higher straw and biological yields than the other 2 varieties. Further, growing of chickpea by using 80 kg/ha seed rate resulted in highest seed (2111 kg/ha), straw (3657 kg/ha), biological yields (5,768 kg/ha), NPK uptake and crude protein content followed by seed rate of 64 kg/ha and 48 kg/ha. Higher net returns and B : C ratio were recorded under 64 kg/ha seed rate. Significantly higher seed, straw, biological yields, net returns, B:C ratio and NPK uptake were observed when nipping practiced at 45 days after sowing (DAS) than the control (no nipping), nipping at 30 DAS and 60 DAS. However, protein content in seed was not influenced by nipping practice. Chickpea var. 'GNG 1581' also revealed significantly higher total nitrogen (120.6 kg/ha); and total phosphorus uptake (23.02 kg/ha) however, total potassium uptake (65.13 kg/ha) was higher in variety 'GNG 1958'.

Key words **:** Chickpea, Nipping, Seed rate, Varieties, Protein, Economics

Rajasthan ranked 3rd in chickpea (gram) production after Madhya Pradesh and Maharastra with acreage of 1.596 million hectare and 1.839 million tonnes of production during winter (*rabi*) 2018–19. (GoR, 2020). Though its acreage is increasing in irrigated areas of arid region of western Rajasthan, its productivity is quite low than its potential yield. Lack of suitable variety, inadequate plant population as per variety and excessive vegetative growth under high-input situation are some important factors of its poor yield.

Varieties play an important role under a set of agro-climatic conditions to achieve maximum yield potential. Of late, the development of early varieties of chickpea has enabled its successful cultivation. Inadequate plant population is one of the important factors responsible for poor yields of chickpea (Nagarajaiah *et al.*, 2005). An increase in the seed rate increases the production; however after a point there is stagnation in yield of chickpea of pods/plant and 1,000-grain weight decreases significantly with theincrease in seed rate and plant population. A seed rate of 50 kg/ha recorded maximum number of pods/plant and 1,000-grain weight (Sethi, 2016). The improvement in yield attributes at lower seed rate could be attributed to a relatively less competition for light, nutrient and moisture, enabling the plant to develop better than the counter parts with higher seed rate. A seed rate of 75 kg/ha gave significantly higher grain and straw yield than 50 kg/ha (Saini and Paroda, 1997). Adequate plant population may be maintained by using cultivar specific seed rate. In chickpea, there is a strong apical dominance; and it is believed that apical meristem/ shoot apex produces auxin, which inhibits the axillary buds into actively growing shoots (Campbell *et al.,* 2008). Nipping has been found to increase lateral branches of plants as a result of the removal of apical dominance of auxin. It promotes the lateral branching, helps to have vigorous plant and produces more flowers and pods. More branches will possibly initiate more flower buds and possibly more yield (Reddy, 2009). Nipping in chickpea is one of the most important agronomic practices

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for the enhancement of crop yield and yield-attributing characters. Nipping at early stages of crop could increase number of branches while restricting profuse vegetative growth thereby promoting crop yield (Singh and Diwakar, 1995). Nipping at different stages tended to increase number of branches and number of pods/plant that lead to boosting chickpea yield (Aziz, 2000). Nipping practice in the research area has two fold advantage. Nipping in chickpea 45 days after sowing increases yield as well as controls disease severity (Chaube and Pundhir, 2005). Aslam *et al.* reported (2008) an increased in height and number of pod bearing branches with topping of chickpea at various levels under water-deficit systems. Kumar *et al.* (2018) found that, nipping in chickpea at 30 and 40 DAS produced more number of pods/plant, number of seeds/pod and test weight as compared to no nipping. The uptake of nutrients and yield of varieties in the changing seed rates and nipping stages helps to select the most promising varieties in terms of yield and nutrient use efficiency (Author not clear). With this view an experiment was conducted to identify the most suitable variety, appropriate seed rate and nipping stage for the nutrient uptake and yield performance in chickpea.

MATERIALS AND METHODS

The experiment was conducted during the winter season 2016–17 and 2017–18 at Instructional Farm, College of Agriculture, Swami Keswanand Rajasthan Agricultural University, Bikaner, (28.01^{O} N, 73.22^{O} E, 234.70 m above sea-level). This region falls under agro climatic zone Ic [Hyper Arid Partially Irrigated Western Plains Zone] of Rajasthan and agro climatic zone XIV [Western Dry Region] of India. The soil was loamy sand in texture, low in organic carbon (0.10 %), available nitrogen (85.31 kg/ha) and available phosphorus (19.40 kg/ha) and medium in potassium (298.20 kg/ha) in 0–30 cm soil depth with *p*H 8.34. The experiment was laid out in split-plot design with 3 replications, assigning 36 treatments, consisting of 3 varieties, viz. 'GNG 1581', 'GNG 1958' and 'GNG 2171', and 3 seed rates (48, 64 and 80 kg/ha) as main plot treatments and 4 levels of nipping practice, viz. control no nipping, nipping at 30, 45 and 60 days after sowing (DAS) as subplot treatments. The chickpea crop was sown on 8.11.2016 and 11.11.2017. The experimental crop was raised as per the recommended package of practices. Crop was harvested on the 25 March 2017 and 21 March 2018 manually through sickle. Protein content in seed was calculated by multiplying nitrogen content (%) in seed with a factor of 6.25 (AOAC, 1990) and nutrient uptake in seed and straw calculated by multiplying nutrient content in seed and straw with this yield. Total nutrient uptake was calculated by adding nutrient uptake of seed and straw.

The uptake of nitrogen, phosphorus and potassium after harvesting in seed and straw was estimated as:

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

Yield parameters were recorded as per standard practice and data were statistically analyzed for estimation of analysis using standard statistically methods (Panse and Sukhatme, 1985). The analysis of data of the various treatments was compared together using CD at 5% significant levels.

RESULTS AND DISCUSSION

Yield

The results revealed that seed, straw and biological yields of chickpea were influenced significantly by the different varieties, seed rates and nipping during both the years as well as average mean basis (Table 1). Significantly highest seed yield (2,142 kg/ha) and harvest index were recorded in variety 'GNG 1581' as compared to 'GNG 1958' and 'GNG 2171' on average mean basis. This yield variation in respect of various varieties may be due to variation in pod-bearing ability, seeds/pod. Ray *et al.* (2017) found that seed yield of chickpea differed with the different varieties of chickpea. Superiority of 'GNG 1581' to the other varieties is ascribed to its higher pod-bearing ability. Similar results were also reported by Nagarjaiah *et al.* (2005). Further, variety 'GNG 1958' recorded significantly higher straw and biological yields than 'GNG 1581' and 'GNG 2171' during both the years as well as on pooled basis. The increase in straw yield directly related to increased vegetative growth and to a negligible extent the increase in the reproduction portion of the plants. Tiwari (2016) also reported that, significantly higher straw yield was recorded in 'GNG 1958'.

The highest seed (2,111 kg/ha), straw (3,657 kg/ha) and biological yield (5,768 kg/ha) were observed in 80 kg/ha over seed rate 48 kg and 64 kg/ha. The increase in yield-attributing characters and yield/plant under lower plant density (seed rate) was not enough to compensate the loss in density for higher seed yield. Nagarajaiah *et al.* (2005) also reported increase in yield owing to higher seed rate of 80 kg/ha resulted in higher straw and biological yields. This might be owing to cumulative effect of poor expression of vegetative growth and yield-contributing characters, i.e. branches/plant, leaves/plant, plant height and dry-matter accumulation. Seed rate of 64 kg/ha resulted in significantly highest harvest index.

Nipping had profound effect on seed and straw yields. Nipping at 45 DAS resulted in the highest seed (2121 kg/ha), straw (3,695 kg/ha), biological yield (5,816 kg/ha) and

harvest index as compared to the control (no nipping), nipping at 30 DAS and 60 DAS (Table 1). Bharathi *et al.* (2014) also reported beneficial effect of nipping on biological yield. Khan *et al.* (2006) reported that, nipping in chickpea, especially during the last week of December to the end of January was not only instrumental in providing extra feeding material for cattle but also have significant effect on yields of chickpea. Similarly, nipping in chickpea has been reported as an innovative and profitable venture by using crop for grazing goats and sheep at seedling stage resulting profuse growth of the plants (Khattak *et al.,* 2007). Baloch and Zubair (2010) also found that seed yield of chickpea improved by nipping practices.

Economics

The net returns and benefit: cost (B : C) ratio were influenced significantly by the different treatment of varieties, seed rates and nipping practice. Maximum net returns and B : C ratio were fetched by chickpea variety 'GNG 1581' compared to the others (Table 1). Shivay *et al.* (2014) and Sethi *et al.* (2016) also reported a varietal impact on net return and B : C ratio. As regards seed rate, maximum net returns were found with seed rate of 80 kg/ha. However, the higher B : C ratio was obtained with 64 kg/ha than 48 kg/ha but remained at par with 80 kg/ha seed rate. The variation in B : C ratio was due to differences in yield. Nagarajaiah *et al.* (2005), Sethi *et al.* (2016) also reported similar trends. Nipping at 45 DAS recorded significantly higher net return than all other nipping practices. This may be owing to the higher branches, pods/plant and higher seeds/pod which ultimately increased the net return and B : C ratio under nipping practice at 45 DAS. Our results confirm the findings of Khan *et al.* (2003) and Baloch *et al.* (2010).

Quality parameter

The quality of chickpea seed in terms of protein content was analyzed. The protein content of chickpea was significantly influenced by different varieties (Table 1). The protein content of chickpea was significantly higher in 'GNG 1581' as compared to 'GNG 1958' and 'GNG 2171'. The increase in protein content owing to 'GNG 1581' was 8.78 and 1.54% over 'GNG 1958' and 'GNG 2171'. The variation in protein content among varieties may be owing to different genetic makeup which led to differential nitrogen uptake. The similar results confirm the findings of Shivay *et al.* (2014). Further, data showed that protein content of chickpea was not influenced by seed rate and nipping.

Nutrient uptake

The nitrogen, phosphorus and potassium uptake by seed, straw and total uptake were significantly influenced by the varieties of chickpea on pooled mean basis (Table 2). Significantly higher nitrogen, phosphorus and potassium uptake in seed was recorded by 'GNG 1581' than 'GNG 1958' and 'GNG 2171'. Further, variety 'GNG 1958' recorded significantly higher nitrogen, phosphorus and potassium uptake by straw than 'GNG 1581' and

Table 1. Effect of seed rate and nipping on yield, economics and protein content of chickpea varieties (average mean basis)

Treatment	Yield (kg/ha)			Harvest index (%)	Net returns (₹/ha)	B:C ratio	Protein content (%)
	Seed	Straw	Biological				
Varieties							
'GNG 1581'	2,142	3,323	5,465	39.09	65,659	3.07	21.41
'GNG 1958'	1,913	3,720	5,633	33.83	57,894	2.83	19.70
'GNG 2171'	1,839	3,576	5,416	33.92	54,436	2.71	21.09
SEm±	14.71	26.11	33.36	0.20	–	–	0.07
CD (P=0.05)	42.39	75.20	96.10	0.58	–	–	0.21
Seed rates							
48 kg/ha	1,712	3,464	5,176	33.00	50,223	2.65	20.73
64 kg/ha	2,072	3,498	5,570	37.21	63,457	3.00	20.76
80 kg/ha	2,111	3,657	5,768	36.62	64,309	2.95	20.71
SEm±	14.71	26.11	33.36	0.20	–	–	0.07
CD (P=0.05)	42.39	75.20	96.10	0.58	–	–	NS
Nipping stages							
Control	1,851	3,420	5,271	35.06	55,398	2.81	20.71
Nipping at 30 DAS	1,977	3,522	5,499	35.69	59,402	2.85	20.73
Nipping at 45 DAS	2,121	3,695	5,816	36.48	65,761	3.05	20.77
Nipping at 60 DAS	1,911	3,521	5,432	35.22	56,759	2.77	20.72
SEm±	13.83	25.26	28.13	0.22	–	–	0.05
CD (P=0.05)	38.77	70.81	78.87	0.63	–	–	NS

Table 2. Effect of seed rate and nipping on nitrogen uptake (kg/ha) by chickpea varieties (average mean basis)

Treatment	Nutrient uptake (kg/ha)								
	Nitrogen			Phosphorus			Potassium		
	Seed	Straw	Total	Seed	Straw	Total	Seed	Straw	Total
Varieties									
'GNG 1581'	73.46	47.13	120.6	14.03	8.99	23.02	20.26	42.40	62.65
'GNG 1958'	60.30	51.88	112.2	11.76	9.55	21.31	17.89	47.25	65.13
'GNG 2171'	62.17	46.31	108.5	9.20	8.55	17.75	14.77	44.15	58.92
SEm±	0.55	0.44	0.8	0.11	0.11	0.17	0.16	0.41	0.46
CD (P=0.05)	1.58	1.27	2.4	0.30	0.32	0.50	0.47	1.19	1.31
Seed rates									
48 kg/ha	56.77	46.97	103.7	10.28	8.83	19.10	15.46	43.55	59.01
64 kg/ha	68.84	47.53	116.4	12.21	8.85	21.06	18.72	44.10	62.82
80 kg/ha	70.31	50.82	121.1	12.51	9.41	21.92	18.73	46.15	64.89
SEm±	0.55	0.44	0.8	0.11	0.11	0.17	0.16	0.41	0.46
CD (P=0.05)	1.58	1.27	2.4	0.30	0.32	0.50	0.47	1.19	1.31
Nipping stage									
Control	60.89	46.62	107.5	10.96	8.52	19.48	15.78	42.82	59.29
Nipping at 30 DAS	65.94	48.65	114.6	11.53	9.09	20.61	16.56	44.29	61.96
Nipping at 45 DAS	70.72	50.76	121.5	12.64	9.61	22.25	18.81	46.81	66.10
Nipping at 60 DAS	63.68	47.75	111.4	11.53	8.90	20.43	16.54	44.48	61.59
SEm±	0.46	0.35	0.6	0.10	0.12	0.15	0.22	0.35	0.37
CD (P=0.05)	1.28	0.99	1.6	0.28	0.32	0.41	0.62	0.98	1.03

DAS, Days after sowing

'GNG 2171'. The highest total nitrogen and phosphorus uptake was observed by variety 'GNG 1581' over 'GNG 1958' and 'GNG 2171'. Similarly, the highest total potassium uptake was observed by variety 'GNG 1958' as compared to 'GNG 1581' and 'GNG 2171'. The percentage increases in the total nitrogen and phosphorus uptake by chickpea variety 'GNG 1581' was 7.48 and 11.15 and 19.30 and 52.50 over 'GNG 1958' and 'GNG 2171', respectively. Further, increase in total potassium uptake by variety 'GNG 1958' was 3.9 and 10.53% over 'GNG 1981' and 'GNG 2171', respectively. Significant increase in nutrient content and uptake may be due to genetic difference and due to difference in seed, straw and total yield of different varieties.

Seed rates significantly affected nitrogen, phosphorus and potassium uptake by straw, seed and total uptake (Table 2). The highest nitrogen, phosphorus and potassium uptake by straw, seed and total uptake were observed by seed rate of 80 kg/ha over seed rate of 48 kg and 64 kg/ha on pooled mean basis. Use of 48 kg/ha seed rate resulted in the lowest nitrogen, phosphorus and potassium removal by crop. Significant increase in nutrient uptake at 80 kg/ha seed rate may be owing to higher seed and straw yield as well as biological yield over seed rate 48 kg/ha and 64 kg/ha. Similar results were also obtained by Sethi (2016).

Nipping practice significantly influenced the nutrient uptake by seed and straw. Nipping at 45 DAS recorded the highest nitrogen, phosphorus and potassium uptake by seed, straw and total uptake as compared to the control (no nipping), nipping at 30 DAS and 60 DAS. The increase in total nitrogen, phosphorus and potassium uptake by crop due to nipping at 45 DAS were 13.02, 6.02 and 9.06%, respectively. The corresponding increase in total phosphorus was 14.21, 7.95 and 8.90% and total potassium was 11.48, 6.68 and 7.32% over the control (no nipping), nipping at 30 DAS and 60 DAS. This may be owing to significantly higher seed and straw yield which ultimately increased the uptake of plant nutrients due to nipping at 45 DAS.

Seed rate and nipping practices in chickpea at various levels would enhance yield and nutrient uptake by chickpea varieties. 'GNG 1581' variety proved better in respect of yield and nutrient uptake. Among the seed rates, seed rate of 64 kg/ha recorded higher yield than others and nutrient uptake in 80 kg/ha. Nipping at 45 DAS was found better in case of yields and nutrient uptake.

REFERENCES

AOAC. 1990. *Official Methods of Analysis of Association of Official Analytical Chemists,* Washington, DC., USA.

Aslam, M., Khalil, A. H., Himayatullah, K., Ayaz, M. Ejaz, M. and Arshad, M. 2008. Effect of available soil moisture depletion levels and topping treatments on growth rate and total dry biomass in chickpea. *Journal of Agricultural Research* **46**(3): 229–243.

Aziz M.A., 2000. Response of chickpea to nipping. *Pakistan Journal of Science and Industrial Research* **43**(3): 191–192.

Baloch, M.S. and Zubair, M. 2010. Effect of nipping on growth and yield of chickpea. *The Journal of Animal and Plant Sciences* **20**(3): 208–210.

Bharathi, K., Panneerselvam, P. and Bhagya, H.P. 2014. Effect of clipping and plant growth regulator along with different kinds of fertilizers on yield and yield parameters in sesame (*Sesamum indicum* L.) during monsoon period. *Indian Journal of Agricultural Research* **48**(3): 232–236.

Campbell, N.A., Reece, J.B., Urry, L.A., Cain, M.L., Wasserman, S.A., Minorsky, P.V., Jackson, R.B. 2008. Biology, pp. 827–830. Pearson Benjamin Cumming. San Francisco & London.

Chaube, H. and Pundhir, V.S. 2005. *Crop Diseases and their Management*. Prentice Hall of India, Pvt. Ltd., New Delhi.

GoI, 2018. *Agricultural Statistics at a Glance*. Ministry of Agriculture and Farmers Welfare, Government of India, New Delhi. www.agriculture.gov.in.

GoR, 2020. Department of Agriculture, Government of Rajasthan. http://www.agriculture.rajasthan.gov.in/content/agriculture/en/Agriculture-Department-dep/agriculture-statistics.html.

Khan H., Latif, A., Mahmood, S. and Khan, M.S.S. 2006. Effect of nipping at various stages on yield and yield components of chickpea (*Cicer aritinum* L.). *Journal of Research Science, Bahauddin Zakariya University,* Multan, Pakistan.

Khan, R.U., Khan, M., Khan, T.N. and Shah, J. 2003. Cutting gram (*Cicer arietinum* L.): Effect on green fodder and seed yield under Rodh Kohi system of Dera Ismail Khan. *Pakistan Journal of Botanical Sciences* **6**(2): 95–98.

Khattak, G.S.S., Ashraf, M., Zmir, R. and Saeed, I. 2007. High yielding desi chickpea (*Cicer arietinum* L.) variety Nifa-2005. *Pakistan Journal of Botany* **39**(1): 93–102.

Kumar, S., Khande, R.S., Sonboir, H.L., Pandey, N. and Bhambri, M.C. 2018. Effect of sowing time, spacing and nipping on growth and yield of chickpea (*Cicer arietinum* L.) under irrigated condition. *International Journal of Chemical Studies* **6**(1): 1,218–1,222.

Nagarajaiah, K.M., Palled, Y.B., Patil, B.N., and Khot, A.B., 2005. Responce of chickpea varieties to seed rate and time of sowing under late sown conditions in Malaprabha Command Area. *Karnataka Journal of Agricultural Sciences* **18**(3): 609–612.

Panse, V.G. and Sukhatme, P.V. 1985. *Statistical Method for Agricultural Workers*, Indian Council of Agricultural Research, New Delhi.

Ray, K., Singh, D. and Jat, B.L. 2017. Effect of sowing time and seed rate on growth and yield of chickpea cultivars. *Advance Research Journal of Crop Improvement* **8**(1): 1–16.

Reddy, P., Ninganur, B.T., Chetti, M.B., and Hiremath, S.M. 2009. Effect of growth retardants and nipping on chlorophyll content, nitrate reductase activity, seed protein content and yield in cowpea (*Vigna unguiculata* L.). *Karnataka Journal of Agricultural Sciences* **22**(2): 289–292.

Sethi I.B., Meena, S., Kumar, P., and Jajoria M. 2016. Yield performance of chickpea cultivars as influenced by sowing time and seed rate. *The Bio Scan* **11**(1): 407–409.

Shivay, Y.S., Prasad, R. and Pal M. 2014. Effect of variety and zinc application on yield, profitability, protein content and zinc and nitrogen uptake by chickpea (*Cicer arietinum*). *Indian Journal of Agronomy* **59**(2): 317–321.

Singh, H. and Diwakar, B. 1995. Chickpean botany and production practices. Internatiuonal Crop Research for Semi-Arid Tropics, Patancheru, Hyderabad. Skill Development Series No. 16.

Tiwari, A.K., 2016. *Pulses in India–Retrospect and Prospects.* Director, Government of India, Ministry of Agriculture and Farmers Welfare (DAC&FW), Directorate of Pulses Development, Bhopal, Madhya Pradesh, Publication No.: DPD/Pub.1/Vol. 2.