Effect of sowing date and variety on pigeonpea production in Nepal

Authors' Contributions

Anil Pokhrel and Sarita Manandhar arranged the research concept, design, data analysis and writing the manuscript. Sangharsh Raj Dangi had contributed recording and entry a data of the experiment. All authors read and approved the final manuscript.

ABSTRACT

Aims: An unsuitable sowing time and selection of inappropriate variety were the main yield limiting factors in pigeonpea (*Cajanus cajan* L. Millsp.) cultivation. Therefore, a field experiment was conducted to study the effect of sowing dates on growth and yield of pigeonpea varieties.
Study design: The experiment was laid out in spit plot design.
Place and duration of study: This experiment was conducted at the Grain Legumes Research Program (GLRP), Khajura, Banke, Nepal in two consecutive years, 2020/21 and 2021/22.
Methodology: The experiment consisted five sowing dates treatments *viz.,* 2nd July, 17th July, 1st August, 16th August and 31st August as the main-factor and two promising varieties *viz.,* ICPL-88039 and MA-6 as the sub-factor, with three replications.
Results: Both the sowing time and variety significantly influenced all the tested growth and yield parameters of pigeonpea at one percent significance level. Early sowing (2nd July) recorded longer days to flowering and maturity and taller plants that affected the yield. Pigeonpea produced the highest ($P \leq 0.01$) seed yield (1482 kg/ha), while seeded on 2nd July. Moreover, the pigeonpea sown on 2nd to 17th July produced 36% more seed yield than sown on 1st to 31st August. Similarly, a promising variety of pigeonpea MA-6 (1028 kg/ha) produced significantly higher ($P \leq 0.01$) seed yield compared to the variety ICPL-88039 (888 kg/ha).
Conclusion: The study identified the 2nd July as the most appropriate time of sowing and the MA-6 as a high yielding variety of pigeonpea for the study area in Mid-Western Terai Region of Nepal.

Keywords: Pigeonpea; sowing time; variety; yield.

1. INTRODUCTION

Pigeonpea (*Cajanus cajan* L. Millsp.) is a hardy and widely adopted drought tolerant crop of the South Asia, and a most important crop in the context of climate change. It is grown in an area about 6.4 million ha in the world with a production of 5.5 million t, but the South Asia contributes an about 83 and 86% of the total world area and its production, respectively [1]. Cultivation of pigeonpea in a tropical and sub-tropical regions is not only an economical benefits for harvesting the grains, but has tremendous important for improving marginal soils by shedding its large amount of its leaves and fixing atmospheric nitrogen by nodulation (2).

Pigeonpea is the most important legume crop in Nepal and its' cultivation is gaining popularity from Terai to Hilly Regions. Pigeonpea is grown in about 16591 ha with the production and productivity of 16649 t and 1.0 t/ha, respectively [3]. It is mostly grown in upland or marginal lands under the rainfed condition in both Terai and Hilly regions of the country. The data over the 15 years indicates the increasing trend in its cultivated area, but the productivity seemed very low and stagnant at less than 1.0 t/ha [4]. There are several constraints like drought, unavailability of suitable variety, inappropriate time of sowing, poor plant population, *etc.* for the lower productivity of pigeonpea [5,6]. The study by [7,8,9] also reported the severe yield reduction of pigeonpea due to the inappropriate sowing time and variety. An appropriate sowing time and selection of suitable varieties are the most important factors for improving the productivity of any crops, mostly in legume crops [10].

Consequently, it is important to study the effect of sowing times and varieties on the growth and yield parameters of pigeonpea in Nepal. Therefore, the study was conducted with the objective for improving the pigeonpea yield by identifying the suitable time of sowing with best suited variety.

2. MATERIALS AND METHODS

A field experiment was conducted at agricultural farm of Nepal Agricultural Research Council, Grain Legumes Research Program (GLRP), Khajura, Banke, Nepal situated at 28° 06'' 45' N latitude, 81° 35'' 58' E longitude and 182 meters above Mean Sea Level in two consecutive years, 2020/21 (Year I) and 2021/22 (Year II). It was laid out in a split-plot design involving five sowing dates *viz.,* D_1: 2nd July, D_2: 17th July, D_3: 1st August, D_4: 16th August and D_5: 31st August as the main-factor, and two promising varieties *viz.,* V_1: ICPL-88039 and V_2: MA-6 as the sub-factor with ten treatments combinations in three replications. The size of the experiment plot was 9 m^2, where the crop was sown at a row spacing of 75 cm and 25 cm plant to plant spacing. Fertilizers were applied @ 20:40:20 kg N:P_2O_5:K_2O per ha at the time of sowing and other cultural practices were applied as per needed. Harvesting was done manually at physiological maturity stage.

The soil characteristics of experimental plots was sandy loam with neutral in pH consisting of a low amount of organic matter (1.76%) and nitrogen (0.08%) but a high level of phosphorous (138.7 kg/ha) and potassium (283.5 kg/ha). All the data on yield, growth and development parameters were analyzed statistically at probability level of $P \leq .05$ by using statistical software SPSS version 16.0.

Table 1. The physical and chemical properties of soil of the study area

Particular	Organic matter (%)	Nitrogen (%)	Phosphorous (kg/ha)	Potassium (kg/ha)
Soil sample I	1.76	0.08	138.7	283.5

3. RESULTS AND DISCUSSION

3.1 Effect of Sowing Date

The effect of sowing dates and varieties on growth, development and yield of pigeonpea are presented in Tables 2 and 3. A combined result indicated a significant effect at $P \leq 0.01$ in flowering days, maturity days, plant height and seed yield due to the effect of sowing dates (Table 3). The similar results on the all recorded growth and yield parameters were shown in both the experimental years (Table 2).

The pooled analysis showed significantly longer days to flowering in pigeonpea under early sown condition *i.e.,* 2nd July (188 days) followed by 17th July (183 days). Similarly, in both the years, pigeonpea took longer duration to flower when seeded on 2nd July. It required 166 days (31st August) to 185 days (2nd July) in the Year I and 160 days (31st August) to 192 days (2nd July) in the Year II, for 50% flowering. Further the maturity days ranged from 213 days (31st August) to 247 days (2nd July) in the Year I, while it ranged from 213 (31st August) to 260 days (2nd July) in the Year II. Similarly, a longer day to mature was recorded when seeded on 2nd July to 1st August (254 days) under pooled analysis (Table 3).

The pigeonpea sown on 2nd July to 1st August (251 to 243 cm) had significantly taller plants than sown on 16th August to 31st August (150 to 143 cm), based on the combined analysis (Table 3). During the Year II, the plant height ranged from 141 cm (16th August) to 252 cm (2nd July), while in Year II it ranged from 138 cm (31st August) to 250 cm (2nd July) (Table 2).

A combined result of the Year I and Year II recorded a significant higher seed yield at $P \leq 0.01$ when sown on 2nd July (1482 kg/ha) followed by 17th July sown conditions (1279 kg/ha), whereas pigeonpea sowing on 31st August produced the lowest seed yield (411 kg/ha) followed by 16th August (593 kg/ha). In both years of the experiment, a significantly higher seed yield of pigeonpea was observed with 2nd July to 17th July sowing conditions. The seed yield of pigeonpea ranged from 390 kg/ha (31st August) to 1575 kg/ha (2nd July) in Year I, while from 432 kg/ha (31st August) to 1399 kg/ha (17th July) in Year II.

In the study, earlier flowering (15 t0 25 days) and maturity (34 to 40 days), shorter plant height (90 to 108 cm) and three-fold lower yield of pigeonpea was recorded under late sown conditions. This might be due to the compression of growing periods that hinder the proper growth and development of the crops. However, the earlier sown condition provides the ample time and favorable climatic conditions, especially light, temperature, *etc.* during growth, development and maturity stages for proper crop growth and development. Similar observation was reported by [11] where heavy vegetative growth was followed by more flowers in early sown crop. The late sowing pigeonpea affects seed germination due to higher soil moisture and affects yield due to lower temperature coupled with low rainfall during reproductive and maturity stages [12,13]. The shorter plant and longer days for flowering and maturity and low yield of pigeonpea in late sown as compared to early sown condition were also observed by different authors [5,6,9], where they reported 37%, 397% and 7% more yield under earlier sown condition than later sown condition, respectively. The results of the study are conformity with the findings of [7,13,14], where they found early sowing of pigeonpea was more productive with regard to growth and yield parameters.

3.2 Effect of Variety

The tested promising varieties of pigeonpea had significant effect at $P \leq 0.01$ on its flowering and maturity time, plant height and seed yield, however in Year I plant height did not differ significantly. The variety of pigeonpea *i.e.,* MA-6 possessed the longer duration to flower (193 days) and maturity (248 days), taller plant (214 cm) and higher seed yield (1028 t/ha), as compared to ICPL-8803. The days to flower, days to maturity, plant height and seed yield were found to be 152 days, 229 days, 197 cm and 888 kg/ha, respectively in ICPL-88039. In both Year I and Year II, the days to flowering, days to maturity, plant height and seed yield in both varieties were noted at 150–194 days and 154–193 days, 220–249 days and 239–248 days, 200–211 cm and 195–216 cm, 866–1024 kg/ha and 911–1031 kg/ha, respectively.

The pigeonpea variety MA-6 required more number of days *i.e.,* 41 days and 19 days for flowering and maturity as compared to ICPI-88039. The long duration variety (MA-6) was 17 cm taller and had 16% more seed yield compared with early maturing variety (ICPL-88039). The differential flowering time, maturing time, plant height and seed yield of the varieties was due to the disparity in their genetic makeup and characters. A study by [7] also reported the different flowering and maturing days, plant height and seed yield due to the effect of varietal characteristics in pigeonpea production, where they noted higher yield of variety UPAS 120 (969 kg/ha), among the three tested varieties. The yield variation in pigeonpea due to varietal difference was also noted by [5,9,14] in their study. A researcher [15] reported that seed yield of pigeonpea depends on source and sink relation which in turn depends on environmental factors.

Table 2. Effects of sowing time and variety on growth attributes and yield of pigeonpea in two different years

Treatment	Days to flowering		Days to maturity		Plant height, cm		Seed yield, kg ha^{-1}	
	Year I	Year II	Year I	Year II	Year I	Year II	Year I	Year II
Sowing time								
2nd July	185	192	247	260	252	250	1575	1389
17th July	181	186	246	262	238	242	1158	1399
1st August	168	169	250	258	248	238	963	1090
16th August	160	163	216	225	141	160	641	545
31st August	166	160	213	213	149	138	390	432
SEm (±)	1.30	3.36	7.01	1.80	10.48	2.32	61.84	61.00
LSD $_{(0.05)}$	3.85	10.00	20.84	5.34	31.13	6.89	183.73	181.23
Variety								
ICPL-88039	150	154	220	239	200	195	866	911
MA-6	194	193	249	248	211	216	1024	1031
SEm (±)	0.82	2.13	4.44	1.14	6.63	1.47	39.11	38.58
LSD $_{(0.05)}$	2.44	6.32	13.18	3.38	19.69	4.36	116.20	114.62
F-test								
Sowing time	**	**	**	**	**	**	**	**

Variety	**	**	**	**	ns	**	**	*
Sowing time × Variety	**	**	ns	ns	ns	**	ns	ns
CV%	1.8	4.7	7.3	1.8	12.5	2.8	16.6	15.4

Table 3. Effects of sowing time and variety on growth attributes and yield of pigeonpea (Pooled data of two years)

Treatment	Days to flowering	Days to maturity	Plant height, cm	Seed yield, kg ha^{-1}
Sowing time				
2nd July	188	254	251	1482
17th July	183	254	240	1279
1st August	168	254	243	1026
16th August	162	220	150	593
31st August	163	213	143	411
SEm (±)	1.80	3.79	5.70	42.94
LSD $_{(0.05)}$	5.16	10.86	16.32	122.93
Variety				
ICPL-88039	152	229	197	888
MA-6	193	248	214	1028
SEm (±)	1.14	2.40	3.61	27.16
LSD $_{(0.05)}$	3.27	6.87	10.32	77.75
F-test				
Year	ns	**	ns	ns
Sowing time	**	**	**	**
Variety	**	**	**	**
Sowing time × Variety	**	ns	ns	ns
CV%	3.6	5.5	9.6	15.5

3.4 Interaction Effect

The interaction effect of sowing time and variety showed non-significant difference on the seed yield of pigeonpea (Figure 1). However, the results of the experiments indicated that the highest yield of pigeonpea was found from variety MA-6 with the sowing time of 2nd July (1578 kg/ha), while recorded lowest from variety ICPL-88039 (371 kg/ha) seeded on 31st August. Both the tested variety performed well under early sowing condition and poor under late sown condition. Similar observation, a non-significant interaction effect of variety and sowing date on pigeonpea was also reported by [16].

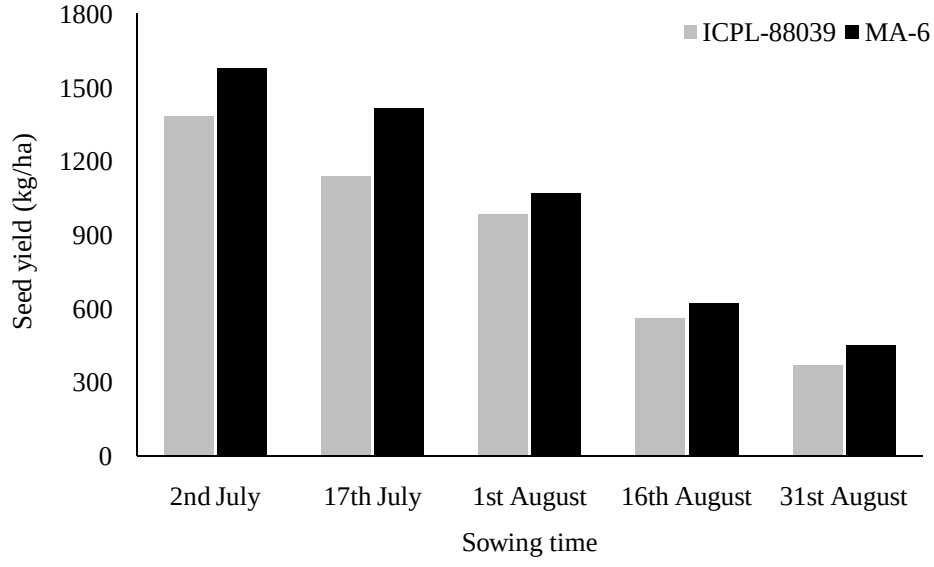

Figure 1. Interaction effects of sowing time and variety on seed yield of pigeonpea (F-test = ns; LSD (0.05) = 173.9)

CONCLUSION

Selection of appropriate variety and sowing time is the most important factor for pigeonpea production. A high yielding variety sown at the right time could help to utilize all the production inputs efficiently and optimize yield. Based on the above findings it can be concluded that the suitable time for pigeonpea sowing is the month of July, after which yield reduced radically. The pigeonpea sown on July produced about 50% more yield as compared to sowing on August in the study area. Similarly, a long duration variety performed better compared to a short duration variety for the pigeonpea cultivation in Mi-West Region of Nepal. However, more research can be carried out for more detailed study of the findings.

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COMPETING INTERESTS

The authors of the paper declare that there is no conflict of interest for the publication of this manuscript.

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