Impact of Sowing Date and Variety on the Performance of Chickpea in the Western-Terai Region of Nepal

ABSTRACT

Aims: An appropriate date of sowing and selecting a suitable variety are the most important factors to produce chickpea (*Cicer arietinum* L.). Thus, a field experiment was conducted to determine the impact of sowing dates on the growth and yield of chickpea varieties.
Study Design: The experiment was laid out in a split-plot design.
Place and Duration of Study: This experiment was conducted at the Grain Legumes Research Program (28° 06'' 45'N latitude, 81° 35'' 58' E longitude, and 182 masl) during the winter season of two consecutive years, 2022/23 and 2023/24.
Methodology: The experiment was conducted under three replications involving five sowing dates *viz*., 1st November, 8th November, 15th November, 22nd November, and 29th November as a main factor, and two promising varieties *viz*., KPG 59 and ICCV 97207 as a sub-factor in ten treatment combinations.
Results: Findings show that the sowing date was highly significant (P = .01) and influenced the days to flowering and maturity, while the yield and harvest index was significantly (P = .05) influenced. The 15th November sown chickpea produced the highest seed yield (2679 kg/ha) and harvest index (38.9%) compared to the other sowings .Comparatively, the variety ICCV 97207 took a longer number of days to flower and mature (98 and 148 days), produced a taller plant (65.5 cm) with a higher 100 seed weight (24.5 g), and ultimately higher seed yield (2544 kg/ha) and harvest index (37.4%) than the KPG 59 variety which yields lower (2338 t/ha).
Conclusion: It can be concluded that the higher seed yield of chickpea was found from variety ICCV 97207 with the sowing on 1st November (2826 kg/ha).

Keywords: Chickpea; sowing date; variety; yield; harvest index.

1. INTRODUCTION

Chickpea cultivation is integral to the Nepalese farming systems, as it plays an important role in food and nutritional security, income generation, and improvement of soil property .This crop is widely cultivated in the Terai region during the winter under a rice-based cropping system .Chickpea is cultivated on about 10793 ha with a production of 12196 t and productivity of 1022 kg/ha [1] .The partially cultivated areas and low productivity of the chickpea as a pulse crop in the country have increased the national import of pulses . The importation of chickpea in the country contributes 22% and 20% of the total pulse import quantity and value, respectively, as Nepal imported 4641 t with an import value of 3.7 billion NRs [1] .The growth rate of area (-2.0%), production (0.4%), and productivity (2.0%) of the chickpea over the fifteen years, the country showed a decreasing trend in the area, while negligible increasing trends in production and productivity [2] . Hence, there is a need to increase the area, production, and productivity of chickpea to substitute its import and increase chickpea farm income .

There are various factors for the low productivity of chickpea, but poor plant establishment and growth due to haphazardly sowing and selection of variety are the most important yield-limiting factors .The identification of a suitable date of sowing and the selection of appropriate variety are the most critical factors for improving its growth and development, and ultimately increasing its production and productivity in the country [3,4,5,6,7,8,9]. Thus, it is imperative to study the influence of different sowing dates and varieties on the seed yield and yield-attributing parameters of chickpea to identify the appropriate sowing date and variety for increasing the production and productivity of chickpea in the western Terai region of Nepal.

2. MATERIAL AND METHODS

A field experiment was conducted at Grain Legumes Research Program (GLRP), Khajura, Banke, Nepal (28° 06'' 45'N latitude, 81° 35'' 58' E longitude and 182 masl) during the winter season for two consecutive years, 2022/23 (Year I) and 2023/24 (Year II). It was laid out in a split-plot design with three replications involving five sowing dates *viz.*, 1st November, 8th November, 15th November, 22nd November, and 29th November as a main factor, and two promising varieties *viz.*, KPG 59 and ICCV 97207 as a sub-factor in ten treatment combinations. The seeds were sown continuously in 50 cm row spacing in the individual plot of 6 m^2. Fertilizers were applied at 20:40:20 kg N:P_2O_5:K_2O per ha and all the recommended practices were adopted as per needed. All the growth development, yield, and yield-attributing parameters were recorded in the experiment. Similarly, the harvest index (HI) was calculated as the ratio of economic yield to total biological yield, while the normalized difference vegetation index (NDVI) was recorded with the use of GeoNDVI Sensor in the study.

2.1 Soil characteristics

The soil characters of the experimental plots were found to be sandy loam with a neutral pH)6.8 (that contains a low amount of organic matter (1.79%) and nitrogen (0.08%) but a high amount of phosphorous (118.5 kg/ha) and potassium (285.2 kg/ha).

2.2 Climatic condition

In both experimental years, the study area did not receive precipitation during the crop-growing season from November to April, while there was a minimum air temperature recorded at 7.5 °C in January and a maximum air temperature of 34.6 °C in April.

2.3 Statistical analysis

All the data recorded in the experiment were analyzed statistically at a probability level of 0.05 by using the statistical software R-stat version R 4.4.1.

3. RESULTS

3.1 Impact of sowing date on growth and yield attributes

The impact of sowing date on growth, development, yield attributes, and yield of the chickpea are presented in Tables 1, 2, and 3. The growth parameter, plant height was not significantly (P = .05) influenced by the sowing date in chickpea. However, on average, the plant height was recorded at 60.3 cm (29th November) to 65.4 cm (15th November), but comparatively taller plants of chickpea were found under 15th November (65.8 cm) sown condition in the 1st year while observed taller under 1st November (65.0 cm) sown condition in the 2nd year of the experiments. In contrast, a significant effect of sowing date at $P \leq 0.01$ was noted on days to flowering and maturity of the chickpea. the pooled data indicated significantly longer days to flowering (105 days) in chickpea under 1st November sowing condition followed by 8th November, whereas shorter days to flowering was observed under 22nd November (90 days) and 29th November (86 days) sown conditions. The days to flowering were observed from 86 to 102 days, and 86 to 110 days in 1st and 2nd years of the experiments, respectively. Similarly, chickpea sown on 1st November took a longer time to mature (160 days) followed by 8th November (152 days), while acquired shorter days to sown under 29th November (132 days). Moreover, the time to mature ranged from 130 to 157 days in the 1st year and 134 to 162 in the 2nd year of the experiments.

The pooled data on the number of pods per plant, normalized difference vegetation index (NDVI), and hundred seed weight were found non-significant due to the effect of sowing date in chickpea. However, the number of pods per plant ranged from 56 (29th November) to 65 (8th and 15th November), NDVI reading ranged from 0.63 (29th November) to 0.75 (1st November), and hundred seed weight ranged from 20.5 g (29th November) to 21.7 g (1st November).

The results from the impact of sowing date on the seed yield and harvest index of chickpea indicated that there was only a significant effect existed on $P \leq 0.05$. The pooled data from the experiment showed that the higher straw yield (4607 kg/ha) was noted under the 22nd November sown condition, while it observed a lower (3750 kg/ha) under the 29th November sown condition. In contrast, a significantly higher seed yield (2679 kg/ha) was established in the 15th November sown condition, which seemed statistically similar to the sown on 1st November, 8th and 22nd November. But, chickpea was sown on 29th November had produced significantly the lowest yield (1834 kg/ha) compared with the rest of the sowing treatments. The seed yield of chickpea ranged from 2137 kg/ha (29th November) to 3038 kg/ha (22nd November), 1531 kg/ha (29th November) to 2334 kg/ha (1st November) in the 1st and 2nd years of the experiment, respectively. Likewise, the significantly higher harvest index (38.9) was experienced under the 15th November sown condition, while it was observed the lowest in the 29th and 22nd November sown conditions. The harvest index of chickpea ranged from 32.2% (29th November) to 35.1% (8th November), 33.9% (29th November) to 44.4% (15thNovember) in the 1st and 2nd years of the experiment, respectively.

3.2 Impact of variety on growth and yield attributes

The days to flowering and maturity were highly significant (P = .01), and plant height (P = .05) was significantly influenced by variety in chickpea (Table 1). Comparatively, longer days to flowering (98 days) and maturity (148 days), and taller plants (65.5 cm) were found in variety ICCV 97207 compared with KPG 59.

The chickpea varieties did not influence the number of pods per plant and NDVI reading but had a significant influenced (P = .01) on the hundred seed weight. The higher number of pods per plant (64) was noted in variety ICCV 97207, while the higher NDVI value was observed in variety KPG 59, but a significantly higher hundred seed weight of 24.5 g was recorded with variety ICCV 97207 as compared to the variety KPG 59 (17.6 g).

The pooled data from the 1st and 2nd years of the experiment determined that all the yield parameters of the chickpea were not significantly impacted by the varieties. However, higher straw yield (4378 kg/ha), seed yield (2544 kg/ha), and harvest index (37.4%) were recorded with variety ICCV 97207 compared with variety KPG 59.

Table 1. Impact of sowing date and variety on growth and development parameters of chickpea

Treatment	Days to flowering (DTF)			Days to maturity (DTM)			Plant height (cm)		
	Year I	Year II	Pooled	Year I	Year II	Pooled	Year I	Year II	Pooled
Sowing date									
1st November	101a	110a	105a	157a	162a	160a	62.8	65.0	63.9
8th November	102a	97b	99b	151b	153b	152b	65.1	62.9	64.1
15th November	94b	95bc	94c	147b	146c	146c	65.8	64.9	65.4
22nd November	93b	88cd	90cd	138c	136d	137d	63.5	60.3	61.9
29th November	86c	86d	86d	130d	134d	132e	61.0	60.0	60.3
LSD (0.05)	4.04	7.73	4.09	5.78	5.22	3.76	7.67	6.35	4.86
Variety									
KPG 59	91b	92b	92b	143	144b	143b	60.9b	60.4b	60.7b
ICCV 97207	99a	97a	98a	147	149a	148a	66.4a	64.6a	65.5a
LSD (0.05)	2.55	4.89	2.59	3.65	3.30	2.059	4.85	4.02	3.07
F-test									
Sowing date	**	**	**	**	**	**	ns	ns	ns
Variety	**	*	**	ns	**	**	**	*	*
Sowing date×Variety	**	ns	ns	ns	ns	ns	ns	ns	ns
MSE	11.56	42.32	11.88	23.63	19.27	10.03	41.65	28.61	16.70

CV%	3.6	6.85	3.62	3.4	3.0	2.17	10.1	8.55	6.47

Table 2. Impact of sowing date and variety on yield attributing parameters of chickpea

Treatment	Number of pods per plant			Normalized difference vegetation index (NDVI)			100 seed weight (g)
	Year I	Year II	Pooled	Year I	Year II	Pooled	Year I
Sowing date							
1st November	70	54	62	0.77a	0.72	0.75	21.7
8th November	78	52	65	0.68b	0.72	0.70	20.9
15th November	74	56	65	0.73ab	0.61	0.67	20.7
22nd November	73	48	61	0.71b	0.62	0.67	21.4
29th November	56	55	56	0.66b	0.60	0.63	20.5
LSD (0.05)	19.20	12.09	10.81	0.058	0.15	0.20	2.0
Variety							
KPG 59	67	52	60	0.72	0.74	0.73	17.6b
ICCV 97207	74	54	64	0.70	0.72	0.71	24.5a
LSD (0.05)	12.14	7.64	6.84	0.036	0.17	0.13	1.27
F-test							
Sowing date	ns	ns	ns	**	ns	ns	ns
Variety	ns	ns	ns	ns	ns	ns	**
Sowing date× Variety	ns	ns	ns	ns	ns	ns	ns
MSE	260.80	103.46	82.75	0.0024	0.130	0.030	2.88
CV%	22.96	19.18	17.61	6.91	25.41	15.10	8.05

Table 3. Impact of sowing date and variety on yield of chickpea

Treatment	Straw yield, kg/ha			Seed yield, kg/ha			Harvest index, %		
	Year I	Year II	Pooled	Year I	Year II	Pooled	Year I	Year II	Pooled
Sowing date									
1st November	5267	3455	4361	2803a	2334a	2569a	34.8	40.5ab	37.7a
8th November	5497	3232	4365	2954a	2205a	2580a	35.1	41.2a	38.2a
15th November	5978	3040	4509	3026a	2332a	2679a	33.6	44.4a	38.9a
22nd November	5743	3471	4607	3038a	2048a	2543a	34.5	37.8ab	36.1ab
29th November	4507	2993	3750	2137b	1531b	1834b	32.2	33.9b	33.1b
LSD (0.05)	1042.08	938.38	743.34	542.04	363.90	401.38	3.37	6.63	3.58
Variety									
KPG 59	5368	3149	4259	2640	2037	2338	32.9b	39.5	36.3
ICCV 97207	5429	3327	4378	2944	2144	2544	35.2a	39.6	37.4
LSD (0.05)	659.0	593.48	470.13	342.81	230.15	253.85	2.13	4.19	2.26
F-test									
Sowing date	ns	ns	ns	*	**	*	ns	*	*
Variety	ns	ns	ns	ns	ns	ns	*	ns	ns
Sowing date× Variety	ns	ns	ns	ns	ns	ns	ns	ns	ns
MSE	76803.5	62272.8	39082.6	20785.7	93601.2	11393.8	8.07	31.15	9.08
CV%	16.23	24.36	14.47	16.32	14.64	13.82	8.34	14.11	8.18

3.3. Interaction effect

The interaction effect of sowing date and variety on chickpea cultivation showed a non-significant difference in the seed yield (Fig. 1). However, the results of the experiment specified that the higher seed yield of chickpea was found from variety ICCV 97207 with the sowing date of 1st November (2826 kg/ha), while the lowest was noted from the variety ICCV 97207 (1770 kg/ha) sown on 29th November.

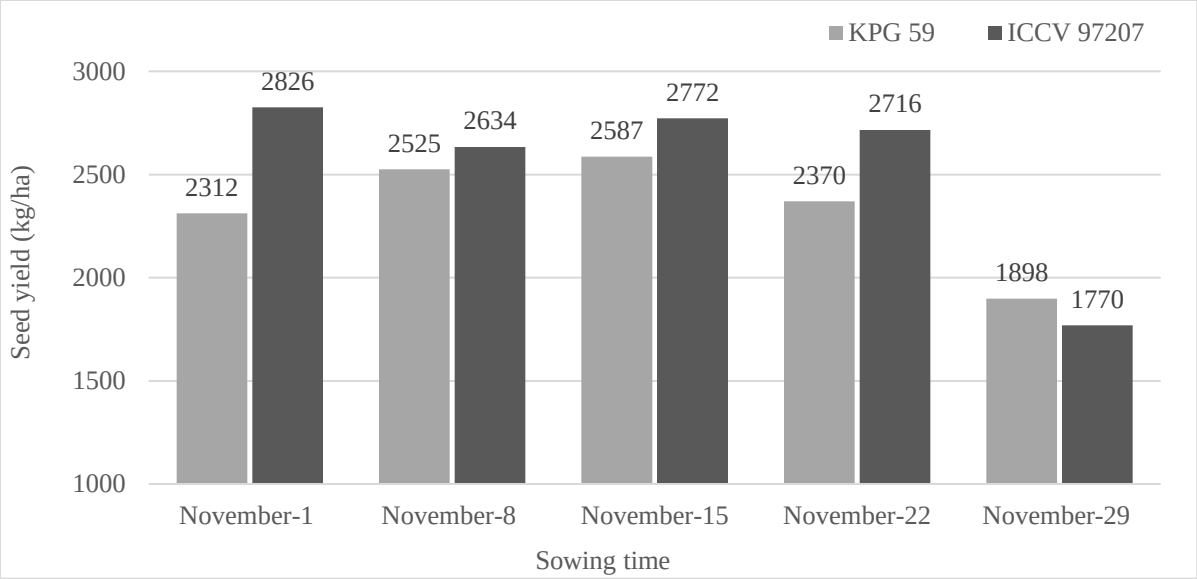

Fig. 1. Interaction effects of sowing date and variety on seed yield of chickpea (F-test = ns)

4. DISCUSSION

In the study, sowing date significantly influenced the days to flower and maturity, plant height, seed yield, and harvest index of the chickpea .The earlier flowering and maturity, shorter plant height, and lowered seed yield and harvest index of chickpea were observed under late sown conditions .The delayed sowing conditions imparted the lowered growth and development of chickpea which might be due to the compression of growing periods .In reverse, the earlier sown condition provides ample time and favorable climatic conditions, especially light, temperature, *etc* .during growth, development, and maturity stages for proper crop growth and development results a longer growing period and higher yield [3]. Richards et al. [10] also conclude that environmental factors such as temperature, moisture availability, and day length are the main drivers of phenological development in chickpea.

The shorter plant height and low yield of chickpea under later sown conditions compared with earlier sown conditions were also reported by different authors [5,7,8,9] .Similar to this study, Thombre et al. [6] also reported a significantly higher yield of chickpea under the 15th November (1737 kg/ha) sown condition as compared to 30th November, 15 December, and 30 December. Likewise, in another study done by Sekhar et al. [9] the higher seed yield of chickpea was found under the 1st November (1522 kg/ha) sowing condition as compared to 1st October, 3rd October, 3rd November, and 1st December sowing environments .But, in contrast to this study, Varoglu and Abak [7] stated the higher seed yield of the chickpea under 10th December (4050 kg/ha) sown conditions as compared to 30th October, 20th November, 30th December, and 20th January in Mediterranean climatic conditions .

Similarly, the variety of chickpea imparted significantly to the days to flowering and maturity, and plant height .This differential in flowering and maturing time, and plant height of the chickpea varieties were due to the inequality in their genetic makeup and characters .The insignificant difference in seed yield of tested chickpea varieties under this study was in line with those of Thombre et al. [6], who reported that the seed yield of chickpea varieties ranged from 1205 to 1460 kg/ha within seven tested varieties .The varietal variation in the yield of chickpea was equally reported by Varoglu and Abak [7], and Salih et al. [8] in their separate studies .

Both the tested varieties performed better under early sowing conditions and poor under later sowing conditions .Similar observation, a non-significant interaction effect of sowing time and variety on chickpea seed yield was also reported by Sekhar et al. [9] under 1st October, 3rd October, and 1st November sowing conditions including four varieties .

5. CONCLUSION

Identifying appropriate variety and suitable dates for sowing are the most important factors for chickpea production. Sowing of appropriate variety at an appropriate date could help to utilize all the production inputs efficiently, which optimizes the yield .Based on the above results, it is concluded that 1st to 3rd weeks of November is an appropriate time for sowing chickpea in the study area .The chickpea sown at 1st to 3rd week of November produced 29% more yield than the sown in the last week of November, where the variety ICCV 97207 is the most suitable for cultivation .

ACKNOWLWDGEMENTS

The authors gratefully acknowledge the necessary support received from the climate-smart technology development in grain legumes project of the Nepal Agricultural Research Council (NARC), Nepal.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

COMPETING INTERESTS

The authors have declared that no competing interests exist.

REFERENCES

1. Pokhrel A and Poudel PP. Kosebali Anusandhan Karykram-Parichay Tatha Upalabdhi . Government of Nepal, Nepal Agricultural Research Council, Grain Legumes Research Program, Khajura, Banke, Nepal. NPSN:107/2080/81 (Nepali Language); 2024 .
2. Pokhrel A, Aryal L and Poudel PP. A review on research work of Grain Legumes Research Program, NARC, NARC Publication serial number:00686-500/2017/18; 2018.
3. Pokhrel A, Manandhar S and Dangi SR. Effect of Sowing Date and Variety on Pigeonpea Production in Nepal .Asian Journal of Research in Crop Science. 2023;8 (3):173-178.
4. Richards MF, Maphosa L and Preston AL .Impact of Sowing Time on Chickpea)*Cicer arietinum* L (.Biomass Accumulation and Yield .Agronomy. 2022;12:1-16 .
5. Kumar M, Khan N, Sachan R, Tiwari A. Effect of Different Sowing Environment on Growth Parameters, Yield and Yield Components of Chickpea (*Cicer aretinum* L.) Varieties. International Journal of Plant and Soil Science. 2022;34(20):679-87.
6. Thombre SV, Goud VV, Jaybhaye JN, Hodole SS and Tupe AR. Effect of sowing dates and varieties on nutrient uptake and yield of chickpea .Journal of Pharmac .Phytochem. 2019;8(5):806-808 .

7. Varoglu H and Abak K .Effect of sowing dates on yield and quality characteristics of chickpea varieties under Mediterranean climate conditions .Legume Research. 2019; 42(3):360-36.
8. Salih RH, Abdullah SA and Mohammed BI .Effect of Sowing Dates and Two Chickpea Cultivars on Some Growth Parameters and Yield. ZANCO Journal of Pure and Applied Science. 2018; 30(4):49-57.
9. Sekhar D, Kumar PBP and Rao KT .Performance of Chickpea Varieties under Different Dates of Sowing in High Altitude Zone of Andhra Pradesh, India .International Journal of Current Microbiology and Applied Science. 2015;4(8):329-332.
10. Richards MF, Preston AL, Napier T, Jenkins L and Maphosa L .Sowing Date Affects the Timing and Duration of Key Chickpea (*Cicer arietinum* L.) Growth Phases.Plants. 2020; https//:doi:10.3390/plants9101257.