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Effect of different sowing dates and nipping on growth and yield of pigeon pea (*Cajanus cajan* L Millsp.)

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Abstract
The field experiment was carried out on the deep black soil of the College of Agriculture, Badnapur, during *kharif* 2022-2023, on the pigeonpea variety BDN 711 in a split plot design with three replications and twelve treatment combinations. The study consisted of three sowing dates: D1 (26th meteorological week), D2 (28th meteorological week), and D3 (31st meteorological week) as main plots and Subplots included N0 (no nipping), N1 (nipping at 45 DAS), N2 (nipping at 60 DAS), and N3 (nipping at 45 and 60 DAS). The study found that the 26th M.W. (D1) had significantly higher growth characteristics such as plant height, number of primary and secondary branches (plant^{-1}), dry matter (plant^{-1}), and plant spread. The plants with no nipping (N0) were the tallest (137.83 cm), while those with 60 DAS nipping (N2) were the shortest. Nipping between 45 and 60 DAS (N3) produced the most branches plant^{-1}, dry matter plant^{-1}, and plant spread plant^{-1}. Early sowing (26th M.W., D1) and nipping at 45 and 60 DAS (N3) increased yield-attributing traits and overall productivity in pigeonpea. The D1N3 (26th M.W. with nipping at 45 and 60 DAS) treatment consistently produced the highest grain, stalk, and biological yields, while The D3N0 (31st M.W. with no nipping) had the lowest values, indicating the significance of timely sowing and nipping for maximum yields.

Keywords: Pigeon pea, significance, nipping, highest grain, stalk

Introduction
Pigeonpea (*Cajanus cajan* L. Millsp.) is a major pulse crop in the tropical and subtropical regions, also known as red gram, tur, or arhar in India. This hardy crop has unique characteristics like hypogeal germination and a deep root system. Pigeonpea is a C3, short-day crop that is frequently cross-pollinated and highly drought-tolerant, making it an important grain legume in India. Pigeonpea appears to have originated in peninsular India, while the term 'Pigeonpea' is thought to have originated in the Americas. It is primarily grown during the kharif season as a single crop or intercropped in a various agroecological zones. In regions with little and irregular rainfall, its deep root system and resistance to drought make it a productive and successful crop. The ability of pigeonpea to fix nitrogen and add organic matter to the soil makes it a desirable crop rotation option. It is an important part of sustainable agricultural practices because, as a legume crop, it helps replenish soil nitrogen.

The impact of different sowing dates on pigeon pea cultivation differs depending on climate, soil type, and region. Early sowings typically produce higher yields due to longer growing periods; plants have more time to develop and mature, resulting in larger and healthier plants. Early sowing may allow for harvesting before adverse weather conditions develop. However, they may be vulnerable to specific pests and diseases. Late sowings may be advantageous in regions with erratic weather patterns or to avoid specific pest incidence and reduce the risk of waterlogging or excess water stress, particularly in areas prone to heavy rainfall, but a shorter growing season may limit yield potential and crop growth. To achieve optimal crop performance and yield, choose the best sowing date based on local conditions and desired harvest timelines. Furthermore, practices such as crop rotation, intercropping, and integrated pest management can improve pigeon pea cultivation's resilience and productivity across multiple sowing dates.

Nipping in pigeonpea is a crucial practice for enhancing yield and yield-contributing characters. According to Tegelli *et al.* (2020), foliage nipping in the early stages of the crop can increase the number of branches while controlling excessive vegetative growth, thus promoting yield. Additionally, nipping at various stages has been shown to increase the number of branches and pods, ultimately boosting pigeonpea yield (Panda et al., 2020) [5]. Veeranna et al. (2020) [12] found that topping pigeonpea at various water deficit stages led to increased plant height and the number of pod-bearing branches. This is because restricting vertical development stimulates lateral branch growth. In various crops like chickpea, cotton, castor, and chrysanthemum, cutting terminal buds is a common practice to induce additional auxiliary branches. When implementing nipping in pigeonpea , factors such as nipping duration, frequency, and economic viability for increased yield should be carefully considered.

Overall, the interaction of sowing dates and nipping in pigeon pea cultivation emphasizes the importance of strategic management practices for increasing crop productivity. Farmers can maximize yield potential and achieve beneficial outcomes in pigeon pea cultivation by implementing appropriate nipping operations that pair with specific growth stages across different sowing dates. With this view, an investigation entitled "Effect of different sowing dates and nipping on growth and yield of pigeon pea (*Cajanus cajan* (L) Millsp)" was carried out.

Materials and Methods

The field experiment was conducted at the farm section of the college of agriculture Badnapur during the *kharif* season of 2022-2023. The experimental plot's topography was relatively level, and the soil was medium black in color, with high moisture retention, a deep clayey texture, and adequate drainage. It additionally featured low organic carbon content, low nitrogen levels, moderate phosphorus availability, high potassium content, and a slightly alkaline pH.

The seeds of pigeonpea variety BDN-711 obtained from the Agricultural Research Station, Badnapur. Sowing was done by the dibbling method with spacing 90 cm x 20 cm and 5 cm depth. The recommended dose of fertilizer was 25:50:00; NPK kg ha^{-1} which was applied as a basal dose.

The experimental plot was laid out in Split plot design with twelve treatment combinations and three replications. The main plots were consisted of three different dates of sowing i.e., D1 (26th meteorological week), D2 (28th meteorological week), D3 (31th meteorological week) and sub plots were N0 (no nipping) N1 (Nipping at 45DAS), N2 (Nipping at 60 DAS) and N3 (Nipping at 45 and 60 DAS)

Results and discussion

Effect of different treatments on growth characteristics

During the current investigation the growth characteristics including plant height, no. of primary and secondary branches plant^{-1}, dry matter plant^{-1} and plant spread plant^{-1} were significantly influenced by different treatments as shown in table 1.

A) Effect of different sowing dates

Different pigeonpea sowing dates had a significant impact on plant height. Plant height was significantly higher in D1 (26th M.W.) (132.79 cm), followed by D2 (28th M.W.), and lowest in D3 (31st M.W.) (79.45 cm). A similar pattern was observed with the number of primary and secondary branches plant^{-1}, dry matter plant^{-1}, and plant spread plant^{-1}. The reflected results were due to a shorter growing period, lower temperatures, shorter day lengths, and the primary concern was water stress, which occurred during later sowing dates. Similar findings were reported by Venkata Rao *et al.* (2016) [13] and Satale *et al.* (2024) [8].

B) Effect of nipping

Due to nipping treatments significantly superior plant height was recorded in (N0) no nipping plants (137.83 cm) than rest of the treatments and lowest plant height was recorded in (N2) nipping at 60 DAS. This reduction in plant height was attributed to the clipping of the apical portion of the pigeonpea plants, which promotes lateral branching and consequently limits vertical growth. In case of number of primary and secondary branches plant^{-1}, dry matter plant^{-1} and plant spread plant^{-1}. Significantly highest values were recorded in (N3) nipping at 45 and 60 DAS i.e., 17.01, 21.01, 146.55, 123.92 respectively. These findings align with the results of studies conducted by Sharma *et al.* (2001) [9], Srinivasan *et al.* (2019) [10], and Veeranna *et al.* (2020) [12].

Table 1: Growth characteristics of pigeonpea influenced by different treatments.

Treatment	Growth characteristics At harvest				
	Plant height (cm)	No. of primary branches plant^{-1}	No. of secondary branches plant^{-1}	Plant spread (cm)	Dry matter plant^{-1} (cm)
Different Sowing Dates (D)					
D1: (26th M.W.) 23 June-1 Jul	132.79	17.77	25.16	135.34	153.53
D2: (28th M.W.) 09 Jul-15 Jul	114.93	16.31	22.6	120.56	150.11
D3: (31th M.W.) 30 Jul-05 Aug	79.45	14.44	19.23	93.01	124.21
SE (m) ±	1.32	0.08	0.85	1.40	0.35
CD at 5%	5.14	0.29	3.43	5.52	1.38
Nipping (N)					
N0: No Nipping	137.83	14.42	11.05	110.20	138.53
N1: Nipping at 45 DAS	103.65	16.50	19.76	118.72	143.99
N2: Nipping at 60 DAS	100.42	15.78	22.27	112.39	141.41
N3: Nipping at 45 & 60 DAS	101.23	17.01	21.01	123.92	146.55
SE (m) ±	1.42	0.99	23.76	0.75	0.31
CD at 5%	4.09	0.29	1.23	2.24	0.93
Interaction D x N					
CD at 5%	NS	NS	Sig	Sig	NS
GM	110.04	16.18	21.68	116.31	142.62

C) Interaction effect of treatments

Interaction effect of both the treatments significantly influenced the secondary branches plant^{-1} and plant spread plant^{-1} as showed in table 1.1 & 1.2. Significantly maximum number of secondary branches at harvest were observed in D1N3 (28th M.W. with nipping at 45 & 60 DAS) as compare to other treatment combinations and D3N0 (31th M.W with no nipping) was basest among them. For plant spread plant^{-1} the treatment combination D1N3 (26th M.W. with nipping at 45 & 60 DAS) Showed significantly superior results than rest of the treatment combinations except D1N1 (26th M.W. with nipping at 45 DAS) which was at par with D1N3.

Table 2: Interaction effect of treatments at harvest on secondary branches.

	N0	N1	N2	N3
D1	20.49	25.32	23.47	26.54
D2	20.23	22.67	20.95	24.13
D3	18.58	18.84	18.61	20.63
SE (m) ±			0.26	
CD at 5%			0.78	

Table 3: Interaction effect of treatments on plant spread at harvest.

	N0	N1	N2	N3
D1	137.517	135.553	129.873	138.450
D2	113.983	123.480	117.473	127.323
D3	79.107	97.143	89.833	105.990
SE (m) ±			1.24	
CD at 5%			3.72	

Effect of different treatments on yield attributing characters

A) Effect of different sowing dates

As reveled in table 2 Different sowing dates significantly influenced the number of pods, pod weight, and grain yield in pigeonpea. The highest number of pods per plant (440.38), pod weight (222.84 g), and grain yield (205.43) were observed in the 26th M.W. (D1) sowing, with a progressive decrease in D2 and D3. The lowest values were recorded in the 31st M.W. (D3) sowing, highlighting the importance of earlier sowing for optimal yield.

B) Effect of nipping

Nipping treatments also had a significant impact on pod production and yield. Nipping at 45 and 60 DAS (N3) resulted in the highest number of pods (437.33), pod weight (221.89 g), and grain yield per plant (202.44 g). In contrast, no nipping (N0) led to the lowest values for these parameters, indicating that nipping promotes better productivity in pigeonpea.

Table 4: Yield attributing characters of pigeonpea influenced by different treatments.

Treatment	Number of pods plant^{-1}	Pod yield plant^{-1} (g)	Grain yield plant^{-1} (g)	Number of grains pod^{-1}	Seed index (g)
Different Sowing Dates (D)					
D1: (26th M.W.) 23 June-1 Jul	446.58	222.84	205.43	3.51	10.60
D2: (28th M.W.) 09 Jul-15 Jul	396.45	197.97	179.02	3.47	10.68
D3: (31th M.W.) 30 Jul-05 Aug	360.20	182.90	163.12	3.46	10.60
SE (m) ±	9.44	4.14	4.18	0.07	0.09
CD at 5%	37.06	16.25	16.43	NS	NS
Nipping (N)					
N0: No Nipping	328.02	171.23	158.08	3.51	10.63
N1: Nipping at 45 DAS	404.52	198.83	184.58	3.50	10.65
N2: Nipping at 60 DAS	385.26	193.16	175.04	3.46	10.47
N3: Nipping at 45 & 60 DAS	437.33	221.89	202.44	3.48	10.68
SE (m) ±	7.90	4.01	3.70	0.05	0.09
CD at 5%	23.49	11.93	11.07	NS	NS
Interaction D x N					
CD at 5%	Sig	Sig	Sig	NS	NS
GM	390.19	201.24	182.52	3.4	10.60

C) Interaction effect of treatments

The interaction effect of different sowing dates and nipping treatments significantly influenced the number of pods plant^{-1}, pod weight plant^{-1}, and grain yield plant^{-1} in pigeonpea (Table 2.1, 2.2 and 2.3). The combination of D1N3 (26th M.W. with nipping at 45 & 60 DAS) consistently produced superior results across all parameters, except D1N1 (26th M.W. with nipping at 45 DAS) which was at par to D1N3. In contrast, the lowest values were recorded in D3N0 (31st M.W. with no nipping) and D3N2 (31st M.W. with nipping at 60 DAS), indicating that earlier sowing with timely nipping results in higher productivity.

Table 5: Interaction effect of treatments on number of pods plant^{-1}

	N0	N1	N2	N3
D1	401.64	468.39	409.28	506.83
D2	382.91	389.80	404.25	408.86
D3	342.52	355.37	349.27	396.31
SE (m) ±			14.48	

CD at 5%	43.03

Table 6: Interaction effect of treatments on weight of pods plant^{-1}

	N0	N1	N2	N3
D1	203.17	217.83	205.83	264.54
D2	193.54	194.74	199.76	203.82
D3	173.65	183.91	176.74	197.31
SE (m) ±		6.95		
CD at 5%		20.66		

Table 7: Interaction effect of treatments on grain yield plant-1

	N0	N1	N2	N3
D1	182.93	208.25	189.91	240.57
D2	169.58	180.59	180.13	185.80
D3	152.28	164.29	154.97	180.95
SE (m) ±		6.41		
CD at 5%		19.06		

Effect of different treatments on yield of pigeonpea

Table 7: Effect of different sowing dates

Treatment	Grain yield (q ha^{-1})	Stalk yield (q ha^{-1})	Biological yield (q ha^{-1})	Harvest Index (%)
Different Sowing Dates (D)				
D1: (26th M.W.) 23 June-1 Jul	13.86	26.93	40.73	33.92
D2: (28th M.W.) 09 Jul-15 Jul	11.67	24.17	35.83	32.63
D3: (31th M.W.) 30 Jul-05 Aug	7.45	17.31	24.70	30.17
SE (m) ±	0.37	0.65	0.99	0.80
CD at 5%	1.46	2.57	3.89	NS
Nipping (N)				
N0: No Nipping	9.25	19.54	28.78	31.95
N1: Nipping at 45 DAS	11.52	23.79	35.13	32.21
N2: Nipping at 60 DAS	10.53	21.60	32.09	32.63
N3: Nipping at 45 & 60 DAS	12.62	26.32	38.91	32.19
SE (m) ±	0.23	0.48	0.66	0.77
CD at 5%	0.71	1.43	1.97	NS
Interaction D x N				
CD at 5%	Sig	Sig	Sig	NS
GM	10.98	22.81	33.75	32.24

The grain, stalk and biological yield q ha-^{1} of pigeonpea were significantly influenced by different sowing dates during the kharif season of 2023. The data revealed (Table 3) a progressive decrease in grain yield from D1 to D3, primarily due to a reduction in the number of primary and secondary branches, fewer pods per plant, and grains per plant in later-sown crops. Similar findings were observed by Kumar *et al.* (2023) [3], Pokhrel *et al.* (2023) [7], Pawar *et al.* (2020) [6].

Table 8: Influenced of different treatments on yield of pigeonpea.

Treatment	Grain yield (q ha^{-1})	Stalk yield (q ha^{-1})	Biological yield (q ha^{-1})	Harvest Index (%)
Different Sowing Dates (D)				
D1: (26th M.W.) 23 June-1 Jul	13.86	26.93	40.73	33.92
D2: (28th M.W.) 09 Jul-15 Jul	11.67	24.17	35.83	32.63
D3: (31th M.W.) 30 Jul-05 Aug	7.45	17.31	24.70	30.17
SE (m) ±	0.37	0.65	0.99	0.80
CD at 5%	1.46	2.57	3.89	NS
Nipping (N)				
N0: No Nipping	9.25	19.54	28.78	31.95
N1: Nipping at 45 DAS	11.52	23.79	35.13	32.21
N2: Nipping at 60 DAS	10.53	21.60	32.09	32.63
N3: Nipping at 45 & 60 DAS	12.62	26.32	38.91	32.19
SE (m) ±	0.23	0.48	0.66	0.77
CD at 5%	0.71	1.43	1.97	NS
Interaction D x N				
CD at 5%	Sig	Sig	Sig	NS
GM	10.98	22.81	33.75	32.24

B) Effect of nipping

Nipping treatments also had a significant effect on grain, stalk, and biological yields. The treatment involving nipping at 45 and 60 days after sowing (N3) produced the highest grain yield of 12.62 q ha-1, as well as the maximum stalk yield of 26.32 q ha^{-1} and biological yield of 38.91 q ha^{-1}. In contrast, the control treatment without nipping (N0) produced the lowest yields across all parameters, with the grain yield at 9.25 q ha^{-1}, stalk yield at 19.54 q ha^{-1}, and biological yield at 28.78 q ha^{-1}. These results were consistent with previous studies by Kolhe *et al*. (2020) [4], Panda *et al*. (2020) [5], Teggelli *et al*. (2020) [11], and Veeranna *et al*. (2020) [12].

C) Interaction effect of treatments

Interaction effect of both treatments had significantly influenced the grain, stalk and biological yield q ha^{-1} which is showed in table 3.1, 3.2 and 3.3. The superior treatment combination was D1N3 (26th M.W. with nipping at 45 & 60 DAS), which resulted in the highest yields across all parameters. This was followed by D1N1 (26th M.W. with nipping at 45 DAS). In contrast, the lowest grain, stalk, and biological yields were recorded in the D3N0 (31st M.W. with no nipping) treatment combination. The interaction effect of these treatments notably influenced the overall performance, with D1N3 consistently producing superior results.

Table 9: Interaction effect of treatments on grain yield q ha^{-1} of pigeonpea

	N0	N1	N2	N3
D1	11.397	14.820	12.780	16.203
D2	9.983	12.077	11.407	13.303
D3	6.390	7.663	7.420	8.360
SE (m) ±			6.41	
CD at 5%			19.06	

Table 7: Interaction effect of treatments on stalk yield q ha^{-1} of pigeonpea

	N0	N1	N2	N3
D1	22.57	27.66	25.14	32.37
D2	21.04	25.50	22.48	27.66
D3	14.96	18.23	17.19	18.94
SE (m) ±			0.83	
CD at 5%			2.48	

Table 8: Interaction effect of treatments on biological yield q ha^{-1} of pigeonpea

	N0	N1	N2	N3
D1	33.963	42.480	37.923	48.577
D2	31.027	37.567	33.887	40.870
D3	21.350	25.893	24.277	27.303
SE (m) ±			1.15	
CD at 5%			3.41	

Conclusion

The study demonstrated that different sowing dates and nipping treatments significantly influenced the growth, yield attributes, and overall productivity of pigeonpea. Early sowing (26^{th} M.W.) produced superior growth characteristics, including plant height, number of branches $plant^{-1}$, and plant spread, as well as yield attributes like pod number $plant^{-1}$, pod weight $plant^{-1}$, and grain yield $plant^{-1}$, compared to later sowing dates. Nipping at 45 and 60 DAS (N3) also resulted in enhanced growth and yield, promoting better branching, higher pod production, and higher grain yield. The interaction of early sowing and nipping (D1N3) consistently delivered the highest growth and yield parameters, while late sowing without nipping (D3N0) yielded the lowest results. These findings highlight the importance of early sowing and timely nipping for optimizing pigeonpea productivity.

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