Vol.66: e23220166, 2023
https://doi.org/10.1590/1678-4324-2023220166
ISSN 1678-4324 Online Edition

Article- Agriculture, Agribusiness and Biotechnology

Pigeonpea Apical Dominance is Controlled for Optimum Yield via Nipping and Planting Distance

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Editor-in-Chief: Bill Jorge Costa
Associate Editor: Adriel Ferreira da Fonseca

Received: 05-Mar-2022; Accepted: 05-Oct-2022.

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HIGHLIGHTS

- Nipping and closer planting enhanced the pigeonpea yield.
- Delayed nipping had no yield advantage.

Abstract: Intensive growth of the pigeonpea crop in Central and South India, caused by adequate rainfall, resulted in taller plants with fewer fruited branches, leading to lower yields. However, pigeonpea crops could produce more pods if they restricted apical growth. Nipping (Cutting off the top growing portion) and planting distances are effective techniques to control apical dominance. Thus, there is a need to explore the benefits of simple techniques like nipping and planting distance, suppressing apical dominance. Therefore, this study aimed to determine the best nipping time and planting distance for pigeonpea in a rainfed environment to increase productivity. The experiment was conducted at the Dr. Panjabrao Deshmukh Krishi Vidyapeeth (Agricultural University), Akola (Maharashtra), India, between 2018 and 2020. The experiment was laid out in a randomized complete block design with two factors with three replications. There were three timings of nipping (45 days after planting, 60 days after planting, and no nipping) and four planting distances (90cm x 30cm, 120cm x 30cm, 150cm x 30cm, and 180cm x 30cm). Results indicated that early loss of apical dominance due to the nipping at 45 days after planting resulted in reduced plant height, increased branches, dry-matter accumulation, pods per plant, and markedly increased pigeon pea productivity by 11 percent. In addition, Pigeonpea crops' growth and yield parameters improved when planted at 180cm x 30cm. However, growing pigeonpea at a distance of 90cm x 30cm resulted in significantly higher pigeonpea seed yield, harvest index, and rainwater use efficiency than planting at a wider spacing.

Keywords: Apical dominance; nipping; planting distance; pigeonpea.

INTRODUCTION

The pigeonpea (*Cajanus cajan*) is India's most widely grown pulse crop [1]. Pigeonpea is a hardy crop and an excellent choice for small and marginal farmers in semi-arid dry-land areas, as it can thrive under rainfed conditions and provides nutritious food and feed. It is an integral part of the subsistence and rainfed farming systems [2]. In India, pigeonpea is consumed mainly as a split pulse. It is a primary and inexpensive vegetarian protein source [3]. About 15% of India's total pulse production comes from it. In the case of other pulses, India produces most of the world's pigeonpea, contributing almost 80% of the total production and area [4].

Maharashtra, Madhya Pradesh, Chhattisgarh, Gujrat, Telangana, Andhra Pradesh, Karnataka, and Tamil Nadu (the Central and South states of India) grow pigeonpea on medium to deep soils. This crop is usually grown in a rain-fed environment in these parts. A satisfactory amount of monsoon season rainfall during the crop's early growth in these parts led to a profuse vertical development of the pigeonpea crop. This vertical growth resulted in taller plants with few branches. A reduced number of fruited branches led to lower yields. Therefore, to increase the number of pods in pigeonpea crops, it is necessary to restrict apical growth and boost lateral branching.

Plant shoot architecture often depends on the number of lateral branches developed and their position along the primary axis of the plant. In the axil of a leaf, meristematic cells form a bud that develops into a unit. However, in some species, a phenomenon known as apical dominance inhibits bud extension by signals from the apex of the main shoot [5]. In plants with strong- apical dominance, primary shoot tip injury or shoot tip loss, caused by pruning or animal, leads to the outgrowth of axillary buds into branches. This decapitation process can cause a relatively unbranched plant to become bushy, drastically changing its morphology [6].

The nipping is an effective agronomic practice to control apical dominance. It promotes the lateral branches and improves the yield of crops. It is also known for its role in the relationship between source and sink and in alleviating the productivity of crops [7]. The growth of the lateral branches is encouraged when the plant's vertical growth is restricted. With this concept, the terminal buds are usually removed in crops like cotton, castor, and chrysanthemum to induce more auxiliary branches. The nipping of terminal buds significantly increased the branching and pods in pigeonpea [8].

Planting distance plays an instrumental role in pigeonpea production. Pigeonpea responds to varied population levels due to its adjusting elastic nature to different planting distances. It mainly varies with planting dates, varieties, soil fertility, and soil types. A wider planting distance is necessary on deeper soils with high fertility, while a narrow row space for shallower soils with low fertility [8]. In the pigeonpea crop, the time of nipping operation significantly influences the yield components and yield. Therefore, there is a need to explore the advantage of simple techniques like nipping and planting distance, which suppresses the apical dominance and facilitates more lateral branches, ultimately resulting in a significantly higher number of pods/plant and yield. The present study aimed to determine the optimal nipping time and planting distance for pigeonpea in a rainfed environment to increase productivity.

MATERIAL AND METHODS

The field base experiment; was conducted at the Dr. Panjabrao Deshmukh Krishi Vidyapeeth (Agricultural University), Krishi Nagar Post, Akola Campus (Latitude:20.42 North, Longitude: 72.02 East; altitude 307 m above sea level), (Maharashtra), India, between the rainy season of 2018, 2019, and 2020. The soil of the experimental plot was clayey (34.4 % sand, 25.5 % silt, 48.5 % clay) [9] in texture having pH 8.1 (1:2.5 soil to water), field capacity of 33.9 %, permanent wilting point of 14.1 % [10], and bulk density of 1.45 Mg m^3 [11]. The soil has 0.41 % organic C [12], 187 kg/ ha available N [13], 20 kg/ ha 0.5 M $NaHCO_3$ extractable available P [14], and 487 kg/ ha NH_4OAc extractable available K [15]. Most rainfall occurs in Akola during the South-West monsoon season (unimodal), which begins in the middle of June. Monsoon season precipitation reaches 770 mm in about 40 to 45 rainy days from June to September. Pigeonpea crops received 895 mm, 929 mm, and 771 mm of rainfall, respectively, in 2018, 2019, and 2020 (Figure 1).

Layout and experimental details

The experiment was laid out in a randomized complete block design with two factors (nipping and planting distance) with three replications. Three timings of nipping (N_1: nipping at 45 days after planting, N_2: nipping at 60 days after planting, and N_0: no nipping) and four planting distances [P_1: 90 cm x 30 cm (37037 plants/ ha), P_2: 120 cm x 30 cm (27777 plants/ ha), P_3: 150 cm x 30 cm (22222 plants/ ha), and P_4: 180 cm x 30 cm (18518 plants/ ha)] were tested. The plot size was 7.5 m (length) x 7.2 m (width) for the P_1, P_2, and P_4 treatments. However, the treatment P_3, the plot size was 7.5 m (length) x 7.5 m (width). The treatment P_1

consisted of eight crop rows distanced at 90 cm, P_2; six crop rows distanced at 120 cm, P_3; five crop rows distanced at 150cm, and P_4; four crop rows distanced at 180cm. The plot sizes were 54 m^2 for treatments P_1, P_2, and P_4. However, for treatment P_3, it was 56.25 m^2. The pigeonpea seeds of the genotype PKV- Tara were densely planted (24th June 2018, 26th June 2019, and 1st July 2020) and thinned to maintain a distance between plants of 30 cm.

Crop management

The seeds were treated with a readily available fungicide mixture of carboxin 37.5% + thiram 37.5% (3g/ kg seed) and then inoculated with *Rhizobium* bacteria inoculum (25g/ kg seed) before planting. The recommended dose of fertilizer for the rainfed pigeonpea (25 kg nitrogen, 50 kg phosphorus, and 30 kg potassium) through urea, single super phosphate, and muriate of potash was applied as a basal application at the time of planting. A pre-emergence herbicide (Pendimethalin 30 EC) was applied immediately after planting, while mechanical weed control was carried out whenever necessary.

Nipping (Cutting off the top growing portion)

At 45 and 60 days after planting, the apical 10 cm portion of the pigeonpea plant (apical bud) was cut with secateurs. After nipping every crop row, the secateurs were disinfected with 1% sodium hypochlorite solution to avoid sap-transmitted disease.

Sampling

To study pigeonpea growth and yield components (plant height, branches, pods, grain yield, and total dry matter/plant), we tagged five representative plants from the net plot area. The final harvesting dates were, determined by successive destructive sampling to determine the maximum percentage of mature pods when pods turn brown. For final yield determination, the area harvested (2nd February 2019, 5th February 2020, and 24th January 2021) was 37.26 m^2, 33.12 m^2, 31.05 m^2, and 24.84 m^2, respectively, for P_1, $P_{,2}$ P_3, and P_4 treatments. The seeds were obtained manually by threshing the pigeonpea pods, and the final seed weight was recorded. Total dry matter was estimated by cutting the plants at ground level and then drying them in a drying oven set at 65 ℃ for 72 hours. The dry weights of plants were recorded.

Rainwater use efficiency (RUE)

The rainwater use efficiency was calculated by dividing seed yield (kg/ha) by cumulative rainfall (mm) from planting to harvest.

$$\text{Rainwater use efficiency (RUE)} = \quad \text{Seed Yield (kg/ha) / Cumulative rainfall (mm)}$$

Since the crop was grown entirely as rainfed and irrigation was not applied, rainwater use efficiency (RUE) would also indicate the water productivity or water use efficiency of treatment under rainfed conditions [16].

Statistical procedure

Based on this experiment's factorial randomized block design, statistical analysis was performed using OPSTAT [17], and Table 1 shows the details of ANOVA (summary). The F value in ANOVA is helpful to confirm whether the variance between the means of two treatments is significantly different and not by chance. Moreover, the Critical Difference (CD) was calculated and used to compare treatment means. A 95% confidence level means there is still a chance of a 5% difference due to unknown variations.

Table1. Accumulated analysis of variance (ANOVA) for plant height, branches/ pods, yield/ plant, seed index DM/ plant, seed, stalk and TDM/ ha, HI, and RUE in three seasons, three nipping, four planting distances at Akola under rainfed environments. DF is the degrees of freedom; ns = non-significant, * indicates significance at 95% probabilities

Source	DF	Plant height	Branches/ plant	Pods/ plant	Yield/ plant	Seed index	DM/ plant (g)	Yield (t/ ha)	Stalk yield (t/ ha)	TDM (t/ ha)	HI (%)	RUE (kg/ ha/ mm)
Replication	2											
Season	2	*	*	*	*	*	*	*	*	*	*	*
Nipping	2	*	*	*	*	NS	*	*	*	*	NS	*
Seas. X Nip.	4	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Planting Distance	3	*	*	*	*	ns	*	*	ns	*	*	*
Seas. X Plant. Dist.	6	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Nip. X Plant. Dist.	6	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Seas. X Nip. X Plant. Dist.	12	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Residual	70											
Total	107											

RESULTS

Effect of season on growth, yield characters, and yield of pigeonpea

Pigeonpea crops received 895 mm, 929 mm, and 771 mm of rainfall, respectively, in 2018, 2019, and 2020 (Figure 1). However, it should be pointed out that in 2018 and 2019, rainfall distribution was good, and the pigeonpea crop received a sufficient amount of rainfall during the reproductive phase of the crop growth, which was lacking in 2020 (Figure 2).

Plant height and number of branches per plant were significantly higher in 2019 (Table 2). Similarly, pods, seed yield, and dry matter per plant were also considerably higher in 2019. The critical growth and productivity determining the parameter number of branches and pods were 44 and 59 % more in 2019 than 2020. In addition, the seed index was significantly higher in 2020 than in 2018 and 2019.

The yield levels were higher in 2019 than 2018 and 2020 (Table 3). In 2019 27 % higher yield than the 2018 and 47 % higher yield than the season 2020 was observed. Receipt of rainfall during the reproductive phases of the crop resulted in the betterment of the growth and yield parameters of pigeonpea in 2019.

Effect of nipping on plant height and branches of pigeonpea

The effect of nipping on pigeonpea plant height and the number of branches per plant was significant (Table 2). Nipping at 60 days after planting recorded significantly dwarfed plants than nipping at 45 days after planting and no nipping treatments. Pigeonpea plant heights were reduced by 4 % (163cm) with nipping at 45 days after planting and by 9 % (155cm) with nipping at 60 days after planting as compared to no nipping (170 cm). We found that the nipping of pigeonpea plants at 45 and 60 days after planting led to an 18% increase in branches (20 branches per plant) compared with the no nipping treatment (17 branches per plant).

Effect of nipping on yield parameters (pods, seed yield, dry matter/ plant, and seed index), seed and stalk yield, total dry matter, harvest index, and rainwater use efficiency of pigeonpea

The effect of nipping on yield parameters was found significant (Table 2). The nipping at 45 days after planting yielded significantly more pods (233 pods per plant) and grain yield per plant (67g) than the nipping at 60 days after planting (212 pods per plant and 61g seed yield per plant, respectively) and no nipping (209 pods per plant and 60g seed yield per plant, respectively). Furthermore, the dry matter accumulation per plant was significantly higher with nipping at 45 days after planting (Table 2) and recorded 12% more dry matter accumulation per plant (237g) than no nipping (215g). The impact of nipping on the pigeonpea seed index and harvest index was non-significant.

The nipping significantly enhanced seed yield (t/ ha), stalk yield (t/ ha), total dry matter (t/ ha), and rainwater use efficiency (kg/ ha/ mm) (Table 3). The significantly higher seed yield (1.77 t per ha), stalk yield (4.19 t per ha), and total dry matter (5.96 t per ha) were achieved with nipping at 45 days after planting compared to nipping at 60 days after planting (1.61 t, 3.95 t and 5.46 t per ha seed yield, stalk yield and total dry matter, respectively) and no nipping (1.59 t, 3.84 t and 5.43 t per ha seed yield, stalk yield and total dry matter, respectively). The early nipping (45 days after planting) had given an 11% yield advantage over no nipping and recorded significantly higher rainwater use efficiency (2.03 kg/ ha/ mm) than the other two treatments (1.86 and 1.83 kg/ ha/ mm), nipping at 45 days after planting increased rainwater utilization by 11% compared to no nipping. Our results indicated that delayed nipping (60 days after planting) does not yield any advantage compared to no nipping in a rainfed environment.

Effect of planting distance on plant stand, growth, yield parameters, and yield of pigeonpea

Planting distance significantly impacted the plant stand (at harvest) of the pigeonpea crop (Figure 3). Planting pigeonpea at a closer distance (90 cm x 30 cm) resulted in a significant increase in the number of plants per ha at harvest compared to a wider planting distance (120 cm x 30 cm, 150 cm x 30 cm, and 180 cm x 30 cm). Planting of pigeonpea at 90 cm x 30 cm recorded 32, 65, and 97 percent more plants/ha at harvest compared to the wider planting distance 120 cm x 30 cm, 150 cm x 30 cm, and 180 cm x 30 cm, respectively.

The effect of planting distance on pigeonpea plant height, branches, pods, and grain yield per plant was significant (Table 2). A significantly lower plant height observed was with a 180 x 30cm planting distance (156 cm). A reduction of 9% height that of closer planting distance (90cm x 30cm) was noted during this study. Similarly, branches per plant (20), pods per plant (259), and grain yield per plant (75g) were significantly higher, with a broader planting distance of 180cm x 30cm. The pigeonpea seed index was not changed significantly due to various planting distances in the present investigation. The dry matter accumulation per plant significantly improved with the planting distances (Table 2). Significantly higher dry matter accumulation per plant of pigeonpea was noted with the wider planting distance of 180cm x 30cm (283g per plant). Pigeonpea seed yield, harvest index, and rainwater use efficiency significantly improved by different planting distances (Table 3). 90cm x 30cm recorded significantly higher pigeonpea seed yield (1.85 t/ ha), harvest index (31.75%) and rainwater use efficiency (2.13 kg/ ha/ mm) than the planting distances of 120cm x 30cm (1.75 t per ha seed yield, 30.35% harvest index, and 2.02 kg/ ha/ mm rainwater use efficiency), 150cm x 30cm (1.53 t per ha seed yield, 28.28% harvest index, and 1.75 kg/ ha/ mm rainwater use efficiency) and 180cm x 30cm (1.50 t per ha seed yield, 27.02% harvest index, and 1.73 kg/ ha/ mm rainwater use efficiency). Similarly closer planting distance of 90 x 30 cm also recorded significantly higher total dry matter (5.84 t/ ha) than the planting distance of 150cm x 30cm (5.36 t/ ha) and 180cm x 30cm (5.53 t/ ha). However, the planting distance of 120cm x 30cm (5.74 t/ ha) was on par with 90cm x 30cm for stalk yield. Different planting distances did not influence the present investigation's stalk yield (t/ ha) (Table 3).

Table 2. Effect of nipping and planting distance on pigeonpea growth and yield characters

Treatment	**Plant height (cm)**	**Branches/ plant**	**Pods/ plant**	**Seed yield/ plant (g)**	**Seed index (g)**	**Dry matter/ plant (g)**
Season (S)						
2018	156^{c}	18^{b}	240^{b}	67^{b}	9.06^{c}	243^{b}
2019	168^{a}	23^{a}	255^{a}	79^{a}	9.36^{b}	259^{a}
2020	164^{a}	16^{c}	160^{c}	43^{c}	9.43^{a}	168^{c}
S.E. (m)$\pm$	1.92	0.23	3.99	1.18	0.01	4.11
CD (P=0.05)	5.40	0.65	11.27	3.32	0.04	11.61
Nipping (N)						
N_1 (@ 45DAP)	163^{b}	20^{a}	233^{a}	67^{a}	9.30^{a}	237^{a}
N_2 (@ 60 DAP)	155^{c}	20^{a}	212^{b}	61^{b}	9.28^{a}	218^{b}
N_0 (No nipping)	170^{a}	17^{c}	209^{b}	60^{b}	9.27^{a}	215^{b}
S.E. (m)$\pm$	1.92	0.23	3.99	1.18	0.01	4.11
CD (P=0.05)	5.40	0.65	11.27	3.32	NS	11.61
Interaction S x N						
S.E. (m)$\pm$	3.32	0.40	6.92	2.04	0.02	7.13
CD (P=0.05)	NS	NS	NS	NS	NS	NS
Planting distance (P)						
P_1 (90cm x 30cm)	170^{a}	18^{c}	178^{d}	51^{d}	9.26^{a}	168^{d}
P_2 (120cm x 30cm)	164^{a}	19^{b}	207^{c}	59^{c}	9.28^{a}	203^{c}
P_3 (150cm x 30cm)	160^{b}	19^{b}	229^{b}	66^{b}	9.28^{a}	238^{b}
P_4 (180cm x 30cm)	156^{b}	20^{a}	259^{a}	75^{a}	9.31^{a}	283^{a}
S.E. (m)$\pm$	2.26	0.27	4.61	1.36	0.01	4.75
CD (P=0.05)	6.39	0.75	13.01	3.83	NS	13.41
Interaction S x P						
S.E. (m)$\pm$	3.92	0.46	7.99	2.36	0.02	8.24
CD (P=0.05)	NS	NS	NS	NS	NS	NS
Interaction N x P						
S.E. (m)$\pm$	3.92	0.46	7.99	2.36	0.02	8.24
CD (P=0.05)	NS	NS	NS	NS	NS	NS
Interaction S x N x P						
S.E. (m)$\pm$	6.79	0.80	13.84	4.08	0.04	14.26
CD (P=0.05)	NS	NS	NS	NS	NS	NS

DAP= days after planting; NS= non-significant
Means followed by the same letter do not differ significantly at the 0.05 probability level.

Table 3. Effect of nipping and planting distance on pigeonpea seed, stalk yield, total dry matter, harvest index, and rainwater use efficiency

Treatment	**Seed yield (t/ ha)**	**Stalk yield (t/ ha)**	**Total dry matter (t/ ha)**	**Harvest Index (%)**	**Rainwater Use Efficiency (RUE) (kg/ha/mm)**
Season					
2018	1.58[b]	3.84[b]	5.42[b]	29.16[b]	1.76[b]
2019	2.02[a]	4.32[a]	6.34[a]	31.84[a]	2.18[a]
2020	1.37[c]	3.72[b]	5.09[c]	26.92[c]	1.78[b]
S.E. (m)±	0.03	0.08	0.10	0.27	0.03
CD (P=0.05)	0.08	0.23	0.29	0.76	0.09
Nipping					
N_1 (@ 45DAP)	1.77[a]	4.19[a]	5.96[a]	29.41[a]	2.03[a]
N_2 (@ 60 DAP)	1.61[b]	3.85[b]	5.46[b]	29.32[a]	1.86[b]
N_0 (No nipping)	1.59[b]	3.84[b]	5.43[b]	29.19[a]	1.83[c]
S.E. (m)±	0.03	0.08	0.10	0.27	0.03
CD (P=0.05)	0.08	0.23	0.29	NS	0.09
Interaction S x N					
S.E. (m)±	0.05	0.14	0.18	0.46	0.05
CD (P=0.05)	NS	NS	NS	NS	NS
Planting distance (P)					
P_1 (90cm x 30cm)	1.85[a]	3.98[a]	5.84[a]	31.59[a]	2.13[a]
P_2 (120cm x 30cm)	1.75[b]	4.00[a]	5.74[a]	30.34[b]	2.02[b]
P_3 (150cm x 30cm)	1.53[c]	3.83[a]	5.36[b]	28.28[c]	1.75[c]
P_4 (180cm x 30cm)	1.50[c]	4.03[a]	5.53[a]	27.02[d]	1.73[c]
S.E. (m)±	0.03	0.09	0.12	0.31	0.03
CD (P=0.05)	0.09	NS	0.34	0.87	0.10
Interaction S x P					
S.E. (m)±	0.06	0.16	0.21	0.54	0.06
CD (P=0.05)	NS	NS	NS	NS	NS
Interaction N x P					
S.E. (m)±	0.06	0.16	0.21	0.54	0.06
CD (P=0.05)	NS	NS	NS	NS	NS
Interaction S x N x P					
S.E. (m)±	0.09	0.28	0.36	0.93	0.11
CD (P=0.05)	NS	NS	NS	NS	NS

DAP= days after planting; NS= non-significant
Means followed by the same letter do not differ significantly at the 0.05 probability level.

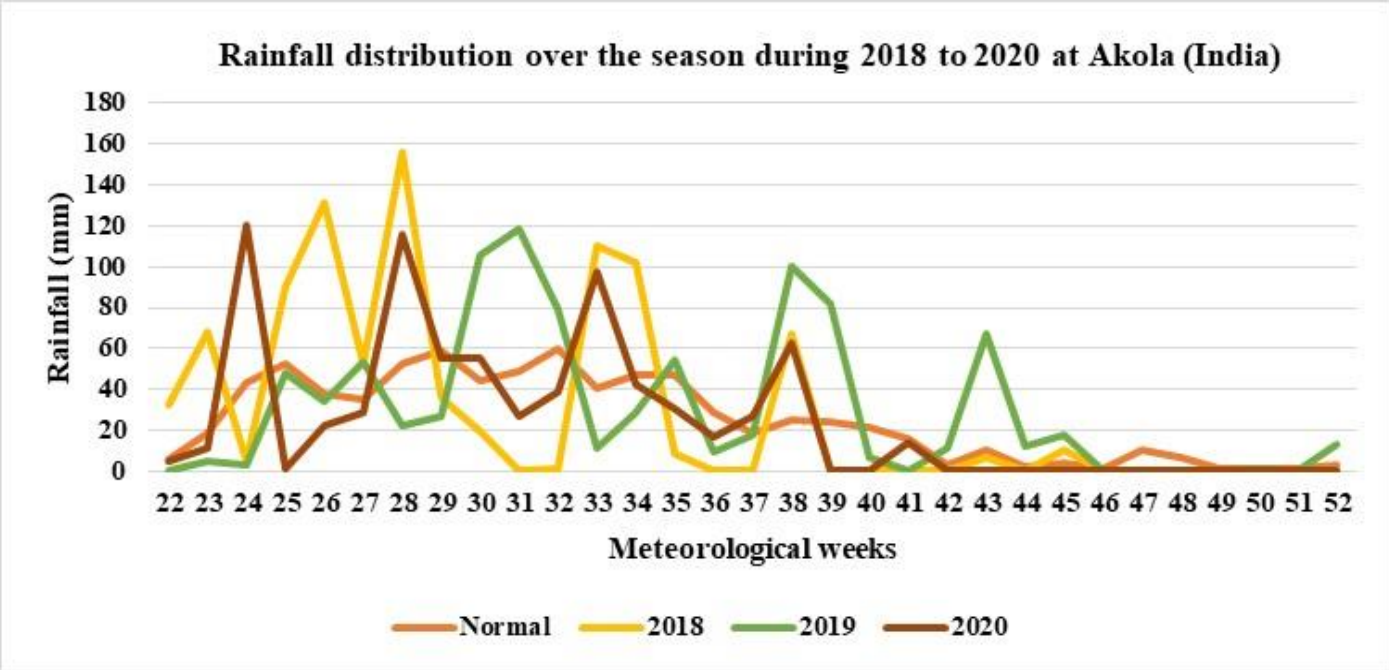


Figure 1. Rainfall pattern over the season at Akola in 2018, 2019, and 2020 and its comparison with the normal rainfall.

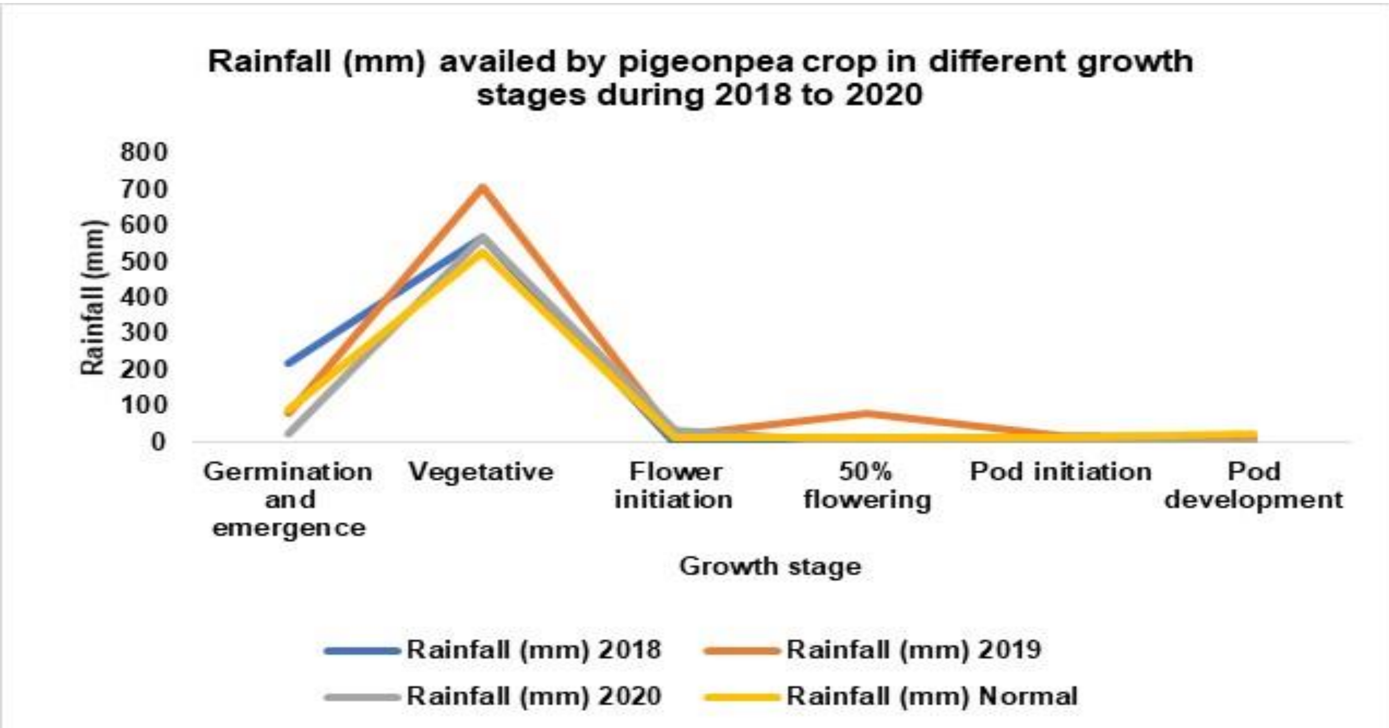
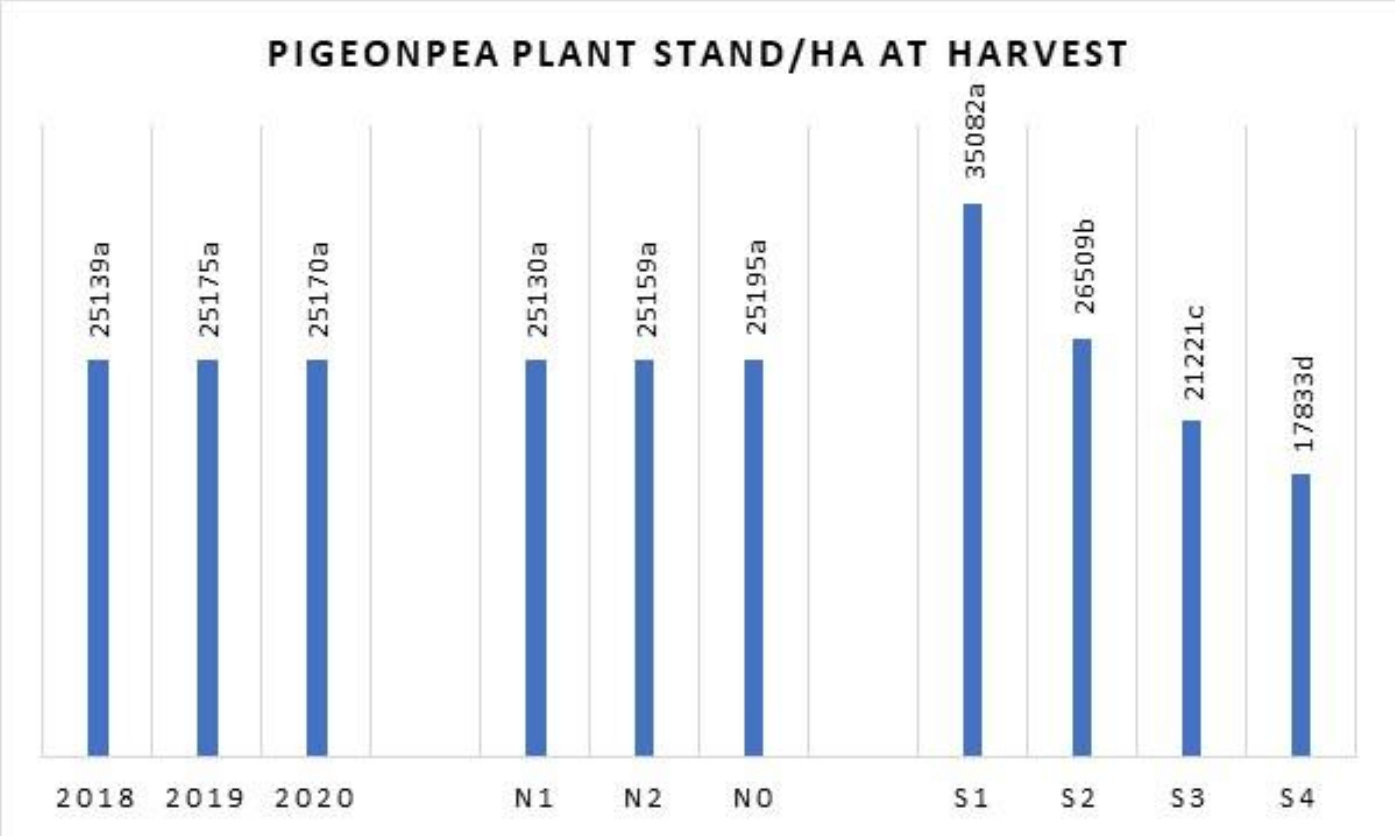


Figure 2. Comparison of the rainfall distribution during the different growth stages of the pigeonpea crop at Akola in 2018, 2019, and 2020 with the normal rainfall.



Means followed by the same letter do not differ significantly at the 0.05 probability level.
N_1: nipping at 45 days after planting; N_2: nipping at 60 days after planting; N_0: no nipping
S_1: 90 cm x 30 cm; S_2: 120 cm x 30 cm; S_3: 150 cm x 30 cm; S_4: 180 cm x 30 cm

Figure 3. Details of the pigeonpea plant stand at harvest

DISCUSSION

The reduction in pigeonpea plant height and increased branches due to nipping have also been observed by [2,8, and18]. As the apical bud develops, it produces a plant hormone called auxin that inhibits the development of the lateral buds. The auxin produced in the growing shoot apex is transported throughout the plant by the phloem and diffuses into the lateral buds, preventing elongation [19]. Cutting off the shoot (nipping), the lateral buds begin to grow, mediated by the release of cytokinin. As soon as the plant is free from its apical dominance, elongation and lateral growth occur, and the lateral buds grow into new branches. When lateral buds prevent the plant from growing upward, it is experiencing lateral dominance. Decapitating a plant's shoot apical meristem (SAM) or artificially reducing auxin concentration can cause lateral dominance to occur. The early loss of apical dominance due to the nipping 45 days after planting led to reduced plant height (4%) and increased branches (18%).

The observed increase in the growth attributes and productivity of pigeonpea in response to nipping in this study agrees with earlier studies made by [2 and 20]. A congenial crop architecture would have utilized the available resources to the maximum extent and resulted in appreciable improvement in the growth and yield parameters by nipping terminal buds. This improvement in the growth and yield contributing parameters ultimately increased the output of seeds significantly by the early loss of pigeonpea apical dominance.

Planting distance is the space between crops and the area required by a particular plant to prosper and flourish. The inadequately spaced crops compete for light, water, nutrients, and air. We can’t accept this type of competition since it reduces the growth potential of the crops, both in terms of quantity and quality. Plants need appropriate distancing to achieve reasonable yields.

Our results indicated that planting pigeonpea at a wider distance (180cm x 30cm) boosted the growth and yield contributing parameters of the pigeonpea crop. However, the yield per hectare was significantly higher, with a closer planting distance of 90 cm x 30cm. The twofold increase in plant population of closer planting distance (90 cm x 30 cm) instead of a widely spaced pigeonpea crop (180 cm x 30 cm) might explain the higher productivity per unit area of the closer planting distance. Similarly, [21] reported that closer planting distance resulted in taller and lankier pigeonpea plants than widely spaced ones due to the plants competing for light and space. Compared to plants with closer spacing, plants with a wide spacing grow, have more branches, and accumulate higher dry matter than plants with a narrow distance. The dry matter accumulation per plant increased with a broader planting distance reported by [22]. Row spacing of 120 cm X 30 cm was found to be most suitable and recorded the highest yield. However, further increases in row spacing failed to compensate for the reduction in grain yield due to the lower plant density observed by [23]. [24] also found significantly higher total dry matter production in wider row spacing than in narrow row spacing. However, narrow row spacing recorded substantially higher grain and stalk yield per hectare.

CONCLUSION

In Central and Southern India, adequate rainfall led to intense growth of the pigeonpea crop, resulting in reduced branches, pods, and yield. Nipping is an effective agronomic practice to control apical dominance. It promotes the lateral branches and improves the yield of crops. Similarly, optimum planting distance and population density affect productivity. The planting distance affects not only yield but also the morphology of the plant. Specifically, our study examined the effect of nipping and planting distances on rainfed pigeonpea yield. The results showed that the early nipping (45 days after planting) caused an early loss of pigeonpea apical dominance, which increased growth, yield contributing parameters, and yield. With wider planting distances, pigeonpea produce better growth and yield parameters, but 90cm x 30cm planting distances produce the highest yields in a rainfed environment. It is our hope that this research will contribute to improving pigeonpea yields in Central and Southern India by identifying the optimal time for nipping and planting distances.

Funding: This research received no external funding.

Acknowledgments: We thank Dr. V.M. Bhale, Hon’ble Vice Chancellor (Dr. PDKV, Akola, Maharashtra, India), Dr. V.K. Kharche, Director of Research (Dr. PDKV, Akola, Maharashtra, India), Dr. I.P. Singh, Project Coordinator, All India Coordinated Research Project on Pigeonpea (Indian Institute of Pulse Research, Kanpur, Uttar Pradesh, India) for providing the administrative help. We thank Dr. A.N. Patil, Dr. N.R. Potdukhe, Dr. Archana Thorat former Senior Research Scientists, and Dr. E.R. Vaidya, Senior Research Scientist, Pulses Research Unit, Dr. PDKV, Akola (Maharashtra), India for providing the field, laboratory, and human resource facilities. We also thank the anonymous reviewers for their constructive suggestions.

Conflicts of Interest: The authors declare no conflict of interest.

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