J. Farm Sci., 37(3): (221-226) 2024
RESEARCH PAPER

Influence of different dates of sowing on growth, yield attributes and yield of different sorghum (*Sorghum bicolor* L.) genotypes

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(Received: November, 2023 ; Accepted: September,2024)

DOI: 10.61475/JFS.2024.v37i3.03

Abstract: A field experiment was conducted at Regional Agricultural Research Station, Vijayapura, during *rabi* season of 2022-23, to study the response of *rabi* sorghum genotypes to different dates of sowing. The experiment was laid out in Randomized Complete Block Design (factorial concept) with three replications. There were sixteen treatment combinations, which consist of four sowing windows *viz*., II FN (fortnight) of September, I FN of October, II FN of October and I FN of November and four genotypes *viz*., M 35-1, CSV-29R, BJV-44, and SPV-2217. Significantly higher grain yield of 2620 kg ha^{-1} and fodder yield of 3958 kg ha^{-1} was recorded when sorghum was sown during I FN of October. Further, it was found on par with sorghum sown during II FN of October which recorded grain yield of 2486 kg ha^{-1} and fodder yield of 3811 kg ha^{-1}. Similarly, significantly higher yield attributes *viz*., panicle length, panicle weight, grain weight per panicle and test weight were recorded with sorghum sown during I FN of October. Among different *rabi* sorghum genotypes, CSV-29R recorded significantly higher grain yield (2509 kg ha^{-1}) and fodder yield (3796 kg ha^{-1}) followed by M 35-1as compared to other genotypes. The interaction effect due to different dates of sowing and genotypes had significant influence on sorghum yield. The genotype CSV-29R when sown during I FN of October recorded significantly higher grain yield of 2989 kg ha^{-1} and fodder yield of 4395kg ha^{-1}. Further combination of these treatments recorded significantly higher gross returns (₹ 1,25,541 ha^{-1}), net returns (₹ 83,266 ha^{-1}) and B: C (2.97) as compared to other treatments combinations.

Key words: Grain yield, Sorghum genotypes, Sowing dates, Yield attributes

Introduction

Sorghum commonly known as Jowar and become a king of millets. Sorghum is the most widely distributed crop in Sudan, Nigeria, India, Niger and United States which accounts for 57% of world's sorghum area and 45% of world sorghum production. Sudan has a maximum area (7.14 m. ha) and United States contributes largest production (10.9 m.t). The average sorghum yield in India is 1064 kg ha^{-1}, which is substantially lower (1460 kg ha^{-1}) than the global average (Bhat *et al*., 2023). Sorghum is India's third-most significant cereal crop, next to rice and wheat. This crop is mainly grown in states like Gujarat, Madhya Pradesh, Tamil Nadu, Karnataka and Maharashtra. India has a largest share in (32.30%) world's sorghum area and ranks fifth in production. *Rabi* sorghum area, production and productivity in India is 2.74 million ha, 2.82 million tons and 1033 kg ha^{-1}, respectively. In Karnataka, *rabi* sorghum area, production and productivity is 0.66 million ha, 0.73 million tons and 1098 kg ha^{-1}, respectively (Anon., 2021).

Sorghum is a short day C4 plant, long day condition delays flowering and maturity. It is a warm weather plant and it is grown even at 1500 m above mean sea level. Optimum temperature requirement for sorghum is 15°C to 32°C. The growth, development and yield of sorghum are influenced by environmental conditions such as temperature and precipitation. The date of sowing greatly influences sorghum primarily through its influence on temperature and the availability of soil moisture during seed germination. The consequences of stress caused by environmental factors on the final yield may be determined by the growth stage at which the stress occurs and the specific sorghum genotype (Jones and Johnson, 1991). The decision to sow the crop early or late depends on the capacity to manage the risk associated with early planting, which may result in poor crop establishment, the risk of water/heat stress during the reproductive stages associated with late planting. Radiation interception and photosynthesis play a pivotal role in determining crop yield due to their significant contributions to dry matter production.

By using suitable elite genotypes, we can mitigate adverse climate conditions. The development of elite genotype is a continuous process and currently many genotypes of different maturity groups are evolved. Therefore, it is important to assess the magnitude of their response to different sowing dates in changing climate scenario and simultaneously finding out the production potential of these elite genotypes. Hence, the present investigation was planned and carried out to find suitable sowing dates and genotypes to get higher productivity.

Material and methods

A field experiment was conducted to study the response of sorghum to different sowing dates and genotypes under rainfed condition during *rabi* of 2022-23 at Regional Agricultural Research Station, Vijayapura, Karnataka on *vertisol* having pH 8.32 and EC 0.46 dSm^{-1}. Low in available nitrogen (165.5 kg N ha^{-1}), medium in available phosphorus (20.54 kg P_2O_5 ha^{-1}) and high in available potassium (329.5 kg K_2O ha^{-1}. The experimental site was located at 16° 77' North latitude, 75° 74' East longitude and at an altitude of 516.29 m above mean sea level in the

Northern dry zone of Karnataka (Zone 3). During the year 2022, a total rainfall of 793.2 mm was received in 56 rainy days from January 2022 to December 2022 as against the normal rainfall of 594.4 mm received in 38 rainy days. The rainfall received during the experimental period (September 2022 and March 2023) was 256.10 mm.

The experiment was laid out in Randomized Complete Block Design (factorial concept) with three replications. There were 16 treatment combinations consisting of four sowing windows *viz*., II FN (fortnight) of September, I FN of October, II FN of October and I FN of November and four genotypes *viz*., M 35-1, CSV 29R, BJV-44 and SPV-2217.The crop was raised with a spacing of 45 x 15 cm and applied fertilizers at recommended dose (50:25:0 NPK kg ha^{-1}) uniformly for all the treatments in the experiment. The N and P were applied in the form of urea and diammonium phosphate respectively. Entire quantities of fertilizers were applied to the crops at the time of sowing as basal dose and other agronomic practices are followed as per the package of practices.

The sorghum panicles from the net plot were harvested at physiological maturity and air dried. Yield attributes and yield observations of sorghum were recorded from the net plots. The grain yield was expressed in kg ha^{-1}. Fodder yield was recorded after complete sun drying of stalks from each net plot and expressed in kg ha^{-1}. The economics of each treatment was computed with prevailing market prices of the year. The yield was further computed for gross and net returns as well B:C to assess the productivity. The B:C was worked out by dividing the gross returns by the total cost of cultivation of respective treatments. The data collected from the experiment at different growth stages and at harvest were subjected to statistical analysis as described by Gomez and Gomez (1984).

Results and discussion

Effect of different dates of sowing, genotypes and their interaction on growth parameters of *rabi* sorghum. Different dates of sowing significantly influenced different crop growth characters in *rabi* sorghum. Among growth attributes *viz*., plant height, leaf area leaf area index and total dry matter production recorded at harvest significantly influenced under varying sowing dates.

In the present study, higher plant height at harvest was recorded under the I fortnight of October (232.58 cm) (Table 1) sowing, which was on par with II fortnight of October sown crop (227.91 cm) at harvest. This is because of effective utilization of available resources by October sown sorghum and better utilization soil moisture. Similar findings were reported by Hulihalli *et al.* (2016) in sorghum, they revealed that higher plant height was recorded during I fortnight of October. Similar findings are in line with Mukri *et al.* (2014) and Desai and Aravidya (2014) on sorghum.

The crop sown either during I fortnight of October or II fortnight of October was equally good in improving the values of various growth parameters studied, over other sowing dates. Subsequent delay in sowing (*i.e.*, I fortnight of November) reduced plant height, leaf area, leaf area index and total dry matter production plant^{-1}. Thus, *rabi* sorghum sown during I fortnight of October or II fortnight of October was significantly superior over delayed sowing. This might be due to timely sown crop may enjoy favorable climatic conditions in terms of temperature, relative humidity and other weather parameter during different growth stages, which reflected into better plant growth. This is also attributed to early germination and initial vigorous growth of plant in October sowing compared to other sowing. Similar findings were reported in sorghum by Biradar and Gollagi (2006) at Bijapur.

The leaf area and leaf area index exhibited a progressive increase up to 60 days after sowing (DAS). However, beyond this point, there was an observable reduction in leaf area and leaf area index up to the harvest stage. This declining trend could be attributed to the natural drying and shedding of leaves as the crop approaches maturity. Sowing *rabi* sorghum either

Table1. Plant height (cm), leaf area (dm^2/plant), leaf area index and total dry matter production (g/plant) of sorghum as influenced by different dates of sowing and genotypes

Treatment	Plant height (cm)	leaf area (dm^2/ plant)	leaf area index	total drymatter production (g/plant)
Sowing dates(D)				
D_1:II FN of September	211.47	18.84	2.79	145.95
D_2:I FN of October	232.58	24.10	3.57	163.77
D_3:II FN of October	227.91	23.31	3.45	159.77
D_4:I FN of November	193.83	15.88	2.35	127.71
S.Em ±	2.04	0.35	0.05	1.75
C D @ 5%	5.89	1.01	0.15	5.06
Genotypes(V)				
V_1: M 35-1	211.43	22.12	3.28	157.50
V_2: CSV-29R	226.14	23.03	3.41	160.87
V_3: BJV-44	221.92	19.60	2.90	144.87
V_4:SPV-2217	206.31	17.37	2.57	133.96
S.Em ±	2.04	0.35	0.05	1.75
C.D @ 5%	5.89	1.01	0.15	5.06
Interaction(D×V)				
D_1V_1	210.29	19.95	2.96	151.31
D_1V_2	214.59	21.84	3.23	153.98
D_1V_3	210.86	16.77	2.48	141.83
D_1V_4	210.13	16.79	2.49	136.67
D_2V_1	220.65	25.43	3.77	172.39
D_2V_2	245.72	26.58	3.94	179.94
D_2V_3	240.25	24.46	3.62	159.45
D_2V_4	223.70	19.93	2.95	143.32
D_3V_1	217.10	25.28	3.75	170.52
D_3V_2	242.00	25.66	3.80	176.71
D_3V_3	235.77	23.34	3.46	149.88
D_3V_4	216.76	18.94	2.81	141.97
D_4V_1	197.67	17.82	2.64	135.80
D_4V_2	202.25	18.02	2.67	132.85
D_4V_3	200.78	13.85	2.05	128.31
D_4V_4	174.63	13.82	2.05	113.88
S.Em ±	4.08	0.70	0.10	3.50
C.D @ 5%	11.78	2.02	0.30	10.11

NS –Non-significant
FN – Fortnight

in the first or second fortnight of October resulted in notably improved and favorable outcomes when compared to the crop sown later, specifically during the I fortnight of November. In the present study, leaf area and leaf area index were recoded when sorghum sown during I fortnight of October (Table 1). Similar results were reported by Nagaraj (2018) in sorghum and concluded that higher number of green leaves was recorded when sorghum was sown during I fortnight of October. Hulihalli *et al.* (2016) observed that higher leaf area and leaf area index at 50% flowering is due to higher radiation use efficiency and higher synthesis of metabolites at early sowing (I week of October).

In the present investigation, total dry matter production was significantly higher in sorghum sown during I fortnight of October (D_2) (163.77g plant^{-1}) (Table 1) at harvest and it was on par with II fortnight of October and lower dry matter accumulation was observed when crop sown during I fortnight of November at harvest. The higher dry matter production in D_2 which could be attributed to cumulative effect of higher plant height, number of leaves and optimum weather conditions, which might have increased photosynthesis and in turn dry matter production. Reduction in dry matter accumulation in late sowing was due to shorter growing period and lower plant height, number of leaves and leaf area and infestation of pest and disease is more in November sown crop (Mukherjee, 2012).

Table 2. Panicle length (cm), panicle weight(g), grain weight per panicle (g) and test weight(g) of sorghum as influenced by different dates of sowing and genotypes

Treatment	Panicle length (cm)	Panicle weight (g)	Grain weight (g panicle^{-1})	Test weight (g)
Sowing dates (D)				
D_1:II FN of September	18.88	57.63	45.73	34.6
D_2:I FN of October	19.78	66.20	53.78	38.2
D_3:II FN of October	19.37	64.63	51.32	36.00
D_4:I FN of November	18.43	44.93	34.12	32.00
S.Em ±	0.34	1.22	1.00	0.51
C.D @ 5%	0.97	3.52	2.89	1.47
Genotypes (V)				
V_1: M 35-1	17.71	61.55	48.50	34.70
V_2: CSV-29R	20.82	63.49	51.03	37.80
V_3: BJV-44	20.51	57.24	44.42	34.50
V_4: SPV-2217	17.42	51.10	40.99	33.90
S.Em ±	0.34	1.22	1.00	0.51
C.D @ 5%	0.97	3.52	2.89	1.47
Interaction (D×V)				
D_1V_1	17.55	60.04	47.82	35.40
D_1V_2	20.56	60.28	48.84	36.90
D_1V_3	20.16	55.67	43.34	33.50
D_1V_4	17.26	54.53	42.91	33.20
D_2V_1	18.14	67.40	54.09	38.00
D_2V_2	21.66	74.03	58.44	40.60
D_2V_3	21.43	65.30	52.30	37.60
D_2V_4	17.90	58.06	50.29	36.70
D_3V_1	17.87	67.01	52.72	34.60
D_3V_2	21.22	73.91	54.18	39.00
D_3V_3	20.82	60.21	50.77	35.70
D_3V_4	17.55	57.39	47.63	34.90
D_4V_1	17.29	51.75	39.38	31.30
D_4V_2	19.85	45.74	42.67	34.80
D_4V_3	19.63	47.79	31.28	31.00
D_4V_4	16.96	34.44	23.13	30.8
S.Em ±	0.68	2.44	2.00	1.02
C.D @ 5%	NS	7.04	5.77	NS

NS –Non-significant
FN – Fortnight

Among the genotypes, CSV 29R performed better when compared to other genotypes and recorded higher plant height (226.14 cm) at harvest, which is on par with genotype BJV-44 (221.92 cm) and lower in genotype SPV-2217 (206.31) (Table 1) at harvest and this may be due to difference in genetic character, genetic potential and performance of these genotypes to photoperiod. The decrease in plant height in genotype SPV-2217, which is long duration compared to other genotypes, can likely be attributed to both the rapid increase in temperature and the depletion of soil moisture. The results of our investigation were in conformation with findings of Bhavya (2015) on sorghum, who reported that genotype CSV 29R recorded higher plant height which is on par with BJV-44.

Higher leaf area and leaf area index was observed in genotype CSV 29R (23.03 dm^2 and 3.41, respectively) at harvest. This is because of effective utilization of solar radiation and higher metabolic activity increased leaf area and leaf area index; it is confirmed from the result obtained by Hulihalli *et al.* (2016).

In the present investigation, genotype CSV 29R showed better performance in terms of plant height, leaf area and leaf area index, as a result of this it produced higher total dry matter per plant .The total dry matter per plant at harvest was higher in genotype genotype CSV 29R (Table 1) at harvest is highest when compared to other genotypes. This is because in the genotype CSV 29R there was a notable increase in the movement of stored photosynthetic products towards the development of all plant parts.

In the present investigation, the interaction between genotype and dates of sowing had shown significant influence on growth parameters. Genotype CSV 29R sown during I fortnight of October recorded significantly higher plant height (245.72 cm) at harvest, while significantly lower plant height at harvest was recorded by genotype SPV-2217 sown during I fortnight of November (174.63 cm). The reduction in plant height were primarily linked to the rise in average mean maximum temperature (T_{max}), a decrease in average mean minimum temperature (T_{min}) and the exposure of plant to moisture stress during late sowing scenarios. At different temperature regimes, genotypic variations in morpho-phenological characters were evident, indicating variability in crop adaptation to adverse environmental conditions. The increase in plant height could be attributed to the efficient utilization of available resources during early sowing and improved utilization of both precipitation and residual soil moisture. The present findings corroborate with findings of Hulihalli *et al.*(2016) in sorghum.

The data pertaining to leaf area and leaf area index was significantly influenced by sowing dates and genotypes. When genotype CSV 29R sown during I fortnight of October recorded significantly higher total dry matter production per plant at harvest (Table 1) This is due to increase in crop photosynthetic activity due to the presence of optimal moisture and temperature when sorghum is sown during I fortnight of October sowing than November sowing. These results are in concurrence with the findings of Hulihalli *et al.* (2016) in sorghum. According to Reddi *et al* (2013), he reported that higher number of leaves, leaf area and leaf area index was recorded in sweet sorghum genotype NSSH-1 sown during I fortnight of October.

Among interactions, higher SPAD values were recorded when CSR 29R sown during I fortnight of October (59.34) at 60 DAS. Its might be due to higher number of green leaves and effective assimilation and utilization of sunlight. These findings were in confirmation with Devkumar *et al.* (2014).

The overall accumulation of dry matter and its distribution across distinct plant components, namely leaves, stem and reproductive parts, experienced a significant decline as sowing was delayed successively. This decrease was attributed to the pronounced temperature, which led to increased respiration losses and diminished growth rate. Consequently, the crop total growth period was abruptly shortened compared to that observed during the first fortnight of October. As a result of this, higher total dry matter production was recorded in CSV 29R sown during I fortnight of October and lowest was recorded in SPV-2217 sown during I fortnight of November sowing (Table 1). These results of our investigation were in conformation with findings of Hulihalli *et al.* (2016) and Reddi *et al.* (2013) in sorghum. This is due to the combined impact of increased plant height and favourable weather conditions. These conditions encompassed optimum periods of bright sunshine and day length, potentially leading to increased photosynthesis. Consequently, this favorable environment likely contributed to an augmented production of dry matter.

Effect of different dates of sowing, genotypes and their interaction on yield and yield attributes of *rabi* sorghum The yield and yield attributes of sorghum were greatly influenced due to different dates of sowing dates and genotypes. The results revealed that, among the different sowing dates, the crop sown during I FN of October resulted significantly higher grain yield (2620 kg ha^{-1}) compared to all other dates of sowing and it was found on par with II FN of October sowing (2420 kg ha^{-1}). Sorghum crop sown during I FN of October increased the grain yield with a tone of 20.7 and 27.3% over sowings taken up in II FN of September and I FN of November, respectively. The increase in grain yield might be attributed due to favorable climatic conditions obtained by the crop during October, including optimal temperatures, relative humidity and other climatic factors during various stages of crop growth. Similar results were recorded by Londhe *et al.* (2022) in sorghum. Genotype CSV-29R registered a notably higher grain yield (2509 kg ha^{-1}) compared to other genotypes and which was on par with M 35-1 (2375 kg ha^{-1}). The higher grain yield of sorghum could be associated with improved buildup of dry matter and its beneficial characteristics, such as higher panicle length,

Table 3. Grain yield (kg ha^{-1}), fodder yield (kg ha^{-1}) and harvest index (%) of sorghum as influenced by different dates of sowing and genotypes

Treatment	Grain yield (kg ha^{-1})	Fodder yield (kg ha^{-1})	Harvest index (%)
Sowing dates (D)			
D_1:II FN of September	1973	3135	38.58
D_2:I FN of October	2621	3958	39.8
D_3:II FN of October	2487	3812	39.4
D_4:I FN of November	1808	2965	37.88
S.Em ±	46.68	64.86	0.61
C.D @ 5%	134.8	187.3	1.77
Genotypes(V)			
V_1: M 35-1	2376	3690	39.06
V_2: CSV-29R	2510	3796	39.69
V_3: BJV-44	2061	3259	38.69
V_4: SPV-2217	1942	3124	38.21
S.Em ±	46.68	64.86	0.61
C.D @ 5%	134.8	187.3	1.77
Interaction (D×V)			
D_1V_1	2008	3184	38.58
D_1V_2	2171	3357	39.23
D_1V_3	1911	3054	38.47
D_1V_4	1804	2945	38.03
D_2V_1	2844	4292	39.91
D_2V_2	2989	4395	40.52
D_2V_3	2345	3601	39.41
D_2V_4	2305	3544	39.35
D_3V_1	2778	4283	39.33
D3V_2	2886	4297	40.21
D_3V_3	2195	3406	39.15
D_3V4	2089	3260	38.89
D_4V_1	1873	2999	38.4
D_4V_2	1994	3136	38.79
D_4V_3	1795	2976	37.74
D_4V_4	1571	2748	36.57
S.Em ±	93.37	129.72	1.23
CD @ 5%	269.7	374.7	NS

NS - Non-significant
FN - Fortnight

panicle weight and also enhanced the test weight which contributed to yield. The interaction effect due to different dates of sowing and genotypes varied significantly. The genotype CSV-29R sown during I FN of October recorded significantly higher grain yield (2989 kg ha^{-1}), followed by genotype M 35-1 sown during I FN of October. The notable increase in grain yield could be attributed to favorable climatic conditions prevailed during crop growth period likely enhanced the photosynthetic rate and provided a greater supply of assimilates for the development of seeds. Thus, the crop sown during October resulted better seed growth rate compared to late or early sown crops. These results are in conformity with findings of Nagaraj (2018).

The panicle length of sorghum differed significantly to different dates of sowing. The crop sown during I FN of October recorded significantly higher panicle length (19.78 cm) followed by the crop sown during II fortnight of October sowing (19.37 cm). The increase in panicle length might be due to favorable climatic conditions during reproductive phase in

Table 4. Cost of cultivation, gross returns, net returns and B:C of sorghum as influenced by different dates of sowing and genotypes

Treatment	Cost of cultivation (₹ ha^{-1})	Gross return (₹ ha^{-1})	Net return (₹ ha^{-1})	B:C
Sowing dates(D)				
D_1:II FN of September	42275	82879	40604	1.96
D_2:I FN of October	42275	110073	67798	2.60
D_3:II FN of October	42275	104453	62178	2.47
D_4:I FN of November	42275	75942	33667	1.80
S.Em±	-	1961	1961	0.05
C.D@5%	-	5663	5663	0.13
Genotypes(V)				
V_1: M 35-1	42275	99788	57513	2.36
V_2: CSV-29R	42275	105418	63143	2.49
V_3: BJV-44	42275	86569	44294	2.05
V_4: SPV-2217	42275	81572	39297	1.93
S.Em±	-	1961	1961	0.05
C.D @ 5%	-	5663	5663	0.13
Interaction(D×V)				
D_1V_1	42275	84338	42063	1.99
D_1V_2	42275	91167	48892	2.16
D_1V_3	42275	80249	37974	1.90
D_1V_4	42275	75764	33489	1.79
D_2V_1	42275	119462	77187	2.83
D_2V_2	42275	125541	83266	2.97
D_2V_3	42275	98470	56195	2.33
D_2V_4	42275	96819	54544	2.29
D_3V_1	42275	116676	74401	2.76
D_3V_2	42275	121220	78945	2.87
D_3V_3	42275	92173	49898	2.18
D_3V_4	42275	87744	45469	2.08
D_4V_1	42275	78676	36401	1.86
D_4V_2	42275	83744	41469	1.98
D_4V_3	42275	75385	33110	1.78
D_4V_4	42275	65962	23687	1.56
S.Em±	-	3921	3921	0.09
C.D @ 5%	-	11326	11326	0.27

NS –Non-significant
FN – Fortnight

October resulted better translocation of photosynthates. These results obtained from our investigation are in conformation with the findings of Madhurya (2018) in sorghum. Different genotypes had significant variation for panicle length. Among the genotypes,CSV-29R recorded highest panicle length (20.82cm), followed by genotype BJV-44 (20.15cm). It might be due to characteristic features of the genotype. Similar results were obtained by Bhavya (2015).

The data on panicle weight $plant^{-1}$ indicated that decreasing trend was observed with delay in sowing. Significantly higher panicle weight was documented with I FN of October sowing (66.2 g) followed by sowing in II FN of October sowing (64.63 g). Lower panicle weight was recorded with sowing was done in I FN of November. Reduction in panicle weight might be because of higher temperature coincides with reproductive phases, which resulted in lower pollen fertility and viability. As per Jan *et al*. (2015), a reduction in panicle weight was noted in pearl millet with delayed planting dates. Among genotype CSV29R recorded the highest panicle weight of 63.49 g and lowest was recorded with SPV-2217(51.10g). This could potentially be attributed to the fact that CSV-29R exhibited greater grain weight $plant^{-1}$and test weight as compared to other genotypes under constant soil moisture condition and possesses a greater capacity to transport photosynthates to economically valuable parts. As a consequence, this led to an increase in the panicle weight. The interaction effect due to different dates of sowing and genotypes varied significantly. The genotype CSV-29R sown during I FN of October recorded significantly higher panicle weight (74.03 g). It might be due to optimum weather conditions prevailed during flowering resulted better pollination and seed setting.

Significantly higher grain weight per panicle was recorded with sowing in I FN of October (53.78 g) followed by II FN of October sowing (51.32 g). The higher grain weight per panicle could be resulted due to crop sown during October which has optimum photo period resulted more accumulation of assimilates in panicle. Similar findings were also reported in pearl millet by Craufurd and Bidinger (1988). The different genotypes studied in the experiment indicated that genotype CSV-29R exhibited highest grain weight per panicle (51.03 g) followed by genotype M35-1. Interaction effect due to different dates of sowing and genotypes registered that the genotype CSV-29R when sown during I FN of October (58.44 g) recorded significantly higher grain weight as compare to other treatments combinations. The increase in grain weight per panicle might be attributed due to the potential of the genotype to produce higher biomass and transport photosynthetes to economic part.

With respect to test weight, significantly higher test weight was recorded with I FN of October sown crop (38.2g) compared to other dates of sowing. The results clearly indicated that delay sowing of crop usually coincide with lower soil moisture content in particularly during reproductive phase produced shriveled grains and also caused due to prevailing hot winds during grain-filling stage. These results are in line with findings of Tripathi *et al*. (2013) in sorghum. The genotype CSV-29R exhibited the highest test weight (37.8g) followed by M 35-1.

Significantly higher harvest index was recorded when sorghum was sown during I FN of October (39.8%). This might be due to favorable weather conditions prevailed throughout the growing period resulted higher plant height, leaf area, leaf area index and dry matter production. These results are closely associated with findings of Nagaraj (2018). Among different genotypes, CSV-29R (39.69%) produced higher plant height, leaf area, leaf area index and total dry matter when compared to other genotypes under residual soil moisture condition. The interaction effect due to different dates of sowing and genotypes did not differ for harvest index. However, numerically higher harvest index of 40.52 was noticed with CSV-29R when sown in I FN of October.

Effect of different dates of sowing, genotypes and their interaction on economics of sorghum

A significant variation in economics was observed due to the different sowing dates of sorghum genotype. The sorghum sown during I FN of October performed better than other sowing dates, which was recorded significantly higher gross returns (₹ 1,10,073 ha^{-1}), net returns (₹ 67,798 ha^{-1}) and B:C (2.6) and lowest was recorded in I FN of November sowing. This outcome can be attributed to the fact that sowing in October resulted in increased grain and fodder yield, subsequently leading to greater returns. Similarly, Nivedita (2021) in chickpea reported that sowing of chickpea during I FN of October produced higher gross returns, net returns and B:C. Among different genotypes, CSV-29R recorded significantly higher gross returns (₹ 1,05,418 ha^{-1}), net ₹ returns (₹ 63,143 ha^{-1}) and B:C (2.49) compared to other genotypes. This clearly indicated that CSV-29R might be more effective in utilizing available nutrients, moisture and weather for its growth and development and produced higher grain yield than other genotypes. Bhutada *et al*. (2019) reported similar results.

The interaction effect due to different dates of sowing and genotypes registered that genotype CSV-29R when sown during I FN of October recorded significantly higher gross returns (₹ 125541 ha^{-1}), net returns (₹ 83,266 ha^{-1}) and B:C (2.97). These results are in conformity with the findings of Reddi *et al*. (2013) in sweet sorghum.

Conclusion

From the present investigation it can be concluded that sowing of genotypes genotype CSV-29R during II FN of October is known to produce higher growth, yield parameters and grain yield and obtained maximum net returns and benefit cost ratio.

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