Int.J.Curr.Microbiol.App.Sci (2020) *9*(5): 2487-2492

International Journal of Current Microbiology and Applied Sciences
***ISSN: 2319-7706* Volume 9 Number 5 (2020)**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2020.905.284

Ensuing Economic Gains due to Different Dates of Sowing on Finger millet Varieties (*Eleusine coracana* L.)

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Keywords

Economics, Grain yield, Test weight, No of fingers

Article Info

Accepted:
18 April 2020
Available Online:
10 May 2020

A B S T R A C T

A field experiment to study the effect of different sowing dates on growth and yield of finger millet cultivars under rainfed conditions was conducted during three consecutive *kharif* seasons of 2016, 2017 and 2018 at the experimental farm of Zonal Agricultural Research Station, Sub-montane Zone, Kolhapur (Maharashtra) India. The experiment was conducted with four dates of sowing as main plot (2^{nd} week of June, 4^{th} week of June, 2^{nd} week of July and 4^{th} week of July) and four finger millet varieties (Phule Nachani, GPU 28, GPU 67 and Dapoli 1) as sub-plot in split plot design with three replications. Pooled results of the three years showed that the significantly highest plant height (88.7 cm), number of tillers (2.6), length (7.3 cm) and number of fingers (6.5), was recorded with second sowing date i.e. on 4^{th} week of July. However, significantly highest grain and straw yield (22.51 and 29.88 q ha^{-1}) as well as monetary returns was observed with sowing of finger millet variety Phule Nachani in 4^{th} week of June i.e. 26^{th} MW on shallow and light soils in IX rainfall situation of sub-montane zone of Maharashtra.

Introduction

In recent years climate change and its variability are emerging as major challenges to Indian Agriculture. Although, climate change impacts are being witnessed world over, the countries in which larger population is dependent on agriculture, such as India, are more vulnerable. Recent research indicated that monsoon rainfall in India became more erratic with intense rainfall events and reduced number of rainy days during the latter half of the 20^{th} century thus increasing the risk of drought and flood damage to crops like rice (Auffhammer *et al.*, 2012).

Rainfed crops are more vulnerable to climate change because of the limited options for coping with variability of rainfall and temperature. This will result in shift in sowing time and shorter growing season, which may necessitate effective adjustment in sowing and harvesting dates. One of the striking features of finger millet is its resilience and ability to

adjust to diverse agro-ecological conditions which is reflected in having highest productivity among millets (Seetharam, 2006). It is grown under diverse situations of soil and all weather conditions more so varying rainfall situations. Finger millet is considered as one of the most drought resistant crops among the field crops with high production potential. Among several agronomic practices, time of planting is an important non-monetary input for realizing higher productivity in any crop. Optimum sowing time and selection of improved cultivars play a remarkable role in exploiting the yield potential of the crop under particular agro-climatic conditions. Hence, it was thought worthwhile to study the effect of sowing dates on finger millet varieties in relation to climate change.

Materials and Methods

The investigation was conducted during *kharif* seasons for three years 2016 to 2018 at the Zonal Agricultural Research Station, Shenda Park, Kolhapur (Maharashtra) at latitude of $16^0$43' N, longitude 74^0 14' E and altitude 574 m above mean sea level. It comes under Sub-montane Zone of Maharashtra. The experimental site was silty loam with pH-7.20, E.C- 0.15dSm^{-1}, organic carbon 0.48 per cent. The available nutrient status was low in N (198.kg ha^{-1}), medium P (10.3 kg ha^{-1}) and low in K (145 kg ha^{-1}). The total annual rainfall received during 2016, 2017 and 2018 was 1067.6 mm in 59 rainy days, 972.2 mm in 70 rainy days and 1252.0 mm in 66 rainy days respectively. The dry spell during grand growth phase (33 to 35 MW) affects on yield of crop in all the years. The present experiment was laid out in split design four sowing dates (24th MW, 26th MW, 28th MW and 30th MW) and varieties (Phule Nachani, GPU 28, GPU 67 and Dapoli 1 replicated three times. The gross plot size was 4.00 x 3.0 m^2 and net plot of size 2.40 m X 4.20 m was harvested for data collection. Seed rate of 3 kg ha^{-1} was used for sowing at spacing 30 cm x 7.5 cm in all treatments. The crop was fertilized with a dose of 60 kg N and 30 kg P_2O_5 and 30 kg K_2O ha^{-1}. Nitrogen supplied as urea, phosphorus as SSP potash as MOP. 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 Panse and Sukhatme (1985).

Results and Discussion

Growth parameters

Pooled ancillary observations on finger millet (Table 1) revealed that the finger millet sown during 2nd week of July (D_3) recorded significantly highest plant height (88.7 cm) over 4th week of July. However, number of tillers (2.6), length of finger (7.3 cm) and no of fingers (6.5) were significantly highest sown during 4th week of June (D_2). The significantly highest plant height (94.3 cm), number of tillers (2.7), and length of finger (8.2 cm) and number of fingers (6.8) were recorded with the variety V_1– Phule Nachani.

The interaction effects between sowing dates and varieties were found to be non-significant. Similar findings were observed by Ashok E.G *et al.,* (2004), Nagaraju and Mohan kumar (2006). Pandiselvi *et al.,* 2010, and Revathi *et al.,* (2018)

Grain and straw yield

Grain yield was significantly influenced by dates of sowing and varieties

Effect of sowing date

The data presented in Table 2, indicated that, the significantly highest grain and straw yield of finger millet (18.20 and 23.64 q ha^{-1} respectively) was recorded with second

sowing date i.e. on 4th week of June over rest of the sowing dates. Among the varieties the significantly highest grain and straw yield of finger millet (18.30 & 23.74 q ha^{-1}) respectively was recorded with the variety Phule Nachani, which was significantly superior over all the varieties.

Interaction between dates of sowing and varieties revealed that the finger millet variety Phule Nachani sown during 4th week of June recorded significantly highest grain and straw yield (22.51 and 29.88 q ha^{-1} respectively).

The higher grain yield recorded with 4th week of June could be attributed to the cumulative effect of more tiller production and crop had an opportunity of longer growth period with sufficient light, temperature, relative humidity bright sunshine hours coupled with optimum day length which might have increased photosynthesis, in turn, dry matter production and yield. Under late sown conditions, lack of soil moisture due to cessation of rains also affects grain yield potential. Similar findings were observed by Parasuraman P (2001), Ashok E.G *et al.*, (2004), Nagaraju and Mohan kumar (2006) and Pandiselvi *et al.*, 2010 (Table 3).

Economics

The data pertaining to economics (Table 4) the highest gross returns, net returns and B:C ratio revealed that, the significantly highest gross and net monetary returns as well as B: C ratio (Rs. 45481, Rs. 15126, 1.50 respectively) was recorded with second sowing date i.e. on 4th week of June over rest of the sowing dates. Among the varieties the significantly highest gross and net monetary returns as well as B: C ratio (Rs. 45853, Rs. 15749, 1.51 respectively) was recorded with the variety Phule Nachani, which was significantly superior over all the varieties.

Table.1 Pooled mean growth and yield attributing characters of finger millet as influenced by different treatments

Treatments	Plant height (cm)	No. of tillers Plant $^{-1}$	Length of finger (cm)	No. of fingers ear $^{-1}$
A. Sowing dates (4)				
D_1– 2nd Week of June	85.0	2.4	6.9	**5.8**
D_2 – 4th week of June	87.5	2.6	7.3	**6.5**
D_3 – 2nd Week of July	88.7	2.5	7.1	**6.4**
D_4 – 4th Week of July	77.8	2.1	6.4	**6.1**
S.E. ±	2.08	0.04	0.11	**0.13**
C.D. 0.05	7.21	0.14	0.39	**0.45**
B. Varieties (4)				
V_1 – Phule Nachani	94.3	2.7	8.2	**6.8**
V_2 – GPU 28	87.0	2.6	7.1	**6.3**
V_3 – GPU 67	82.5	2.4	6.7	**6.4**
V_4 – Dapoli 1	75.3	2.1	5.7	**5.3**
S.E. ±	0.90	0.05	0.21	**0.11**
C.D. 0.05	2.61	0.15	0.60	**0.32**
Interaction				
S.E. ±	1.79	0.10	0.41	**0.22**
C.D. 0.05	**NS**	**NS**	**NS**	**NS**

Table.2 Pooled mean grain and straw yield (q ha^{-1}) of finger millet as influenced by different treatments

Treatments	Grain Yield (q ha^{-1})			Mean	Grain Yield (q ha^{-1})			Mean
A. Sowing dates (4)	2016	2017	2018		2016	2017	2018	
D_1– 2nd Week of June	13.19	16.32	12.52	14.21	17.23	19.09	15.91	**17.41**
D_2 – 4th week of June	18.91	20.14	15.57	18.20	24.58	26.43	19.88	**23.64**
D_3 – 2nd Week of July	17.79	18.40	14.26	16.82	23.12	26.08	18.29	**22.50**
D_4 – 4th Week of July	11.77	12.64	9.71	11.37	13.94	15.94	12.32	**14.07**
S.E. ±	0.34	0.82	0.57	0.36	0.57	0.88	0.74	**0.71**
C.D. 0.05	1.19	2.84	1.98	1.25	1.97	3.51	2.56	**2.45**
B. Varieties (4)								
V_1 – Phule Nachani	17.71	20.40	16.76	18.30	22.66	26.37	22.14	**23.74**
V_2 – GPU 28	17.11	18.34	13.75	16.40	21.11	24.35	17.57	**21.00**
V_3 – GPU 67	15.08	15.70	11.77	14.18	19.31	20.42	14.65	**18.12**
V_4 – Dapoli 1	12.34	13.02	9.77	11.71	15.80	16.41	12.05	**14.75**
S.E. ±	0.54	0.71	0.49	0.23	0.86	1.04	0.60	**0.43**
C.D. 0.05	1.57	2.07	1.42	0.68	2.52	3.04	1.76	**1.26**
Interaction								
S.E. ±	1.07	1.42	1.02	0.47	1.73	2.08	1.28	**0.86**
C.D. 0.05	**NS**	**NS**	**NS**	**1.36**	**NS**	**NS**	**NS**	**2.51**

Table.3 Pooled mean grain and straw yield (q ha^{-1}) of finger millet as influenced by different treatments – Sowing dates X Varieties

Treatments	Grain yield (q ha^{-1})				Mean
	V_1- Phule Nachani	V_2- GPU 28	V_3- GPU 67	V_4- Dapoli 1	
D_1– 2nd week of June	17.32	14.82	13.83	10.85	14.21
D_2– 4th week of June	**22.51**	19.98	17.06	13.26	**18.20**
D_3 – 2nd week of July	19.84	17.66	16.30	13.47	**16.82**
D_4 – 4th week of July	13.55	13.13	9.53	9.27	11.37
Mean	**18.30**	16.40	14.18	11.71	15.15
	Sowing date	Varieties	Interrelation Dates X Varieties		
S.E. ±	0.36	0.23	0.47		
C.D. 0.05	1.25	0.68	1.36		

Treatments	Straw yield (q ha^{-1})				Mean
	V_1- Phule Nachani	V_2- GPU 28	V_3- GPU 67	V_4- Dapoli 1	
D_1– 2nd week of June	21.89	19.21	16.20	12.32	17.41
D_2– 4th week of June	**29.88**	25.69	21.93	17.04	**23.64**
D_3 – 2nd week of July	25.77	23.69	22.43	18.09	**22.50**
D_4 – 4th week of July	17.40	15.41	11.93	11.55	14.07
Mean	**23.74**	21.00	18.12	14.75	19.40
	Sowing date	Varieties	Interrelation Dates X Varieties		
S.E. ±	0.71	0.43	0.86		
C.D. 0.05	2.45	1.26	2.51		

Table.4 Pooled economics of finger millet as influenced by different treatments (Economics Interaction) - Sowing dates X Varieties

Treatments	Gross Monetary Returns (Rs. ha^{-1})				Mean
	V_1- Phule Nachani	V_2- GPU 28	V_3- GPU 67	V_4- Dapoli 1	
D_1– 2nd week of June	42498	37130	34468	27073	35292
D_2– 4th week of June	**56689**	49922	42375	32937	**45481**
D_3 – 2nd week of July	49979	43975	40661	33546	42040
D_4 – 4th week of July	34250	32563	23642	22970	28356
Mean	**45853**	40897	35286	29131	37792
	Sowing date	Varieties	Dates X varieties		
S.E. ±	594	807	1613		
C.D. 0.05	2055	2354	4709		

Treatments	Net Monetary Returns (Rs. ha^{-1})				Mean
	V_1- Phule Nachani	V_2- GPU 28	V_3- GPU 67	V_4- Dapoli 1	
D_1– 2nd week of June	13413	6775	4113	-3282	5188
D_2– 4th week of June	**26334**	19567	12020	2583	**15126**
D_3 – 2nd week of July	19625	13620	10306	3191	11686
D_4 – 4th week of July	3895	2208	-6712	-7385	-1998
Mean	**15749**	10542	4931	-1223	7500
	Sowing date	Varieties	Dates X Varieties		
S.E. ±	632	788	1577		
C.D. 0.05	2189	2301	4602		

Treatments	B : C Ratio)				Mean
	V_1- Phule Nachani	V_2- GPU 28	V_3- GPU 67	V_4- Dapoli 1	
D_1– 2nd week of June	1.43	1.22	1.13	0.89	1.17
D_2– 4th week of June	**1.86**	1.64	1.40	1.09	**1.50**
D_3 – 2nd week of July	1.64	1.45	1.34	1.11	**1.39**
D_4 – 4th week of July	1.12	1.07	0.78	0.76	0.93
Mean	**1.51**	1.35	1.16	0.96	
	Sowing date	Varieties	Dates X Varieties		
S.E. ±	0.02	0.02	0.05		
C.D. 0.05	0.07	0.07	0.13		

The interaction effects between sowing dates and varieties were found to significant. The finger millet variety Phule Nachani sown during 4th week of June recorded significantly highest gross and net monetary returns as well as B: C ratio (Rs. 56689, Rs. 26334, 1.86 respectively). The lowest gross returns, net returns and B:C ratio were noticed with Dapoli 1 variety sown during 30th MW i.e. in 4th week of July which might be because of lesser grain yield and straw yield. These results are in agreement with the findings of Revathi *et al.,* (2018). From present research it is recommended that sowing of finger millet variety Phule Nachani during 22nd to 28th June (26th MW) for higher grain, straw yield and monetary returns under delayed onset of monsoon in Sub montane Zone of Maharashtra.

Acknowledgments

We thanks to authorities of All India Coordinated Small Improvement Project, Zonal Agricultural Research Station, Shenda Park, Kolhapur for conduct of research, support and encouragement during experimentation.

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How to cite this article:

Nigade, R. D., S. V. Bagade and Bhilare, R. L. 2020. Ensuing Economic Gains due to Different Dates of Sowing on Finger millet Varieties (*Eleusine coracana* L.). *Int.J.Curr.Microbiol.App.Sci.* 9(05): 2487-2492. doi: https://doi.org/10.20546/ijcmas.2020.905.284