Eco. Env. & Cons. 30 (July Suppl. Issue) : 2024; pp. (S284-S292)
Copyright@ EM International
ISSN 0971–765X

DOI No.: http://doi.org/10.53550/EEC.2024.v30i04s.050

Effect of sowing dates and varieties on growth and yield of finger millet (*Eleusine coracana*) under rainfed condition of Nagaland, India

Sungpha P Phom, Lanunola Tzudir*, D. Nongmaithem, Rekha Yadav, Noyingthung Kikon and Merentoshi[1]

Department of Agronomy, SAS, Nagaland University, Medziphema, Nagaland, India
[1]Department of Genetics and Plant Breeding, SAS, Nagaland University, Medziphema, Nagaland, India

(Received 6 December, 2023; Accepted 17 January, 2024)

ABSTRACT

The present study was conducted during the *kharif* season 2022 at the School of Agricultural Sciences, Nagaland University (NU: SAS) to evaluate the performance and variability for yield and yield contributing characters of finger millet varieties against different dates of sowing under rainfed conditions of Nagaland. The experiment was conducted in Split Plot Design (SPD) with three replications. The treatment combination consisted of three varieties (Simhadri, Bharathi and CO-15) and three dates of sowing (20th June, 30th June and 10th July). The results revealed that finger millet yield and its attributing character were significantly affected by different dates of sowing and varieties. The result showed that the first date of sowing (20th June) recorded the highest growth and yield attributes at all the growth stages. Among the three varieties used, number of tillers plant^{-1} (2.96) number of green leaves (24.04) and length of finger (7.39 cm) were higher in variety CO-15. However, plant height (93.53cm), dry weight (21.37 g plant^{-1}), LAI (5.02), number of ear heads plant^{-1} (3.76) and harvest index (34.94) were maximum with the variety Simhadri. The result also revealed that among the varieties, Simhadri recorded the highest straw yield (4641.69 kg ha^{-1}) and grain yield (2506.96 kg ha^{-1}) followed by variety CO-15 (4517.32 kg ha^{-1}, 2347.11 kg ha^{-1}). Among the sowing dates, crop sown on 20th June produced the highest grain yield followed by the 30th June. After a comparative study of different sowing dates and varieties of finger millet, it was found that variety Simhadri sown on 20th June was most suitable followed by variety CO-15.

Key words: *Finger millet, Date of sowing, Varieties, Growth attributes, Yield attributes, Yield*

Introduction

Finger millet (*Eleusine coracana*) commonly known as ragi is a valuable grain used for food, fodder and other commercial purposes. It is an important millet grown in India and serves as the main cereal crop for the monsoon season in some hilly areas. Ragi belongs to the family Graminae or Poaceae. It originated in East Africa approximately 5000 years ago and was introduced into India, 3000 years ago (Upadhyaya *et al.*, 2007).

Millet grains are sometimes referred to as "Nutri-cereals" since they are excellent providers of minerals and have much larger amounts of nutrients including carbohydrates, protein, dietary fibre, and good quality fat. Although the proportion of minerals varies according to the type, millet is often higher in calcium, iron, and other nutrients than rice and

wheat. The carbohydrate content of finger millet grain is 81.5%, the protein content is 9.8%, the crude fibre content is 4.3%, and the mineral content is 2.7%, which is comparable to rice, wheat, maize, and other millets. It has significantly greater crude fibre and mineral content than wheat (1.2% fibre, 1.5% minerals) and rice (0.2% fibre, 0.6% minerals). It has a more balanced protein profile than other millets, with higher lysine, threonine, and valine than other millets (Gull *et al.,* 2014). Finger millet is a relatively simple crop that has proven to be reliable in situations where other cereal crops would have perished due to famine or adverse agro-ecological conditions. Ragi has a wide range of ecological and geographical compliancy and is resilient to a variety of agro-climatic condition, allowing to grow in adverse agro-ecological conditions with minimal input, tolerance to moisture stress, low pest and disease susceptibility, and ability to sustain on marginal land. Finger millet is particularly adaptable to higher elevations and is cultivated up to an altitude of 2300 m in the Himalayas. (Bhat *et al.*, 2019).

India is the world's largest producer of millets with a share of 41 percent in 2020 (Anon., 2022). In Nagaland finger millet is grown in an area of about 350 ha with the production of 340 MT and Mokokchung district rank highest in area (80 ha) and production (80 MT) in the year 2020-21 (Anon., 2022)

The low production and productivity of finger millet are due to an imbalance nutrient management, insufficient irrigation, heavy weed infestation, use of local varieties, incident of blast disease and late sowing *etc*. The time of sowing is one of the most important non- monetary inputs influencing finger millet production, and hence timely sowing is paramount important to ensure higher productivity. Timely sowing of crops usually offers ample time for root development and vegetative growth, allowing for the best accumulating of available nutrients and radiant energy (Soler *et al*., 2008). Delay in sowing reduce the values of all parameters and decrease yield (Iping, 1997).

The varieties play an important role in the production of crop, and a varieties potential for yield within genetic boundaries is limited by its environment. The yield of any crop is determined by the production potential of the cultivar as well as the climatic, edaphic and management practices to which the cultivar is subjected (Sarawale *et al*., 2016).

Keeping in view the importance of interaction between the sowing dates and finger millet varieties, the experiment entitled "Effect of sowing dates and varieties on growth and yield of finger millet (*Eleusine coracana*) under rainfed condition of Nagaland" was conducted at the Agronomy farm of the School of Agricultural Sciences (SAS), Medziphema campus during the *kharif* season 2022.

Materials and Methods

The experiment was conducted during the *kharif* season from June to November, 2022 at the Agronomy farm of School of Agricultural Sciences (SAS), Medziphema campus. The farm is located at 25° 45' 43" North latitude and 95° 53' 04" East longitude with elevation of 310 m above mean sea level (MSL). The experiment site has tropical sub-humid climate. During *kharif* season, the weekly mean of maximum temperature ranged from 31 °C to 34 °C with an average of 35 °C and the weekly mean relative humidity was 67%. The annual rainfall of the region varies from 2000 - 2300 mm.

The experiment was laid out in Split Plot Design (SPD) with three replication. The treatment consisted of three dates of sowing *viz.,* 20th June, 30th June and 10th July as main factor and three varieties *viz.,* Simhadri (V_1), Bharathi (V_2) and CO-15 (V_3) as sub-factor. The treatment combination comprised of three different dates of sowing against three varieties with 24 treatment combinations. The seed material of finger millet variety was obtained from Andhra Pradesh, south India. Based on the soil analysis the soil of the experiment field was classified as sandy loam in texture, uniform levelled and well drained having pH 4.5 high in organic carbon and medium in Nitrogen, Phosphorus and Potassium. The total plot size was 27 × 11 m^2 and the plots size 4.5 m × 3 m was maintained. The row to row and plant to plant spacing was maintained at 25 cm × 10 cm for the experiment. The recommended dose of fertilizer (RDF) 40:20:20 kg ha^{-1} was applied in the form of Urea, SSP and MOP. Entire quantity of phosphorus, potash and ½ nitrogen was applied as basal dose and the remaining dose of nitrogen was applied in two equal split at 30 DAS and 60 DAS. Observations was recorded from five randomly selected plants for growth and yield attributes and then by calculating the average value for each plot. Biometric observation on growth, yield attributes and grain yield were recorded. The tabulated data were statistically processed by standard method of

analysis of variance for the split plot design and test of significance as given by Gomez and Gomez (1984).

Results

The observation data recorded during the course of the investigation were carefully analysed statistically to assess the degree of variance due to different treatments and the results obtained are prescribed and illustrated below.

Effect of sowing dates and varieties on growth attributes

Plant height (cm)

The tallest plant height (93.53 cm) was produced when the crop was sown at D_1 (20th June) than that of D_2 (30th June) and D_3 (10th July). However, D_2 (30th June) was found to be statistically at par in respect to plant height at all growth stages, while sowing on D_3 (10th July) recorded the shortest plant height (75.08 cm) (Table 1).

The variation in plant height due to different finger millet varieties was statistically significant at 60 DAS and it was found to be non-significant at 30 DAS and 90 DAS. Among the different varieties used the highest plant height was recorded from variety Simhadri (17.71 cm, 81.05 cm and, 85.92 cm) at all the stages of observation. The lowest (55.81cm) was recorded with V_3 (CO-15) at 60 DAS.

Number of tillers plant^{-1}

Among the sowing dates, the maximum number of tillers plant^{-1} (3.04) was observed with D_1 (20th June) which was also found to be statistically at par with D_2 (30th June). There was an increased in the number of tillers at 30 DAS and 60 DAS, and it was also found that number of tillers decrease slightly at 90 DAS among the varieties (Table 1).

It was observed that there was a significant difference in the number of tillers plant^{-1} among the varieties. The Maximum numbers of tillers (2.96) was recorded with variety V_3 (CO-15) and was found at par with the variety V_1 (Simhadri) and the minimum number of tillers (2.23) was recorded with V_2 (Bharathi).

Leaf Area Index (LAI)

The data given demonstrated that there was a considerable variation in leaf area index due to different dates of sowing at all growth stages of finger millet cultivars (Table 1). Among the dates of sowing, crops planted at D_1 (20th June) resulted in a higher leaf area index (3.74) and the second highest (3.56) with D_2 (30th June) followed by (2.62) D_3 (10th July). It was also observed that D_2 (20th June) was at par with D_1 (20th June) at all the growth stages of the finger millet varieties.

Among the different varieties, a higher leaf area index (LAI) was recorded with the varietySimhadri (2.14, 5.03) at 30 and 60 DAS. However, at 90 DAS the trend changed and variety CO-15 (3.89) was found to be higher in leaf area index but comparable with variety Simhadri (3.30).

Plant dry weight (g plant^{-1})

Data showed that sowing dates significantly influenced plant dry weight at all the growth stages (Table 1). Highest plant dry weight (2.59 g, 22.04 g, 35.26 g) was recorded with D_1 (20th June). The lowest plant dry weight (1.47 g, 13.37 g and 25.45 g) was recorded in D_3 (10th July) date of sowing.

Significant variation in plant dry weight due to variety was observed at 60 DAS. However, 30 DAS and 90 DAS plant dry weight did not show any significant variation. Among the different varieties used highest plant dry weight (21.37 g) was observed with V_1 (Simhadri) while the lowest plant dry weight (11.73 g) was recorded with the variety V_3 (CO-15).

Crop growth rate (g m^{-2} day^{-1})

Sowing dates showed significant variance in crop growth rate at 30-60 DAS (Table 1). It is evident from the data that the highest crop growth rate (25.93g m^{-2} day^{-1}) was recorded with D_1 (20th June) compared to the other dates of sowing, and the lowest (15.87 g m^{-2} day^{-1}) was recorded with D_2 (30th June). However, at 60-90 DAS crop growth rate was found to be non-significant.

Among the different varieties used, the highest crop growth rate (25.60 g m^{-2} day^{-1}) was recorded with the variety V_1 (Simhadri) which was also found at par with V_2 (Bharathi) and the lowest crop growth rate (12.79 g m^{-2} day^{-1}) was recorded with variety V_3 (CO-15) at 30 - 60 DAS. However, later at 60 - 90 DAS, the highest crop growth rate (22.77 g m^{-2} day^{-1}) was recorded with the variety V_3 (CO-15) while the lowest (13.34 g m^{-2} day^{-1}) was recorded with variety V_2 (Bharathi).

Table 1. Effect of sowing dates and varieties on growth attributes of finger millet

Treatments	Plant Height (cm)			No. of tillers plant^{-1}			Leaf Area Index (LAI)			Plant dry weight (g plant^{-1})			CGR (g m^{-2} day^{-1})		RGR (g g^{-1} day^{-1})	
	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS	30-60 DAS	60 - 90 DAS	30 - 60 DAS	60 - 90 DAS
Sowing dates																
D_1	19.83	78.64	93.53	1.83	3.17	3.04	2.24	5.48	3.74	2.59	22.04	35.26	25.93	17.64	0.070	0.017
D_2	17.77	73.09	84.69	1.69	2.93	2.79	1.89	4.88	3.56	2.39	17.10	29.93	19.62	17.10	0.064	0.020
D_3	13.23	64.16	75.08	1.54	2.36	2.08	1.25	3.49	2.62	1.47	13.37	25.45	15.87	16.11	0.073	0.022
SEm ±	1.05	1.47	2.73	0.05	0.15	0.17	0.16	0.38	0.19	0.09	0.75	1.11	0.98	1.18	0.002	0.002
CD (p=0.05)	4.14	5.78	10.72	0.20	0.58	0.66	0.61	1.49	0.76	0.34	2.96	4.36	3.86	NS	NS	NS
Varieties																
V_1	17.71	81.05	85.92	2.01	2.91	2.72	2.14	5.03	3.30	2.18	21.37	32.42	25.60	14.73	0.077	0.014
V_2	17.21	79.03	81.70	1.31	2.42	2.23	1.38	4.18	2.73	2.14	19.41	29.41	23.03	13.34	0.073	0.015
V_3	15.91	55.81	85.69	1.74	3.12	2.96	1.85	4.63	3.89	2.14	11.73	28.81	12.79	22.77	0.057	0.030
SEm±	0.84	2.38	1.71	0.09	0.10	0.08	0.15	0.21	0.27	0.12	1.10	0.98	1.43	1.30	0.002	0.002
CD (p=0.05)	NS	7.34	NS	0.29	0.32	0.25	0.45	0.64	0.83	NS	3.40	NS	4.39	4.02	0.007	0.006

Relative growth rate (g g^{-1} day^{-1})

The effect of different sowing dates on relative growth rate did not show a significant difference both at 30 - 60 and 60 - 90 DAS (Table 1).

There was a significant effect on the relative growth rate at all the growth stages of the crop. At 30 - 60 DAS highest relative growth rate (0.077 g g^{-1} day^{-1}) was recorded with variety V_1 (Simhadri) and the lowest (0.057 g g^{-1} day^{-1}) with V_3 (CO-15). At 60 – 90 the trend changed and the highest relative growth rate (0.030 g g^{-1} day^{-1}) was recorded with the variety V_3 (CO-15) and the lowest (0.014 g g^{-1} day^{-1}) with the variety V_2 (Bharathi).

Effect of sowing dates and varieties on yield attributes

Number of ear heads plant^{-1}

Influence of sowing dates on the number of ear heads plant^{-1} showed significant variation (Table 2). The highest number of ear head plant^{-1} (3.59) was recorded by D_1 (20th June) which was also at par with D_2 (30th June). The lowest number of ear heads plant^{-1} (2.52) was recorded with D_3 (10th July).

Among the different varieties used, the highest number of ear heads plant^{-1} (3.76) was recorded with the variety V_1 (Simhadri) which was also significantly superior to the other two varieties *i.e.* V_2 (Bharathi) and V_3 (CO-15). The lowest number of ear heads plant^{-1} (2.81) was recorded from variety V_3 (CO-15).

Number of fingers ear head^{-1}

Different dates of sowing did not produce any significant result on the number of fingers ear head^{-1}. Almost similar values of a number of fingers ear head^{-1} were recorded due to different sowing dates (Table 2).

Although there was no significant difference in the number of fingers ear head^{-1} among the varieties used, it was observed that the variety V_1 (Simhadri) produced the highest number of fingers ear head^{-1} followed by variety V_2 (Bharathi) and V_3 (CO-15).

Length of finger (cm)

There was no significant difference in length of finger due to different sowing dates (Table 2).
The length of finger ear head^{-1} due to varieties was found significant. The highest finger length (7.32 cm) was recorded by variety V_3 (CO-15) while the

lowest finger length (6.30 cm) was recorded by variety V_2 (Bharathi). At par relation (6.68 cm, 6.30 cm) was found in the varieties V_1 (Simhadri) and V_2 (Bharathi).

Weight of ear head (g)

Sowing dates significantly influenced on the weight of ear head (Table 2). The highest value of weight of ear head (6.04 g) due to different sowing dates was recorded with D_1 (20th June) and the second highest (5.46 g) was recorded in D_2 (30th June) which was also observed to be in par with D_1 (20th June) dates of sowing. The lowest weight of ear head (5.02 g) was recorded in D_3 (30th June).

The difference in weight of ear head due to the varieties was found to be non-significant. The variety V_1 (Simhadri) recorded the maximum weight of ear head (5.82 g) than the other two varieties.

Test weight (g)

The difference in test weight due to different date of sowing and varieties did not show any significant results (Table 2).

Number of grains finger^{-1}

After a thorough analysis of data, it was observed that the difference in the number of grains finger^{-1} due to sowing dates was found to be non-significant (Table 2). However, the highest number of grains finger^{-1} (285.04) was recorded with D_1 (20th June) and the lowest (267.81) with D_2 (30th June).

The effect of varieties on number of grains finger^{-1} was also found to be non-significant. Although, the highest number of grains finger^{-1} (281.38) was recorded in the variety V_3 (CO-15) and the lowest (247.43) was recorded with V_2 (Bharathi).

Grain yield (kg ha^{-1})

A critical examination of the data revealed that significant variation was recorded in respect to grain yield due to different dates of sowing (Table 2). The highest grain yield (2684 kg ha^{-1}) was recorded with D_1 (20th June) which was also at par with D_2 (30th June). The lowest grain yield (1778.07 kg ha^{-1}) was recorded with D_3 (30th June) dates of sowing.

The observation revealed that the grain yield of finger millet was significantly influenced by different varieties. Among the varieties, the highest grain yield (2506.96 kg ha^{-1}) was recorded in V_1 (Simhadri) which was superior to other varieties. While the lowest grain yield (2051.85 kg ha^{-1}) was recorded with the variety V_2 (Bharathi).

Straw yield (kg ha^{-1})

The highest straw yield (4966.31 kg ha^{-1}) was observed with D_1 (20th June) which was also found to be statistically at par with D_2 (30th June), while the lowest straw yield (3544.74 kg ha^{-1}) was recorded with D_3 (10th July) date of sowing (Table 2).

The variation in straw yield due to varieties is found to be significant. The highest straw yield (4641.69 kg ha^{-1}) was recorded by V_1 (Simhadri). The lowest straw yield (4029.43 kg ha^{-1}) was recorded with the variety V_2 (Bharathi).

Table 2. Effect of sowing dates and varieties on yield attributes and yield of finger millet

Treatment	No. of ear heads plant^{-1}	No. of finger ear head^{-1}	Length of finger (cm)	Weight of ear head (g)	Test weight (g)	No. of grain finger^{-1}	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Harvest index (%)
Sowing dates									
D_1	3.59	6.36	7.04	6.04	2.97	285.04	2684.00	4966.31	35.04
D_2	3.33	6.14	6.77	5.46	2.93	278.80	2443.85	4677.39	34.26
D_3		2.52	6.49	6.56	5.02	3.02	267.81	1778.07	3544.74
33.43									
SEm ±	0.15	0.32	0.27	0.17	0.10	5.15	67.72	60.18	0.39
CD (p=0.05)	0.59	NS	NS	0.66	NS	NS	265.91	236.29	NS
Varieties									
V_1	3.76	6.41	6.68	5.82	3.03	275.84	2506.96	4641.69	34.94
V_2	2.88	6.20	6.30	5.10	2.90	274.43	2051.85	4029.43	33.70
V_3	2.81	6.38	7.39	5.60	2.99	281.38	2347.11	4517.32	34.08
SEm±	0.14	0.20	0.14	0.21	0.07	14.49	53.75	67.70	0.32
CD (p=0.05)	0.44	NS	0.44	NS	NS	NS	165.61	208.61	0.99

Harvest index (%)

After thorough analysis of the data, it was observed that different dates of sowing did not show any significant influence on harvest index (Table 2). However, a higher harvest index (35.04) was recorded with the D_1 (20th June).

Data revealed that higher a harvest index (34.94) was produced by V_1 (Simhadri), which was also observed to be at par with V_3 (CO-15). The lowest harvest index was recorded with the variety V_2 (Bharathi).

Discussion

Effect of sowing dates and varieties on growth attributes

Plant height (cm)

Different dates of sowing showed significant differences in plant height at all growth stages. The variance in plant height observed may be related to the availability of favourable conditions such as temperature, relative humidity and average rainfall during the crop growth period. Gueye *et al*. (2015) reported similar findings, where they observed that early sowing of crops ensue in better plant growth compared to later sowing dates. The experiment result was also in conformity with the finding reported by Bello *et al.* (2022) and Vishwanath *et al*. (2019).

There was a significant difference in plant height due to different varieties of finger millet at 60 DAS. The difference in the plant height (55.81cm) for V_3 (CO-15) at 60 DAS may be due to its longer duration of the crop as compared to V_1 (Simhadri) and V_2 (Bharathi). However, during 90 DAS, all the varieties produced similar height of the crop. The enhanced plant height for the finger millet variety Simhadri could be attributed to its well-developed rooting pattern and genetic potential, which has allowed the plant to reach its maximum height. Similar line of work was also reported by Veeraputhiran *et al.* (2009).

Number of tillers plant^{-1}

The number of tillers plant^{-1} is an indicator of good crop establishment methods as well as good growth development. It was observed that different sowing dates had a significant effect on the number of tillers plant^{-1} of finger millet. The results obtained were in conformity with the findings reported by Pandiselvi *et al.* (2010) and Upadhyay *et al.* (2015).

Among the varieties there was an increased in the number of tillers at 30 DAS and 60 DAS, and decrease slightly at 90 DAS. The possible explanation could be due to the crop at 90 DAS have reached the maturity and senescence stage of growth and development. The current study's findings were also in line with the findings reported by Sendhilvel and Veeramani (2020), Neeruganti (2021), and Pandiselvi *et al.* (2010). Wu *et al*. (1998) found that enhanced tillering ability related to higher yield of the cultivars. It can be also concluded that the treatment combination D_1V_1 was the best possible combination as it produced significantly higher number of tillers plant^{-1} compared to the other treatment combination.

Leaf Area Index (LAI)

The persistence of the assimilatory surface area is a well-known requirement for sustained photosynthetic activity. The considerable variation in leaf area index due to different dates of sowing at all growth stages of finger millet cultivars may be attributed to the early favourable conditions for the crop growth and development. The gradual decrease in LAI due to delay in planting of finger millet varieties was also reported by Nandini and Sridhara (2019). Similar findings were observed by Pandiselvi *et al.* (2010).

Variations in the leaf area index (LAI) was found significant at all the growth stages of different finger millet varieties. The change in trend in LAI is due to the fact that the variety Simhadri has reached the senescence stage due to its short duration in comparison to the variety CO-15. Among the treatment combination the highest LAI was recorded with D_1V_1 which was superior to other treatment combination. Similar line of work was also reported by Pandiselvi *et al.* (2010).

Plant dry weight (g plant^{-1})

The total dry matter content produced by the plant was determined by destructive sampling, and the weight of each variety was recorded at three stages. Because of the longer development time, the total number of leaves and dry matter production is larger with early sowing Kouressy *et al.* (1998). Early sowing recorded significantly higher total dry matter production which decreased with delayed sowing Hugar *et al.* (2001). Performance under different

dates of sowing, a steady increase in plant dry weight was also reported by Maurya *et al.* (2016) in pearl millet.

The variation in plant dry weight due to variety was observed at 60 DAS. This was contributed by the higher number of tillers and plant height of variety Simhadricompared to the variety CO-15. However, at later stage almost similar value was recorded for all the varieties. Similar line of work was also reported by Neeruganti (2021) with variety KMR201 having higher dry matter content at all growth stages comparing with other varieties including CO-15 during *kharif* season.

Crop growth rate (g m^{-2} day^{-1})

Crop growth rate was recorded at 30-60 DAS and 60-90 DAS. Significant variance in crop growth rate due to sowing dates was recorded at 30-60 DAS. Among the different dates of sowing, a steady increase in CGR during the initial stages of plant growth and decrease at later intervals in CGR was also reported by Maurya *et al.* (2016).

There was a change in trends in crop growth rate in finger millet varieties at 30-60 and 60-90 DAS, the possible reason could be due to the fact that the variety CO-15 crop duration is longer than the other two varieties and hence, the crop growth rate was recorded higher at 60-90 intervals rather than 30-60 DAS.

Relative growth rate (g g^{-1} day^{-1})

Relative growth rate is a growth relative to size that is a rate of growth per unit time, as a proportion of its size at that moment in time. The change in trend was also observed in relativive growth rate which may be due to the different duration of the varieties, where the variety V_1 (Simhadri) and V_2 (Bharathi) crop duration comparatively reached maturity at 90DAS than the variety V_3 (CO-15).

Effect of sowing dates and varieties on yield attributes

Number of ear heads $plant^{-1}$

Significant variation of sowing dates on the number of ear heads $plant^{-1}$ is most likely since the rain is firmly established at this time, providing the crop an edge over the crop sowed on D_3 (10^{th} July). Pandiselvi *et al.* (2010) also reported a significant effect on the number of ear heads $plant^{-1}$ due to different dates of sowing. The findings reported a higher number of ear heads $hill^{-1}$ at June 14^{th} date of sowing.

There is also significant effect on the number of ear heads $plant^{-1}$ due to different finger millet varieties. Similar line of work was also reported by Veeraputhiran *et al.* (2009), and Sarawale *et al.* (2016).

Number of fingers ear $head^{-1}$

Different dates of sowing and varieties did not produce any significant result on the number of fingers ear $head^{-1}$. Almost similar values of a number of fingers ear $head^{-1}$ were recorded due to different sowing dates and varieties.

Length of finger (cm)

Except for variety CO-15, the magnitude of differences in the length of fingers between varieties were not much remarkable. The variation in finger length of finger millet was also reported by Nigade *et al.* (2020), Sarawale *et al.* (2016), and Dash *et al.* (2021).

Weight of ear head (g)

Early sowing resulted in highest value of weight of ear head in comparison with the later sowing. Delaying planting from 15^{th} June significantly decreased panicle weight of millet Leila *et al*. (2008). Changes in the period of light interception can be attributed to a decrease in panicle weight for late planting dates Craufurd *et al.* (1988). Similar line of works was also reported by Jan *et al.* (2015) in pearl millet.

Test weight (g)

The difference in test weight due to different date of sowing and varieties was found to be non-significant.

Number of grains $finger^{-1}$

After a thorough analysis of data, it was observed that the difference in the number of grains $finger^{-1}$ due to sowing dates and varieties was also found to be non-significant.

Grain yield (kg ha^{-1})

Changes in weather and soil moisture conditions, particularly during inflorescence and pollination, could be attributed to the significant impacts of different sowing dates and varieties, which are sufficient to have a negative effect on the development of ear heads due to the direct effect of intense solar ra-

diation. Significant variation was recorded in respect to grain yield due to different dates of sowing. Earlier planting such as May 17th and May 24th yielded all the other planting windows reported by Pandiselvi *et al.* (2010). Sarala *et al.* (2022) also confirmed that the grain yield of finger millet decreased with a delay in sowing. Upadhyay *et al.* (2015), reported that maximum yield can be obtained when crop is sown on May 23rd compared to May 30th or June 10th. Similar line of work was also reported by Revathi *et al.* (2018).

The higher yield of finger millet varieties V_1 (Simhadri) could be attributed to the appreciably higher yield contributing characters such as the number of ear heads plant^{-1}, number of fingers ear head^{-1}, weight of ear head (g), and test weight (g). Similar line of work was also reported by Nigade *et al.* (2020), Veeraputhiran *et al.* (2009) and Sarawale*et al*. (2016).

Straw yield (kg ha^{-1})

Straw yield is the result of better growth, dry matter production and leaf area which was recorded more with the respective varieties that produce higher yield. Different dates of sowing and varieties significantly influenced the straw yield. Similar line of work was also reported by Sarawale *et al.* (2016), Sendhivel and Veeramani (2020), Revathi *et al.* (2018), Upadhyay *et al.* (2015) and Nigade *et al.* (2020).

Harvest index (%)

A perusal of the data revealed that harvest index was significantly influenced by different varieties but not by the sowing dates. This may be attributed due to varieties that produced different plant height, numbers of tillers, and numbers of leaves and also the different growth pattern of variety.

Conclusion

From the findings of the present investigation the following conclusion can be drawn; Early sowing *i.e.,* D_1 (20th June) showed the best performance in term of growth and yield attributes compared to the later sowing dates *i.e.,* D_2 (30th June) and D_3 (10 July). Among the finger millet varieties, Simhadri was found to be most adaptable followed by the variety CO-15. The most suitable date of sowing of finger millet (*Eleusine coracana*) under rainfed condition of Nagaland was found to be 20th June according to the present investigation.

Conflict of Interest

Authors declare that there is no conflict of interest.

References

Anonymous, 2022. Agricultural and Processed Food Products Export Development Authority. Ministry of Commerce and Industry.

Anonymous, 2022. Area and production of principal crops for the year 2020-21. *Statistical Handbook of Nagaland*. Directorate of Economics and Statistics, Government of Nagaland, Kohima, Nagaland. pp. 26.

Bhat, B.V., Arunachalam, A., Kumar, D., Tonapi, V.A. and Mohapatra, T. 2019. Millets in the Indian Himalaya, Indian Council of Agricultural Research, New Delhi. pp.84**.**

Bello, T.T., Mahadi, M.A. and Lado, A. 2022. Effect of weed control treatments, sowing dates and method on growth and yield of finger millet (*Eleusine coracana* L. Gaertn) in Sudan Savanna of Nigeria. *FUDMA Journal of Agriculture Technology*. 8(1): 30-37.

Craufurd, P.Q. and F.R. Bidinger. 1988. Effect of the duration of the vegetative phase on shoot growth, development and yield in pearl millet (*Pennisetum americanum* L.) *Leeke Journal Experimental Botany*. 38: 124-139.

Dash, S., Mishra, P.J., RaI, A.k., Dash, H. and Rautray, B.K. 2021. A comparative study on yield performance of finger millet varieties under rainfed condition in south eastern Ghat zone of Odisha. *International Journal of Research Scientific Research*. 12(05): 41759-41764.

Gomez, K.A. and Gomez, A.A. 1984. *Statistical Procedure for Agricultural Research.* 2nd Edn., A Wiley-Interscience publication John Wiley &Sons, New York. pp. 97-101.

Gueye, M., Kanfany, G. and Fofana, A. 2015. Effect of planting date on growth and grain yield of fonio millet in the south east of Senegal. *International Journal of Biological and Chemical Sciences.* **9**(2): 581-592.

Gull, A., Jan, R., Nayik, G.A., Prasad, K. and Kumar, P. 2014. Significance of Millet in Nutrition, Health and Value Added Product: A Review. *An International Peer Review E-3 Journal* of *Science and Technology*. **3**(3): 1601-1608.

Hugar, A.Y., Halikatti, S.I. and Palled, Y.B. 2001. Influence of sowing dates and row spacing on growth attributes of different small grain millets. *Karnataka Journal of Agricultural Sciences.* **14**(3): 767-769.

Iping, S.A.1997. The effects of date of planting on yield and yield components of Pearl millet. Ministry for Agriculture, water and Rural Development, Privet Bag 13184, Windhoek, Namibia. pp. 52-53.

Jan, A., Khan, I., Ali. S., Amanullah and Sohail, A. 2015.

Sowing dates and sowing methods influenced on growth yield and yield component of pearl millet under rainfed condition. *Journal of Environment and Earth Science.* **5**(1):105-109.

Kouressy, M., Niangado, O., Vaksman, M. and Reyniers, F.N. 1998. Study on phenological variation of sorghums in Mali and its use for cultivar improvement. The future of photoperiodical cereals for sustainable production in the semiarid tropics of Africa. *Florence.* 123-137.

Leila, R. 2008. Autochthonous pearl millet ecotype (*Pennisetum glaucum.*) response to different sowing dates Tunisia. *Journal of Seed Science.* 25(2): 123-138.

Maurya, S., Nath, S., Patra, S.S. and Rout, S. 2016. Effect of different sowing dates on growth and yield of Pearl millet varieties under Allahabad condition. *International Journal of Sciences and Nature*. 7(1): 62-69.

Nandini, K.M. and Sridhara, S. 2019. Performance of foxtail millet (*Setaria italic* L.) genotypes to sowing dates in south transition zone of Karnataka. *Journal of Pharmacognosy and Phytochemistry.* 8(1): 2109-2112.

Neeruganti, K. 2021. Performance of high yielding varieties of finger millet [*Eleusine coracana* (L.) Gaertn]. M.Sc. (Ag.) Thesis, College of Agriculture, Vellanikkara, Thrissur, Kerala.

Nigade, R.D., Bagade, S.V. and Bhilare, R.L. 2020. Ensuring economic grains due to different dates of sowing on finger millet varieties (*Eleusinecoracana* L.). *International Journal of Current Microbiology and Applied Sciencces.* 9(5): 2487-2492.

Pandiselvi, T., Narayana, A.L. and Karthikeyan, R. 2010. *Evaluation of Optimum Time of Sowing of Finger millet* (*Eleusine coracana* G.) Varieties in Karaikal Region. 6(1): 94-96.

Revathi, T., Rekha, M. S. and Kumar, P. S. 2018. Ensuing Economic Gains from Fingermillet (*Eleusine coracana* L.) due to Different Dates of Sowing and Varieties. *International Journal of Current Microbiology and Applied Sciences.* (6): 2050-2054.

Sarala, N.V., Priya, M.S.,Madhavilatha, L., Vajantha, B. and Kumar, M.H. 2022. Influence of dates of sowing and varieties on flowering, growth and yield of finger millet. *International Journal of Agriculture Sciences.* 14(9): 11625-11627.

Sarawale, P.P., Rajemahadik, V. A., Shendage, G. B. and Mane, S.V. 2016. Effect of different varieties and establishment method on growth and yield of finger millet (*Eleusine coracana* (L.) *Gaerth*) under Konkan Condition. *Journal on Indian Society Costal Agricultural Research.* 32(2): 22-26.

Sendhivel, V. and Veeramani, P. 2020. Evaluation of high yielding and blast resistant finger millet (*Eleusine coracana*) varieties in north eastern zone of Tamil Nadu. *Journal of Krishi Vigyan*. 8(2): 124-128.

Soler, C.M., Maman, T.N., Zhang, X. and Mason, S.C. 2008. Determination optimum planting dates for Pearl millet for two contrasting environments using a modelling approach. Department of Biological and Agricultural Engineering, the University of Georgia. *Journal of Agricultural Science*. 146: 445–459.

Upadhyaya, H.D., Gowdaand C.L.L. and Reddy, V.G. 2007. Morphological diversity in finger millet germplasm introduced from Southern and Eastern African. *Journal of SAT Agriculture Research*. 3(1).

Upadhyay, R.G., Ranjan, R., Yadav, S. and Negi, P.S. 2015. Influence of Sowing Date and Variety and Growth and Yield of Finger millet on Mild Himalaya region of Uttarakhand: National Academy of Agriculture Science (NAAS). 33(4): 3591-3595.

Veeraputhiran, R., Chellamuthu, V., and Pandian, B.J. 2009. Performance of Finger millet Varieties in Coastal Region of Karaikal: *International Journal of Agricultural Sciences.* 5: 190-192.

Vishwanath, S., Medar, Parashivamurthy, P.J. Devaraju, K. Madhusudan, R. Siddaraju and Boraiah, B. 2019. Effect of Sowing Time on Growth and Seed Yield of Finger Millet [*Eleusine coracana* (L.) Gaertn.] Varieties under Climate Change Regime. *International Journal of Current Microbiology and Applied Sciences*. 8(08): 1775-1786.

Wu, G., Wilson, L.T. and McClung, A.M. 1998. Contribution of rice tillers to dry matter accumulation and yield. *Agronomy Journal.* 90(3): 317-323.