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Performance of Finger Millet Varieties (*Eleusine coracana L.*) in Different Establishment Methods

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

A field experiment was conducted at the Instructional cum Research (ICR) Farm, AAU, Jorhat during the Sali season (2022-23) with a view "Performance of finger millet varieties (*Eleusine coracana L.*) In different establishment methods". The experiment was laid out in Factorial RBD which was replicated thrice. The treatments consisted of 4 (Four) establishment methods viz., broadcasting (M_1), line sowing (M_2), transplanting (M_3), and SFMI {System of finger millet intensification} (M_4) and 3 (Three) varieties namely- GPU-67 (V_1), CFMV-2 (V_2) and AAU-GSG-Maruvadhan(V_3). Based on results obtained from the present investigation, it was concluded that finger millet grown in the transplanting method with a combination of CFMV-2 variety must obtain higher growth, yield, and quality parameters of finger millet.

Keywords: Establishment methods; variety; yield attributes; yield; growth parameters; quality parameters; SFMI; finger millet.

1. INTRODUCTION

Global food security today is intricately tied to the performance of a handful of key crops, leaving behind many others like millets and pseudo cereals due to advancements in enhancing the productivity of dominant crops such as rice, wheat, and maize. Millets, a diverse group of small-seeded cereal grains, once the earliest cultivated crops across Asia and Africa, have faded from prominence. This group includes Jowar or sorghum, bajra or pearl millet, and various small millets like mandua/ragi, kangni, kutki, Kodo millet, jhangora, cheena, and korale [1-7].

Millets thrive in tropical and subtropical climates with minimal inputs, covering about 12.45 million hectares and contributing 10% to India's food grain supply. These "Nutri-cereals" boast resilience to climate variations, making them vital for food and nutritional security. Millets' gluten-free nature has sparked public interest, and their richness in polyphenols, antioxidants, and fibers makes them nutritionally valuable [8-13].

India stands as the global leader in millet production, contributing around 40% of the world's output, approximately 16 million metric tons annually. The country is also the second-largest millet exporter, with a consistent 12% Compound Annual Growth Rate (CAGR) in exports over the past three years. The millet market's value is projected to grow from over $9 billion to $12 billion by 2025 [14-20].

Among the minor millets, finger millet stands out for its exceptional nutritional properties, earning it the moniker "wonder grain." Predominant in arid and semi-arid regions of developing countries, finger millet serves as both a staple food and animal feed. India's finger millet cultivation stretches from Tamil Nadu to Uttarakhand, with Karnataka leading in cultivation area followed by Maharashtra and Uttarakhand [21-26,27,28].

Finger millet's nutritional superiority, rich in fibers, iron, zinc, calcium, vitamins, and essential amino acids, makes it a critical calorie source, especially in resource-poor regions of Asia and Africa. It surpasses rice and wheat in nutritional value and boasts longer seed storage potential, aiding famine-prone areas [29-34].

However, in regions like Assam, finger millet cultivation is limited and practiced by economically disadvantaged farmers due to its suitability in less favorable conditions. To improve productivity, adoption of high-yielding varieties and proper management practices are crucial [35-38,39-41].

In essence, while dominant crops like rice and wheat ensure food security, finger millet steps in to provide much-needed nutritional security, considering its exceptional nutritional content, hardiness, and storability. Efforts to harness its potential through high-yielding varieties and optimized cultivation practices can further elevate its contribution to global food and nutritional stability [42-46].

2. MATERIALS AND METHODS

The research endeavor took place at the Instructional-cum-Research Farm of Assam Agricultural University, Jorhat, in the Kharif season of 2022-2023. The primary focus of this study was, "To study the performance of finger millet varieties in different establishment methods in terms of growth, yield, and quality *(Eleusine coracana* L)."

The meticulously designed experiment adopted a Factorial Randomized Block Design (F-RBD) to ensure robustness, incorporating three replications for each treatment. Four distinct establishment methods were evaluated: Broadcasting does not maintain spacing, Line Sowing with a spacing of 22.5 × 10 cm, Transplanting with a spacing of 25 × 15 cm, and the innovative System of Finger Millet Intensification (SFMI) with a spacing of 25 × 25 cm. Furthermore, three finger millet varieties were selected for the study: GPU-67 (V 1), CFMV-2 (V 2), and AAU-GSG-Muruadhan 1 (V 3).

The experiment's groundwork commenced with the careful preparation of finger millet nursery beds. To bolster the nursery area, Farm Yard Manure (FYM) was incorporated into the soil during seedbed preparation, effectively enhancing the soil's nutritional content. Prior to sowing, the seeds underwent a treatment with Bavistin (Carbendazim) to safeguard against potential pathogens.

For the Transplanting method, nursery seedlings aged 25 days were selected for transplantation. In the case of SFMI, seedlings were raised in pro trays filled with a mixture of coco pit, vermicompost, and soil, maintaining a ratio of 1:1:2. These seedlings were then transferred to the experimental field at the age of 12 days.

In the experimental field, the Line Sowing method was executed with precision, maintaining a spacing of 22.5 × 10 cm between seeds. For the Transplanting method, two seedlings were transplanted per hill, with a spacing of 25 x 15 cm. The System of Finger Millet Intensification (SFMI) approach utilized 12-day-old seedlings, with one seedling per hill.

The varietal choices in the study encompassed a diverse range of growth cycles and yields. GPU-67 (V 1) boasted a growth cycle of 114-118 days and a yield potential of 30-35 quintals per hectare, holding a notable position at the national level. CFMV-2 (V 2) exhibited a growth cycle of 115-120 days and a yield of 35.56 quintals per hectare, also making its mark at the national level. On the other hand, AAU-GSG-Muruadhan 1 (V 3) showcased a slightly longer growth cycle of 125-130 days and represented a local variety specifically adapted to the Assam region. this ambitious study carried out at the Assam Agricultural University aimed to unravel the intricate dynamics of finger millet growth, yield, and quality across different establishment methods and varieties. Through meticulous experimental design, diligent nursery preparation, and precise execution of establishment methods, this research contributes to a deeper understanding of finger millet cultivation practices and their potential implications for agricultural advancement.

2.1 The Geographic Location of the Experimental Site

The experiment was conducted at the Instructional-cum-Research Farm, Assam Agricultural University, Jorhat during the kharif season, 2022-2023which is situated at 26047’N latitude and 94012’E longitude and at an altitude of 86.6 meters above the mean sea level.

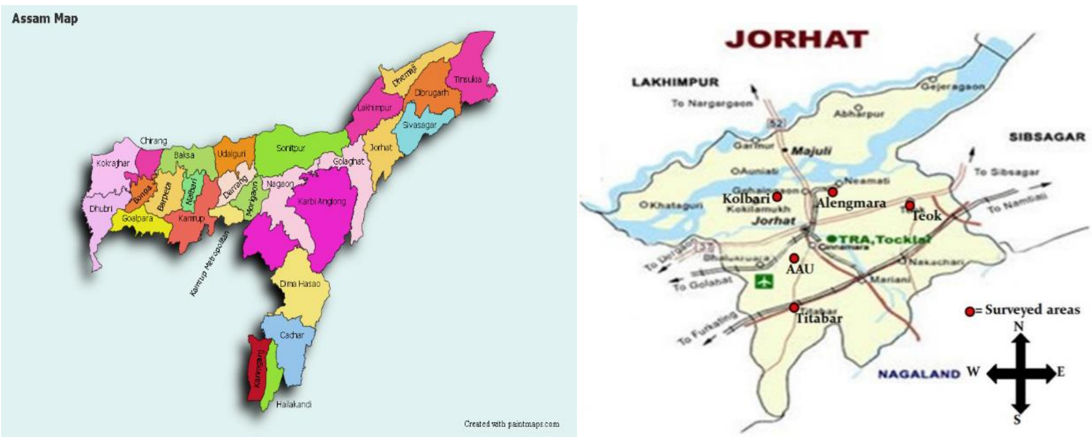

Fig. 1. Location of the study area

Fig. 2. Study location

3. RESULTS AND DISCUSSION

3.1 Varietal Impact on Plant Growth Parameters

Three finger millet varieties were scrutinized in the study: GPU-67, CFMV-2, and AAU-GSG-Muruadhan 1. Analysis of plant height revealed minimal varietal differences, with CFMV-2 displaying the highest value at 104.53 cm, closely followed by AAU-GSG-Muruadhan 1 (104.07 cm) and GPU-67 (103.95 cm). Similar trends were observed for the number of tillers per square meter, where CFMV-2 exhibited the most vigorous tillering (81.16), followed by GPU-67 (80.16) and AAU-GSG-Muruadhan 1 (79.05). However, in terms of leaf area index (LAI), CFMV-2 again showcased the most robust growth (2.34), surpassing AAU-GSG-Muruadhan 1 (1.43) and GPU-67 (1.63). Additionally, CFMV-2 achieved the highest dry matter production per plant (27.44), outperforming GPU-67 (26.42) and AAU-GSG-Muruadhan 1 (24.33). This superiority in the variety CFMV-2 for exhibiting higher plant height might be due to the inherent capacity of the variety in reference and the result of more no of tillers plant^{-1} could be attributed to the method of transplanting of 25 days old seedlings. They had a better chance to get moisture, nutrient supply, and optimum growth conditions at the nursery. A similar result was reported by Krishnamurthy [47] and Ramamoorthy et al. [48] (Table 1).

3.2 Establishment Method Influence on Plant Growth Parameters

Four establishment methods were explored: Broadcasting, Line Sowing, Transplanting, and SFMI (System of Finger Millet Intensification). Among these, Transplanting exhibited the most favorable results across various growth parameters. Plants subjected to the Transplanting method displayed the tallest plant height (112.29 cm), the highest number of tillers per square meter (102.11), the largest leaf area index (2.82), and the greatest dry matter production per plant (32.45). The SFMI method followed closely, demonstrating promising growth attributes, albeit slightly lower than the Transplanting approach. Line Sowing produced intermediate results while Broadcasting yielded the least desirable outcomes across all growth parameters. In comparison to the method of transplanting, the SFMI method showed a reduced number of tillers which may have resulted because of transplanting 12 days old seedlings with poor root growth and less tolerance to transplanting shock. The taller plants and the higher number of tillers/m^2 in the transplanting method might be due to the availability of optimum crop geometry for the vegetative growth with the availability of moisture as well as microenvironment which may result in more nutrient absorption by the roots for the synthesis of protoplasm responsible for rapid cell division; thereby it may result in an increase in the plant shape and size and ultimately the production of tillers may be more. Similar findings were reported by Negi [49] (Table 1).

3.3 Varietal Influence on Yield Parameters

Three finger millet varieties - GPU-67, CFMV-2, and AAU-GSG-Muruadhan 1 - were meticulously evaluated across various significant parameters. The number of ear heads per square meter displayed slight variability, with CFMV-2 having the highest count (58.68), followed by AAU-GSG-Muruadhan 1 (56.99) and GPU-67 (57.39). Similarly, the number of fingers per ear head demonstrated minor differences, with CFMV-2 leading (6.78), followed by GPU-67 (6.40) and AAU-GSG-Muruadhan 1 (6.20).

Notably, the length per finger exhibited variations, with CFMV-2 showcasing the longest fingers (7.64 cm), followed by GPU-67 (5.92 cm) and AAU-GSG-Muruadhan 1 (5.83 cm). The weight of ear heads mirrored these trends, with CFMV-2 yielding the heaviest ear heads (12.01 g), followed by GPU-67 (10.74 g) and AAU-GSG-Muruadhan 1 (10.61 g).

The quality assessment also extended to test weight, where CFMV-2 displayed a higher value (2.84 g), followed by AAU-GSG-Muruadhan 1 (2.63 g) and GPU-67 (2.77 g). This consistency signifies uniform grain density across the evaluated varieties.

Three finger millet varieties - GPU-67, CFMV-2, and AAU-GSG-Muruadhan 1 - were meticulously examined across key yield parameters. In terms of grain yield, CFMV-2 emerged as the highest performer (21.42 q/ha), closely followed by GPU-67 (20.55 q/ha) and AAU-GSG-Muruadhan 1 (19.88 q/ha).

The evaluation extended to fresh stover yield, where CFMV-2 led (52.54 q/ha), trailed by AAU-GSG-Muruadhan 1 (51.70 q/ha) and GPU-67 (52.00 q/ha). Similarly, in dry stover yield, CFMV-2 continued to showcase its superior performance (30.16 q/ha), followed by AAU-GSG-Muruadhan 1 (28.33 q/ha) and GPU-67 (28.18 q/ha).

The harvest index, a crucial parameter reflecting yield efficiency, displayed marginal differences, with CFMV-2 leading (41.40%), trailed by AAU-GSG-Muruadhan 1 (41.18%), and GPU-67 (41.90%). (Table 2).

3.4 Establishment Method Influence on Yield Parameters

The study evaluated four establishment methods: Broadcasting, Line Sowing, Transplanting, and SFMI. The number of ear heads per square meter was highest under Transplanting (76.93), followed by SFMI (62.67) and Line Sowing (50.82). Broadcasting yielded the lowest number of ear heads (40.32).

A similar trend emerged in the number of fingers per ear head, with Transplanting displaying the highest count (7.82), followed by SFMI (7.07) and Line Sowing (6.29). Length per finger indicated Transplanting (7.18 cm) as the most favorable method, closely trailed by SFMI (6.73 cm) and Line Sowing (6.41 cm).

The weight of the ear head showcased a substantial disparity, with Transplanting yielding the heaviest ear heads (15.75 g), followed by SFMI (14.31 g) and Line Sowing (9.14 g). In terms of test weight, Transplanting exhibited the highest value (2.84 g).

Four establishment methods underwent meticulous scrutiny: Broadcasting, Line Sowing, Transplanting, and SFMI. Grain yield exhibited substantial variation across these methods, with Transplanting yielding the highest (23.46 q/ha), followed by SFMI (22.44 q/ha), Line Sowing (18.75 q/ha), and Broadcasting (17.81 q/ha).

Fresh stover yield followed a similar pattern, with Transplanting leading (59.32 q/ha), trailed by SFMI (54.27 q/ha), Line Sowing (48.59 q/ha), and Broadcasting (46.14 q/ha). Dry stover yield mirrored the trend, with Transplanting outperforming (32.95 q/ha), followed by SFMI (30.05 q/ha), Line Sowing (26.81 q/ha), and Broadcasting (25.75 q/ha).

Harvest index exhibited minor variations across establishment methods, with Transplanting leading (42.12%), followed by SFMI (41.83%), Line Sowing (41.17%), and Broadcasting (40.84%).

Transplanting shows better results thismight be due to the optimum crop geometry, availability of proper moisture and nutrients during the critical growth stages like ear head emergence, flowering, and grain filling periods,and due to higher tillers/m^2. The number of fingers per ear head is a principal yield contributing parameter in finger millet, similar results were reported by R. Veeraputhiran et al. [50] and Revathi [51]. The transplanting method recorded the highest grain yield, fresh stoveryield,drystover yield, and harvesting index.Similar results were reported by Suryanarayana et al. [52], Bisht et al. [53], and Negi, S. [54] while working on finger millet.

The higher grain yield istheresult of enhanced yield attributes, forming a larger sink size in addition to efficient translocation of photosynthates to the sink was reported in the transplanting method. Similar results were reported by R. Veeraputhiran et al. [50], Tejeswararaoet al. [54], Sarawaleet al. [55], and Sarawaleet al. [56]. Among the establishment methods, the broadcasting method performed poorly which might be due to a greater number of plant populations which led to more competition between the plants. Similar results were recorded by Vikaset al. (2023) (Table2).

3.5 Varietal Influence on Quality Parameters

The results indicated that the crude protein content in the grain of finger millet varied among the different varieties. Among the varieties tested, CFMV-2 (V2) exhibited the highest crude protein content in the grain (6.30%), followed closely by AAU-GSG-Muruadhan 1 (V3) with 6.12%, and GPU-67 (V1) with 5.93%. This demonstrates the variability in protein content among different finger millet varieties, with CFMV-2 showing the most favorable protein content.

In terms of crude protein content in stover, the highest value was observed in the transplanting method (M3) with a content of 4.18%, followed by SFMI (M4) with 3.43%, line sowing (M2) with 3.25%, and broadcasting (M1) with the lowest content of 2.05%. This suggests that transplanting the finger millet plants led to higher protein accumulation in the stover compared to other establishment methods. (Table 3).

3.6 Establishment Method Influence on Quality Parameters

The establishment methods also had a significant impact on the quality parameters of finger millet. The highest crude protein content in the grain was observed in the transplanting method (M3) with a value of 7.68%, followed by SFMI (M4) with 6.37%, and line sowing (M2) with 6.00%. Broadcasting (M1) resulted in the lowest crude protein content in the grain at 4.42%. This indicates that the transplanting method led to a significant increase in the protein content of the grain.

Similarly, calcium, zinc, and iron content were also influenced by the establishment methods. Transplanting (M3) showed the highest calcium content (339.11 mg/100g), while broadcasting (M1) had the lowest (319.56 mg/100g). For zinc content, transplanting (M3) again showed the highest value (2.00 mg/100g), followed by SFMI (M4) with 1.83 mg/100g, and line sowing (M2) with 1.82 mg/100g. In terms of iron content, SFMI (M4) demonstrated the highest value of 4.23 mg/100g, while broadcasting (M1) had the lowest content of 3.28 mg/100g.similar results recorded by Prashanet al. [57] (Table 3).

3.7 Observations at Harvest

Variety V_1

LAI ranged from 2.00 (M_1 - Broadcasting) 2.10 (M_2-Line sowing) 2.74 (M_3 - Transplanting) and also 2.27 (M_4 - SFMI).

Transplanting (M_3) had the highest LAI for V_1 at harvest, while Broadcasting (M_1) and SFMI (M_4) showed slightly lower LAI.

Variety V_2

LAI ranged from 1.70 (M_1 - Broadcasting) to 2.83 (M_3 - Transplanting) and 2.23 (M_2 - Line sowing).

Transplanting (M_3) resulted in the highest LAI for V_2 at harvest, while Broadcasting (M_1) and Line sowing (M_2) had slightly lower LAI.

Table 1. Effect of varieties and establishment methods on Plant growth parameters of Finger Millet

Treatments	Plant height	Number of tillers/m²	LAI	Dry matter production/plant
Varieties				
V_1 - GPU-67	103.95	80.16	1.63	26.42
V_2 - CFMV-2	104.53	81.16	2.34	27.44
V_3 - AAU-GSG-Muruadhan 1	104.07	79.05	1.43	24.33
SEm(±)	0.26	2.93	0.04	1.92
CD (P=0.05)	NS	NS	0.12	NS
Establishment methods				
M_1 – Broadcasting	95.18	54.34	1.41	19.82
M_2 - Line sowing	99.74	70.83	1.59	25.44
M_3 –Transplanting	112.29	102.11	2.82	32.45
M_4- SFMI	109.52	93.22	2.24	26.54
SEm(±)	0.30	3.38	0.05	2.21
CD (p=0.05)	0.87	9.92	0.14	6.50
Interaction	NS	NS	S	NS

***= Significant NS= Non-significant*
**S=Standard mean of error*

Table 1a. interaction effects of varieties and establishment methods leaf area index of finger millet

	Method of sowing/transplanting			
	Harvest			
Varieties	**M_1**	**M_2**	**M_3**	**M_4**
V_1	2.00	2.10	2.74	2.27
V_2	1.70	2.23	2.83	2.23
V_3	1.9	2.00	2.50	2.17
SEm(±)	0.08			
CD(p=0.05)	0.24			

**S=Standard mean of error*

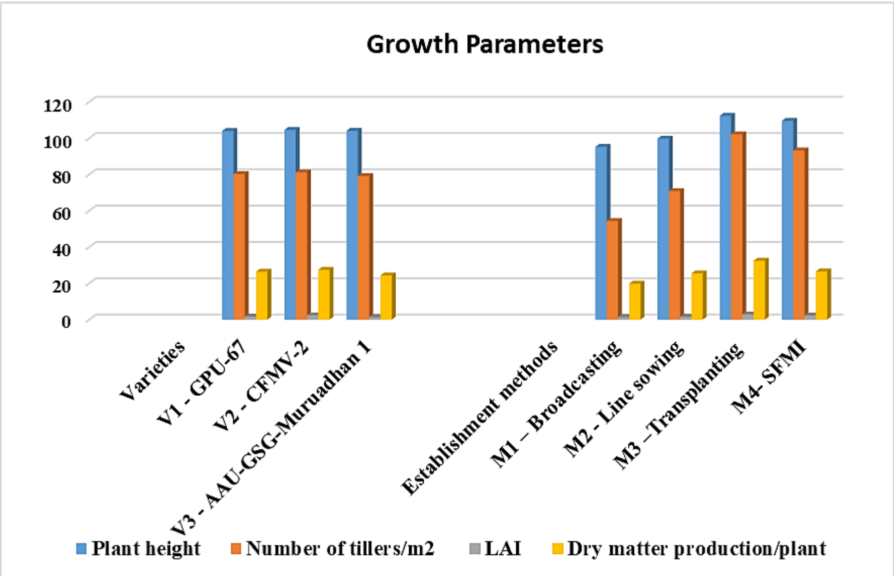

Fig. 3. Effect of varieties and establishment methods on plant growth parameters of finger millet

Table 2. Effect of varieties and establishment methods on yield parameters of finger millet

Treatments	Number of ear heads per m^2	Number of fingers per ear head	Length per finger (cm)	Weight of ear head (g)	Test weight (g)	Grain yield (q/ha)	Fresh stover yield (q/ha)	Dry stover yield (q/ha)	Harvest index (%)
Varieties									
V_1 - GPU-67	57.39	6.40	5.92	10.74	2.77	20.55	52.00	28.18	41.90
V_2 - CFMV-2	58.68	6.78	7.64	12.01	2.84	21.42	52.54	30.16	41.40
V_3 - AAU-GSG Muruadhan 1	56.99	6.20	5.83	10.61	2.63	19.88	51.70	28.33	41.18
SEm(±)	0.68	0.23	0.16	0.18	0.05	0.10	0.17	0.23	0.36
CD(p=0.05)	NS	NS	0.46	0.52	0.14	0.30	0.49	0.68	NS
Establishment methods									
M_1 - Broadcasting	40.32	4.67	5.53	5.28	2.63	17.81	46.14	25.75	40.84
M_2 - Line sowing	50.82	6.29	6.41	9.14	2.71	18.75	48.59	26.81	41.17
M_3 -Transplanting	76.93	7.82	7.18	15.75	2.84	23.46	59.32	32.95	42.12
M_4- SFMI	62.67	7.07	6.73	14.31	2.82	22.44	54.27	30.05	41.83
SEm(±)	0.79	0.26	0.18	0.20	0.05	0.12	0.19	0.27	0.42
CD(p=0.05)	2.31	0.76	0.54	0.60	0.16	0.35	0.57	0.78	NS
Interaction	NS	NS	S	NS	NS	NS	NS	NS	NS

***= Significant NS= Non-significant*
**S=Standard mean of error*

Table 2a. Interaction effect of varieties and establishment methods on length per finger (cm) of finger millet

	Method of sowing/transplanting			
Varieties	**M_1**	**M_2**	**M_3**	**M_4**
V_1	5.50	5.93	8.07	6.50
V_2	5.70	6.00	8.30	7.23
V_3	4.90	5.23	8.00	6.20
S.Em.±	0.32			
CD (p=0.05)	0.93			

**S=Standard mean of error*

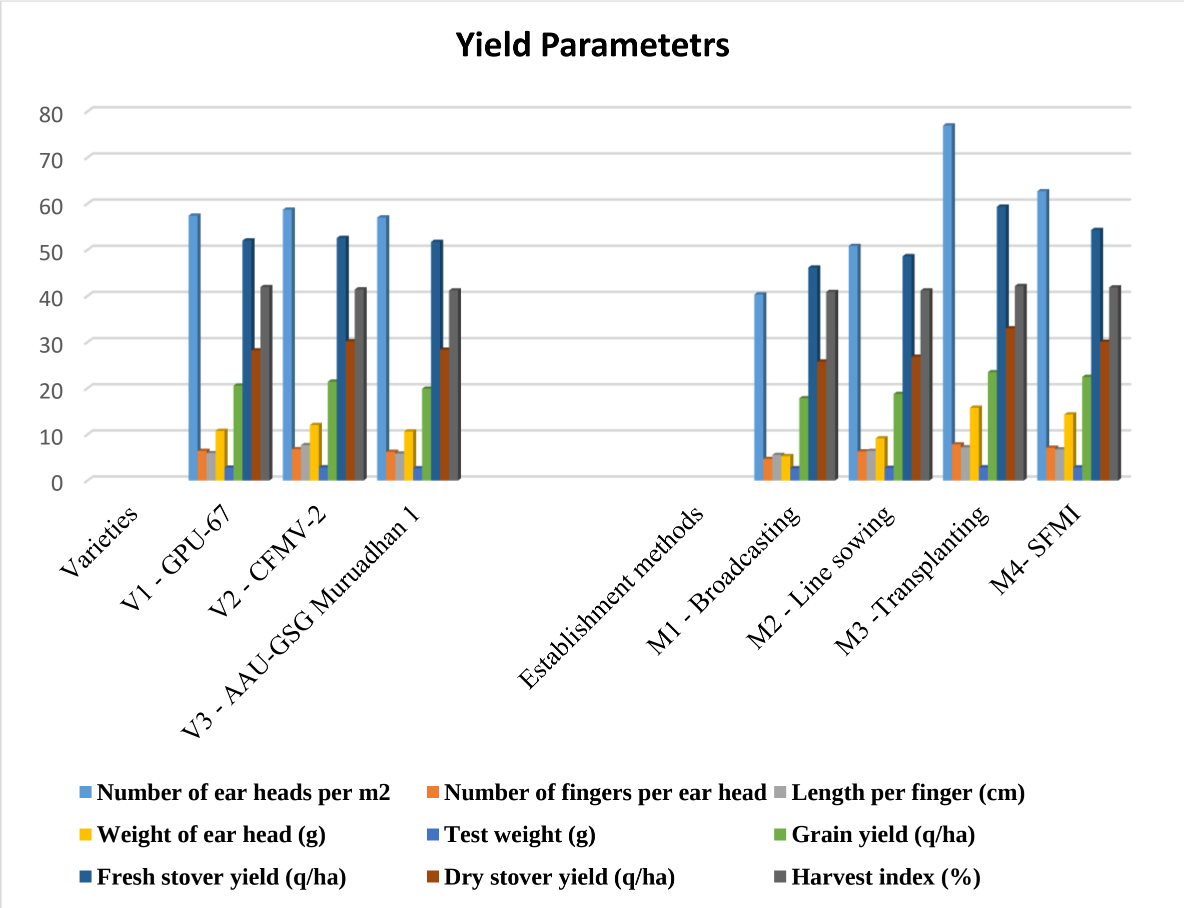

Fig. 4. Effect of varieties and establishment methods on yield parameters of finger millet

Variety V_3

LAI ranged from 1.90 (M_1 - Broadcasting) to 2.50 (M_3 - Transplanting) and 2.17 (M_4 - SFMI).

Transplanting (M_3) had the highest LAI for V_3 at harvest, while Broadcasting (M_1) and SFMI (M_4) showed slightly lower LAI.

3.8 Overall Discussion

At harvest, the effect of establishment methods on LAI was more pronounced. Transplanting (M_3) consistently promoted higher LAI values for all three varieties at harvest, indicating more robust canopy development and potentially higher photosynthetic activity. Broadcasting (M_1) and SFMI (M_4) generally had lower LAI values at both growth stages compared to the other establishment methods.

The significant interaction effect suggests that the combination of specific varieties with suitable establishment methods can lead to variations in LAI values.

The table presents the interaction effect of different varieties and establishment methods on the length per finger (cm) of finger millet.

3.9 Interaction Effect

The interaction effect between varieties and establishment methods on the length per finger is significant, as indicated by the different values observed for each combination.

The results showed that the length per finger (cm) of finger millet is influenced by the interaction between varieties and establishment methods. Each variety responds differently to the various establishment methods, leading to variations in finger length.

Variety V_1 - GPU-67: The length of fingers for V_1 ranged from 5.50 cm (M_1 - Broadcasting) to 8.07 cm (M_3 - Transplanting). The longest fingers were observed when using the transplanting method (M_3), indicating that this method is favorable for promoting longer fingers in GPU-67.

Variety V_2 - CFMV-2: The length of fingers for V_2 varied from 5.70 cm (M_1 - Broadcasting) to 8.30 cm (M_3 - Transplanting). As with V_1, the transplanting method (M_3) resulted in the longest fingers for V_2 - CFMV-2 as well.

Variety V_3 - AAU-GSG-Muruadhan 1: The finger length for V_3 ranged from 4.90 cm (M_1 - Broadcasting) to 8.00 cm (M_3 - Transplanting). Once again, transplanting (M_3) promoted longer fingers in V_3 - AAU-GSG-Muruadhan 1.

Overall, the transplanting method (M_3) consistently resulted in longer fingers across all the three varieties, while broadcasting (M_1) generally led to shorter fingers. Line sowing (M_2) and SFMI (M_4) fall in between these two extremes, indicating that they have a moderate effect on finger length.

The results highlight the importance of selecting the appropriate establishment methods based on the desired characteristics of finger millet. Farmers and researchers can use this information to make informed decisions about the best combination of variety and establishment method to achieve the desired finger length for finger millet cultivation [58-63].

3.10 Varieties

Crude Protein Content in Grain: Among the three varieties, V_2 - CFMV-2 had the highest crude protein content in the grain with 5.15% at both 30 and 60 DAS/DAT. Varieties V_1 - GPU-67 and V_3 - AAU-GSG-Muruadhan 1 had similar crude protein content in the grain at both stages with 3.66% and 4.43%, respectively.

Table 3. Effect of varieties and establishment methods on quality parameters of finger millet

Treatments	Crude protein content in grain (%)	Crude protein content in stover (%)	Calcium content (mg/100g)	Zinc content (mg/100g)	Iron content (mg/100g)
Varieties					
V_1 - GPU-67	5.93	3.19	331.08	1.74	4.39
V_2 - CFMV-2	6.30	3.36	332.75	1.80	4.63
V_3 - AAU-GSG-Muruadhan 1	6.12	3.14	304.67	1.75	3.93
SEm(±)	0.12	0.09	14.70	0.02	0.18
CD @ 5%	NS	NS	NS	NS	0.54
Establishment methods					
M_1 - Broadcasting	4.42	2.05	319.56	1.39	3.28
M_2 - Line sowing	6.00	3.25	328.22	1.82	4.70
M_3 - Transplanting	7.68	4.18	339.11	2.00	5.06
M_4- SFMI	6.37	3.43	304.44	1.83	4.23
SEm(±)	0.13	0.10	16.97	0.03	0.21
CD (p=0.05)	0.39	0.29	NS	0.08	0.62
Interaction	S	NS	NS	NS	NS

***= Significant NS= Non-significant*
**S=Standard mean of error*

Table 3a. Interaction effect of varieties and establishment methods on Crude protein content of grain and stover (%) at 30 and 60 DAS/DAT of finger millet

	Method of sowing/transplanting			
	Grain crude protein content (%)			
Varieties	**M_1**	**M_2**	**M_3**	**M_4**
V_1	3.66	6	7.68	6.37
V_2	5.15	6	7.68	6.37
V_3	4.43	6	7.68	6.37
SEm(±)	0.23			
CD(p=0.05)	0.68			

**S=Standard mean of error*

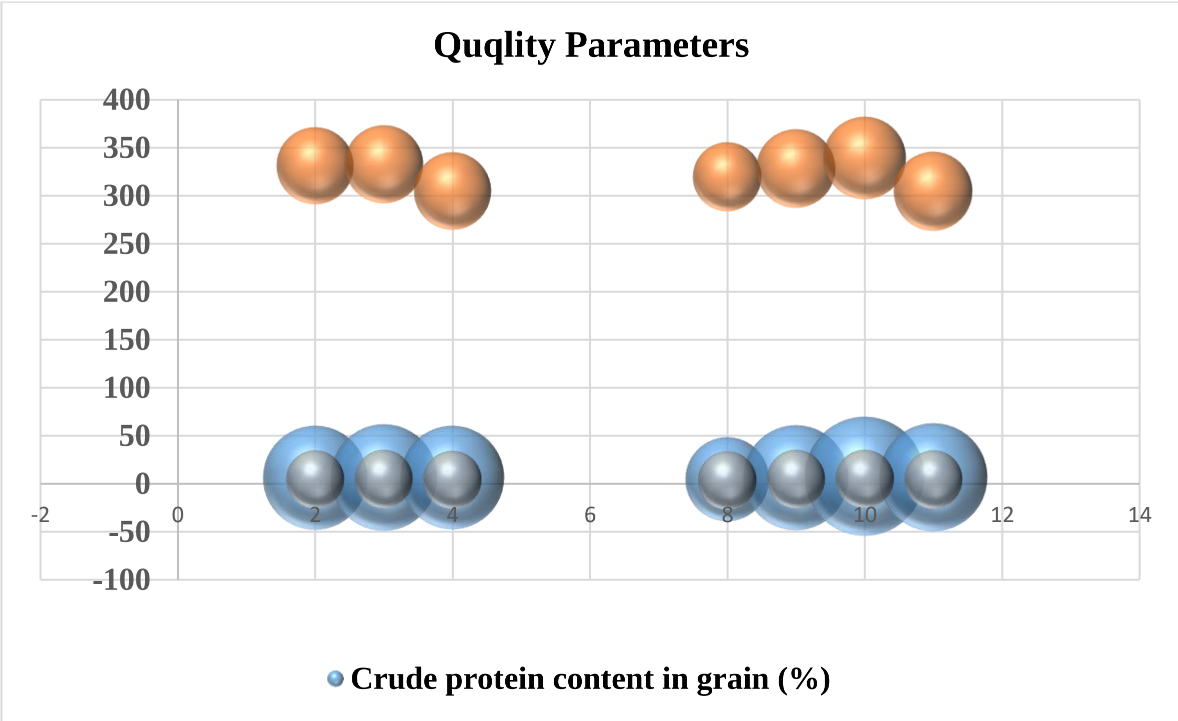

Fig. 5. Effect of varieties and establishment methods on quality parameters of finger millet

Crude Protein Content in Straw: All three varieties (V_1, V_2, and V_3) had the same crude protein content in the straw with 6.00% at both 30 and 60 DAS/DAT.

3.11 Establishment Methods

Crude Protein Content in Grain: Transplanting (M3) resulted in the highest crude protein content in the grain at both 30 and 60 DAS/DAT, at 7.68%, followed by SFMI (M4) at 6.37%, line sowing (M2) at 6.00%, and broadcasting (M1) at 3.66% at 30 DAS/DAT and 6.37% at 60 DAS/DAT.

Crude Protein Content in Straw: All four establishment methods (M_1, M_2, M_3, and M_4) resulted in the same crude protein content in the straw at 6.00% at both 30 and 60 DAS/DAT.

3.12 Interaction Effect

The interaction effect between varieties and establishment methods on the crude protein content of grain and straw is not significant. The values for crude protein content in grain are the same across all varieties (V_1, V_2, and V_3) for each establishment method (M_1, M_2, M_3, and M_4) at both 30 and 60 DAS/DAT. Similarly, the crude protein content in straw remains constant across all establishment methods (M_1, M_2, M_3, and M_4) for each varieties(V_1, V_2, and V_3) at both stages.

4. CONCLUSION

Based on the forgone results, among the establishment methods, transplanting shows better results compared to others. Similarly, among the varieties, CFMV-2 yields favorable outcomes in comparison to the rest. Interestingly, when combining V2 (CFMV-2) with the transplanting method, shows good results. These findings are from only one year of investigation, further experimentation may be required to derive a valid conclusion**.**

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 writing or editing of manuscripts.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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