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Original Research Article

Effect of Sowing Dates on Growth, Fodder Yield and Quality of Sorghum [*Sorghum bicolor* (L.) Moench] under Temperate Conditions of Kashmir

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A B S T R A C T

The present investigation was carried out at experimental field at Faculty of Agriculture, Division of Agronomy, Wadura (SKUAST-K) during *Kharif* 2018, in split plot design with three dates of sowing (11th June, 26th June and 10th July). The soil of the experimental field was clay loam in texture, neutral in reaction, medium in organic matter, potassium (224 kg/ha), phosphorus (19.6 kg/ha) and low in nitrogen (240 kg/ha). The crop sown on 11th June and26th June recorded significantly higher plant height, dry matter accumulation and leaf area index as compared to 10th July sowing. Sowing of 11th June and26th June also recorded significantly higher green fodder yield, dry matter yield and nitrogen uptake as compared to 11th July sowing. Crude protein content was also found higher in first two sowings however the crude fibre content was found higher in 3rd sowing. Net returns (Rs 60602ha^{-1} and Rs 57214 ha^{-1}) as well as benefit cost ratio (1.70 and 1.62) were higher with 11th June and 26th June sowing than third date of sowing.

Keywords

Productivity, Dry matter, Crude protein, Leaf area index

Introduction

India is having the largest livestock population of 529.7 million heads, which is about 15 per cent of the world's livestock population. India supports 55, 16, 20 and 5 per cent of world's buffalo, cattle, goat and sheep population, respectively (Anonymous, 2014). But, the country has only 4.4 per cent (8.3 million hectare) of the cultivated area under fodder crops with an annual total forage production of 833 m t (390 m t green and 443 m t dry fodder). The annual forage requirement is 1594 m t (1025 m t green and 569 m t dry fodder) to support the existing livestock population (Source: Livestock census, Dept. of Animal Husbandry, Dairing & Fisheries, Ministry of Agri., GOI. 2012).

Forages are the mainstay of animal wealth and their production is the backbone of livestock industry. The scarcity of green forages and grazing resources in India has made the livestock to suffer continuously with malnutrition resulting in their production potentiality at sub-optimum level as

compared to many developed nations. The present feed and fodder resources of the country can meet only 48 per cent of the requirement with a vast deficit of 61.1, 21.9 and 64 per cent green, dry fodder and concentrate feeds, respectively (Anonymous, 2014). Even though the farmers are rearing the livestock breeds with higher milk yield potential, they are suffering from deficit in green and dry fodder availability in the country. Because of ever growing demand for food, land area for fodder production is declining with consequent shortage of fodder supply. The problem is further aggravated by increased urbanization contributing to shrinking cultivable land area and preference of farmers to grow cash crops rather than fodder crops. To overcome this deficit, dairy farmers resort to the increased use of costly concentrate feeds which increases the cost of production.

The only way to bridge the large gap between supply and demand of fodder is to maximize the fodder production per unit area per unit time within the existing farming systems and utilising marginal, sub marginal dry lands and problematic soils for developing feed and fodder resources. Simultaneous efforts in the genetic upgradation of the livestock as well as fodder resources with the identification and introduction of new high yielding nutritious fodder crops and identifying suitable agronomic practices are the need of the day.

Sorghum [*Sorghum bicolor* (L.) Moench] is one of the potential fodder crops with perennial growth habit, high biological yield potential and good nutritive value. It can be fed as green fodder or converted to high quality silage for use during the lean period. It occupies the maximum area (2.8 m ha) among different forage crops (Bhag Mal, 2007). It is better suited to semi-arid conditions for several reasons including lower transpiration ratio, slower leaf and stalk wilting, recovery after drought (Martin John, 1930) and lower irrigation requirements (Lamm *et al.,* 2007). Additionally, sorghum may deplete less water from the soil (Merrill *et al.,* 2007). It possesses a wide range of ecological adaptability because of its xerophytic characteristics (Iptas *et al.,* 1997).

The proper sowing time exerts a marked effect on the growth, suppressing weeds and eventually on the yield of the crop. There are evidences that optimum time of sowing is one of the several cultural manipulations boosting yield, particularly in Indian sub-continent where the optimum time of sowing varies to great extent due to varying agro-climatic conditions. The yield and quality of sorghum has been reported to vary with different sowing dates (Hipp *et al.,* 1969, Broad head, 1972). Besides weather parameters, management practices also influence the overall performance the crop. There is urgent need to understand the crop response to management practices in relation to climatic factors which help in manipulating crop cultural practices to suit in varying environmental conditions.

The productivity and availability of good quality herbage like fodder sorghum is most important to fulfil the feeding requirement of dairy cattle. However, the information on its agronomic aspects, especially location specific requirements is meagre. Among the various agronomic factors affecting fodder sorghum, proper crop nutrition and appropriate time of sowing are of prime importance in getting higher forage yield of better quality.

Materials and Methods

The investigation was conducted at the experimental farm of Division of Agronomy at Wadura campus of Sher-e-Kashmir

University of Agricultural Sciences and Technology of Kashmir, Wadura, Sopore that lies at 34º17' N latitude and 74º33' E longitude at 1524 meter above mean sea level. The details of the materials used, experimental procedures followed and techniques adopted have been described. The experimental site was well drained and had uniform topography. Climatically the experimental site is in mid to high altitude temperate zone characterized by hot summers and very cold winters. The total precipitation is 339.5 mm (average over past twenty years) and more than 80% of precipitation is received from western disturbances. The maximum and minimum temperatures were 28.6^{o}C and 14.4^{o}C, respectively.

The total numbers of sunshine hours recorded during the crop growth period were 122.5 and the mean maximum and minimum relative humidity were 80.45 % and 55.9 %, respectively during the crop growth period. The treatments comprised of three sowing dates (11th June, 26th June and 10th July) and four nitrogen levels (90, 120, 150, 180 kg ha^{-1}). MP Chari variety was used as the test variety. The experiment was laid out in split plot design with three replications and 12 treatment combination. Main plots were assigned to nitrogen fertilizer levels of 90(N1), 120 (N2), 150 (N3) and 180 (N4) kg per hectare while the planting dates of T1 (June, 11th), T2 (June 26th) and T3 (July 10th) were allocated to subplots. Seeds were sown by hand on the rows with 10 cmintervals. The sowing density was considered 170,000 plants per ha. Sowingdepth was 2-3 cm with 2-3 seed in each hole to guarantee the expected plant population. Recommended package of practices were adopted to raise a healthy crop. Plant height was measured from the base of the plant to the tip of the longest leaf stretched at 20 days interval from randomly labelled five plants in each net plot area and expressed in cm. Leaf area was recorded by destructive samples at 20 days interval, using Li-COR model, LT-300 portable leaf area meter with transparent conveyor belt and electronic digital display. Fordry matter accumulation. Five plants were randomly selected from penultimate rows of each plot at 20 days interval from sowing date to harvest. These plants were cut from ground level and sun dried for 2-3 days. These samples were chopped into small pieces after sun drying, mixed homogenously and dried in hot air oven at 60^{0}C temperature till constant weight.

The dry weight of plant samples was recorded as g plant^{-1}.The plants from the net plot area, including the tagged plants were harvested to the ground level at 90 per cent moisture, cut in to bits of one meter length and the weight of the green fodder was recorded and expressed in q ha^{-1} for recording of green fodder yield.

The green fodder was sun dried on the threshing floor for 7 days and later dry fodder yield was recorded at 15 per cent moisture and the weights were expressed as dry fodder yield in q ha^{-1}.Protein content of fodder was determined by multiplying respective nitrogen concentration with a factor 6.25.Crude fibre was estimated by treating the sample with 1.25% H_2SO_4 and 1.25% NaOH and the residue left was ashed in muffle furnace at 550-600 ^{0}C. The loss due to ashing was considered as crude fibre, and was expressed in percentage.

Results and Discussion

Growth parameters

Plant height

A perusal of data (Table 1.1) on plant height revealed that among dates of sowing the plant

height was significantly higher (261cm & 260cm) in 11th June and 26th June sowing when compared with 10th July (254cm) sowing as the early sown crop got longer time period to utilise available growth resources. The significant gain in height was due to the faster growth accelerated by cell division and cell enlargement in specialized meristematic tissue, this finding is supported by Gardner *et al.,* 1988 who reported that Apical meristem generates new cells in the tip of the roots or shoots, resulting in increased height or length.

Sufficiency of nitrogen in the crop plants resulted in full nutrients activity in growing points which might have resulted in taller plants.

Leaf Area Index

Leaf area index of fodder sorghum was significantly influenced by different dates of sowing. Among dates of sowing the highest LAI was recorded in 11th June sowing compared to other sowings. Leaf area index was recorded highest during 11th June sowing and showed a gradual decrease in subsequent sowings because of shortening of growing cycle. These results were consistent with the results of Yadav *et, al.* (1997); Singh and Singh, (2002).

Dry matter accumulation

Dry matter accumulation is the most important yield attributing character in fodder sorghum as the entire plant excluding root system is usable as fodder. High dry matter accumulation is always associated with higher yields.

Dry matter is the expression of different morphological components like stem, number of leaves and number of tillers etc. Among dates of sowing dry matter accumulation decreased with delay in sowing, this decrease in dry matter yield with delay in sowing could be due to exploitation of favourable climatic condition at important growth stages by the crop sown early and higher leaf area index which might have provided more photosynthetic area and contributed more dry matter. This results are with conformation with Turk *et al.,* (2009).

Yield

Green Fodder Yield

The study on the green fodder yield of sorghum revealed that green fodder yield was the maximum at first date of sowing and decreased gradually from first to third sowing. With each incremental dose of nitrogen from 90 to 180 kg ha^{-1} a significant increase in the green fodder yield was observed.

Among different dates of sowing the highest fodder yield was recorded at first date of sowing when 180 kg N ha^{-1} was applied whereas the lowest was observed at 90 kg N ha^{-1}. The decrease in green fodder yield with delay in sowing might be due to the reduced growing period.

Dry fodder yield

The data pertaining to dry fodder yield of fodder sorghum indicated significant influence of sowing dates. Among dates of sowing, the highest dry fodder yield (125.13 qha^{-1}) was recorded in 11th June sowing followed by 26th June sowing.

The application of nitrogen @180 kg ha^{-1} was found significantly superior to the rest of the treatments in which the dry fodder yield recorded was highest (121.07qha^{-1}). Dry fodder yield significantly increased with each increment in N level from 90 to 180 kg N ha^{-1}.

Table.1 Effect of sowing dates plant height (cm) of fodder sorghum

Treatments	20DAS	40DAS	60DAS	At Harvest
		Sowing dates		
11th June	36.5	97.5	241.9	261.8
26th June	35.9	95.9	239.5	260.2
10th July	34.2	92.2	234.6	254.2
SEm±	0.23	0.38	0.61	1.24
CD(p≤0.05)	**0.91**	**1.49**	**2.40**	**4.85**

Table.2 Effect of sowing dates on leaf area index of fodder sorghum

Treatments	20DAS	40DAS	60DAS	At Harvest
		Sowing dates		
11th June	2.39	4.92	5.37	5.23
26th June	2.32	4.93	5.36	5.06
10th July	2.15	4.25	4.33	4.10
SEm±	0.021	0.05	0.01	0.03
CD(p≤0.05)	**0.08**	**0.21**	**0.05**	**0.13**

Table.3 Effect of sowing dates on dry matter accumulation (g/plant) of fodder sorghum

Treatments	20DAS	40DAS	60DAS	At Harvest
		Sowing dates		
11th June	5.7	27.8	58.7	65.8
26th June	5.7	25.1	56.1	63.2
10th July	5.5	21.1	53.8	60.1
SEm±	0.039	0.36	0.54	0.54
CD(p≤0.05)	**0.15**	**1.43**	**2.11**	**2.11**

Table.4 Effect of sowing dates on green fodder yield (qha^{-1}) of fodder sorghum

Treatments	Green fodder yield (qha^{-1})
Sowing dates	
11th June	450.19
26th June	435.16
10th July	358.43
SEm±	14.30
CD(p≤0.05)	**53.86**

Table.5 Effect of sowing dates on dry fodder yield (qha^{-1}) of fodder sorghum

Treatments	Dry fodder yield (qha^{-1})
Sowing dates	
11th June	125.13
26th June	120.95
10th July	104.35
SEm±	2.19
CD(p≤0.05)	**6.57**

Table.6 Effect of sowing dates on Crude protein content (%) of fodder sorghum

Treatments	Crude protein content (%)
Sowing dates	
11th June	8.21
26th June	7.81
10th July	7.68
SEm±	0.24
CD(p≤0.05)	**NS**

Table.7 Effect of sowing dates on Crude fibre content (%) of fodder sorghum

Treatments	Crude Fibre content (%)
Sowing dates	
11th June	34.12
26th June	33.33
10th July	32.97
SEm±	0.45
CD(p≤0.05)	**NS**

Fig.1 Effect of dates of sowing on plant height of fodder sorghum [*Sorghum bicolor* (L.) Moench]

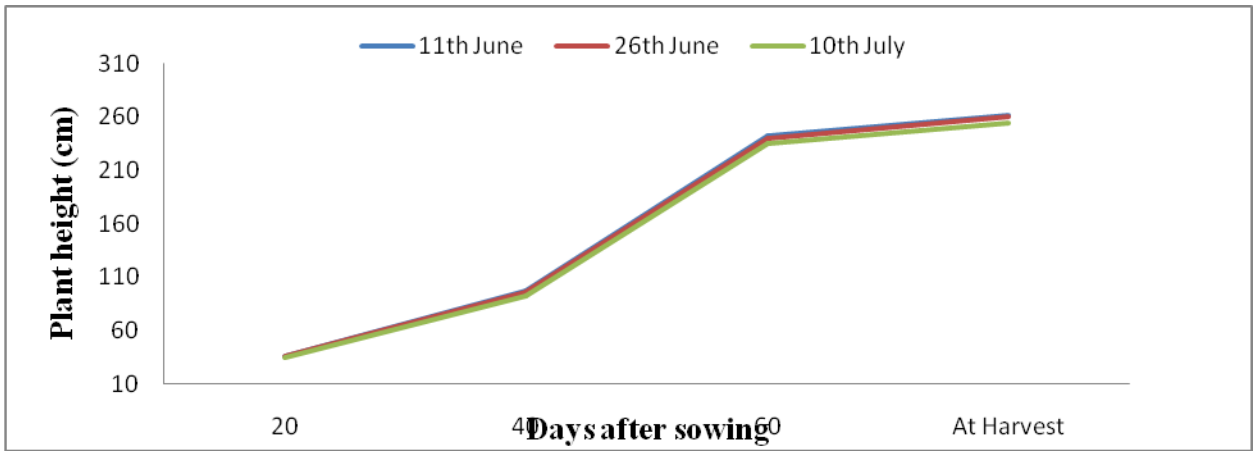


Fig.2 Effect of dates of sowing on leaf area index of fodder sorghum [*Sorghum bicolour* (L.) Moench]

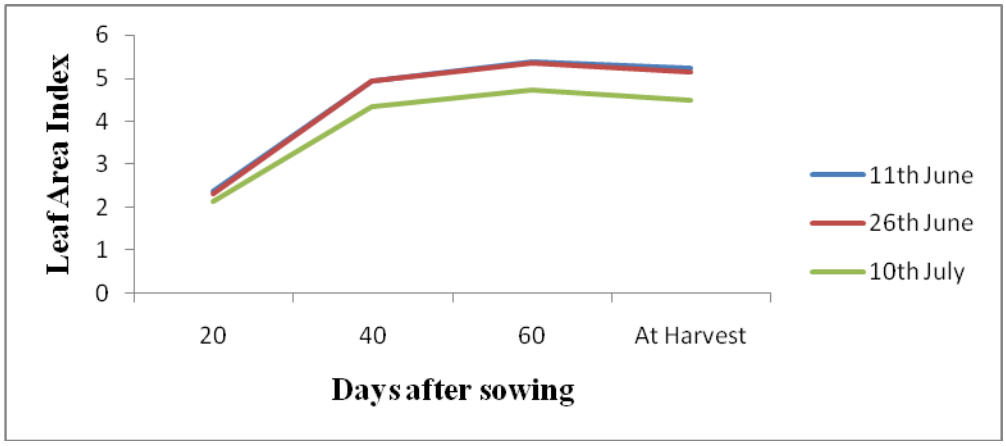


Fig.3 Effect of dates of sowing on dry matter accumulation of fodder sorghum [*Sorghum bicolour* (L.) Moench]

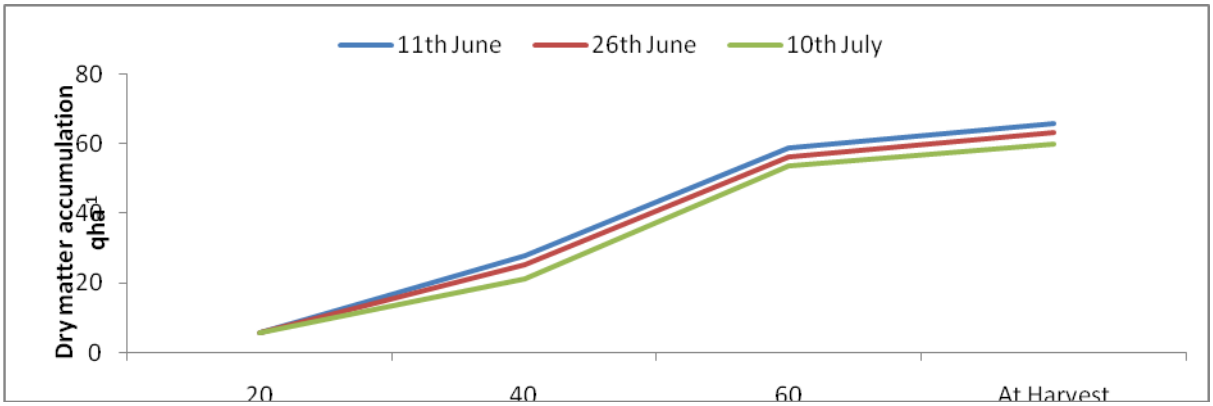


Fig.4 Effect of dates of sowing on green fodder yield of fodder sorghum [*Sorghum bicolour* (L.) Moench]

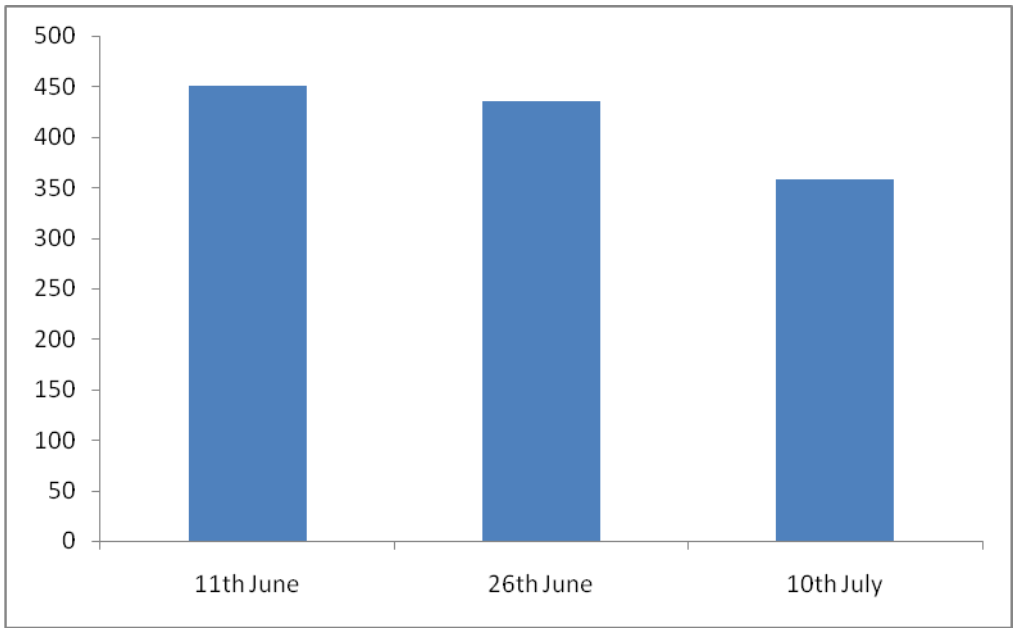
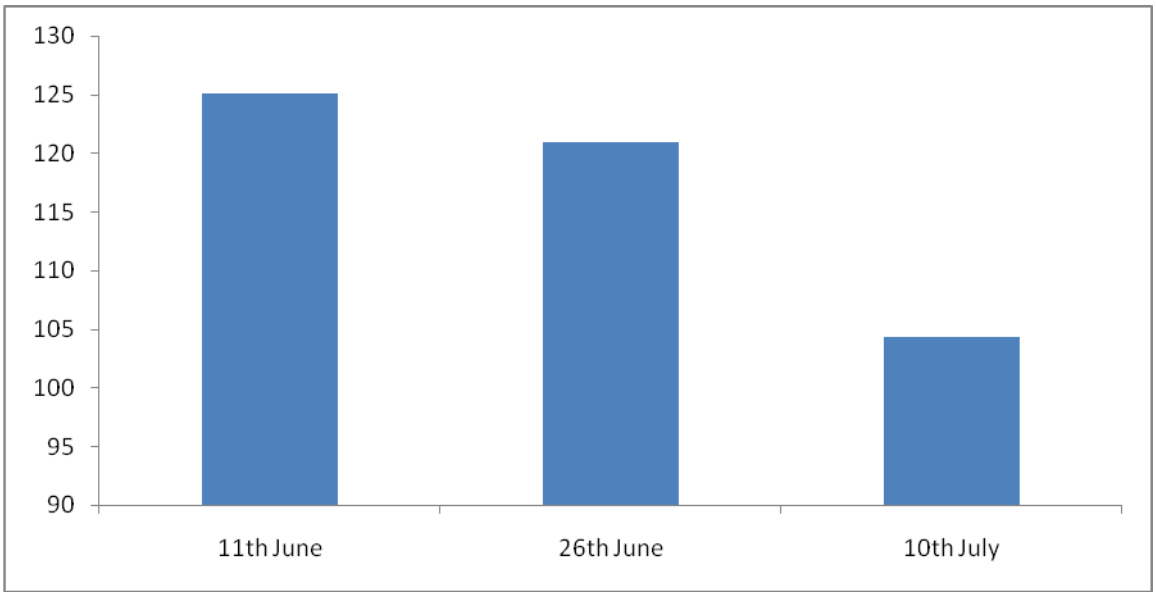


Fig.5 Effect of dates of sowing on dry fodder yield of fodder sorghum [*Sorghum bicolour* (L.) Moench]



Quality parameters

Crude protein content

Crude protein content is the most important parameter to evaluate the quality of fodder sorghum. Higher the crude protein better is the quality of fodder. During all the three sowings, with each incremental dose of N from 90 to 180 kg N ha^{-1}, there was a progressive and significant increase in crude protein per cent. There was no significant

effect of sowing dates on crude protein content of fodder sorghum, data revealed that among different dates of sowing crude protein contents of fodder sorghum recorded in 11th June sowing was 8.21% and 10th July sowing was 7.68%. Turk *et al.,* (2009) also found the similar results with forage sorghum.

Crude fibre content

Crude fibre content is the most important quality parameter influencing the digestibility of fodder. Low crude fibre content is the indication of higher palatability and digestibility of fodders. Lower crude fibre in the fodder means higher total digestible nutrients. Among all the three sowings, the highest crude fibre content was registered when 90 kg N $ha^{-1}$was applied treatment while the lowest was with the application of 180 kg N ha^{-1}. Each incremental dose of N from up to 180 kg N ha^{-1} significantly decreased the crude fibre per cent at all three sowings.

The present investigation was conducted at Wadura campus of Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir, Wadura, Sopore during Kharief 2018 with following objective.

To evaluate growth, fodder yield and quality of sorghum under varying dates of sowing.

The treatments comprised of three sowing dates (11th June, 26th June and 10th July) and four nitrogen levels (90, 120, 150, 180 kg ha^{-1}). MP Chari variety was used as the test variety. The experiment was laid out in split plot design with three replications and 12 treatment combination. The salient findings of the investigation are summarized. The crop sown on 11th June and 26th June recorded significantly higher plant height, leaf area index, dry matter and leaf to stem ratio as compared to 10th July sowing. Also 11th June sowing recorded significantly higher green fodder yield and higher dry fodder yield as compared to 10th July sowing because the early sown crop got longer period to utilise the available growth resources. Also with delayed sowing the growing period of the crop decreased. Crude protein content (%) in 11th June sowing was higher than other dates of sowing. Net returns (Rs. 60602) as well as benefit cost ratio (1.70) was higher with 11th June sowing than other dates of sowing. 11th June sowing recorded significantly higher plant height, dry matter accumulation, green fodder, crude protein, crude fibre, net returns as well as benefit cost ratio.

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