**Determining the effect of date of sowing and spacing on forage yield of sunflower (*Helianthus annus* L.)**

**ABSTRACT**

The present study aimed to determine the effect of date of sowing and spacing on forage yield of sunflower (*Helianthus annus* L.). A field experiment was conducted at Agronomy Instructional Farm, Chimanbhai Patel College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar during *rabi* season of 2020-21 to study the effect of date of sowing and spacing on forage yield of sunflower (*Helianthus annus* L.). The experiment consisting of twelve treatment combinations comprising four dates of sowing (15th October, 1st November, 15th November, 30th November) and three spacing (15 cm, 30 cm, 45 cm spacing) were evaluated in split plot design with four replications. Results revealed that sowing of forage sunflower crop in the second fortnight of October produced numerically higher green forage yield (677.09 q/ha), dry forage yield (102.40 q/ha), head diameter (15.41 cm) and fibre content (26.13 %).Among the spacings, significantly higher green forage yield (675.08 q/ha) and dry forage yield (103.44 q/ha) were recorded under the 30 cm row spacing as compared to rest of the treatments. A significantly higher head diameter (15.71 cm) was recorded by 45 cm row spacing whereas, fibre content was significantly higher at 15 cm row spacing. The maximum net realization (₹ 90880/ ha) with B:C ratio (3.04) was accrued by the 15th October sowing.

***Key words:*** Date of sowing, Row spacing, Organic carbon, Potential hydrogen

**Introduction**

“Livestock, an integral component of farming system in India can plays an important role in sustainability of the economy of India. It serves as the regular source of income for small and marginal farmers and provide cushion for overall development of agriculture. Thus, the inclusion of livestock component can make agriculture more profitable as well as sustainable. The GDP of the livestock sectors is the highest due to higher contribution of milch animals. Besides this, availability of milk in India was 178 g/capita/day in 1991-92 which was increased to 471g/capita/day in 2023-2024” (Anonymous, 2025).

“In India, only 4.4 per cent of the cultivated area is under fodder crops with annual total forage production of 878.9 million tonnes having a 405.9 and 473 million tonnes of green and dry fodder, respectively. While the demand of green and dry fodder were 1134 and 630 million tonnes, respectively, which contributes 64.21 per cent and 24.81 per cent deficit of forage production, respectively” (Anonymous, 2020).

“In Gujarat, the total area under forage crops is about 7.96 thousand hectares. Looking to the scenario from 1995 to 2015, Gujarat is also fodder deficit state and availability of green and dry fodder was 26.2 and 15.2 million tonnes, respectively, while the requirement of green and dry fodder was 39.6 and 16.2 million tonnes respectively” (Shah *et al*., 2011).

**MATERIALS AND METHODS**

A field experiment was conducted during *rabi* season of 2020-21 at Agronomy Instructional Farm, Chimanbhai Patel College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar. The soil of experimental field was loamy sand in texture with low in organic carbon (0.20 %) and low in available nitrogen (179.8 kg/ha), medium in available phosphorus (48.6 kg/ha) and potash (272 kg/ha) having pH value of 7.48. The experiment consisting of twelve treatment combinations comprising four dates of sowing (main plot) *i.e.,*D1: 15th October, D2: 1st November, D3: 15th November and D4: 30th November and three levels of spacings treatments (Sub-plot) *i.e.,* S1: 15 cm, S2: 30 cm and S3: 45 cm were evaluated in Split Plot Design with four replications.

The crop was sown with 60, 30 and 20 kg seeds per hectare at the spacing of 15, 30 and 45 cm apart between the two rows, respectively. The recommended dose of fertilizers *i.e.,*40 kg N + 30 kg P + ha-1 was applied as a basal dose, through Urea (46 % N) and Single Super Phosphate (16 % P2O5) at the time of sowing and 40 kg/ha Nitrogen was applied as a top dressing, through Urea (46 % N).All the agronomic practices measures were adopted as per recommendation. Observations on different growth and yield parameters were recorded from five randomly sampled plants from each treatment.

 **RESULTS AND DISCUSSION**

*Effect of date of sowing on yield*

Sowing the forage sunflower crop on 15th October produced numerical higher green forage yield which was to the tune of 13.15 per cent higher over of 30th November sowing at harvest. The higher green forage yield was due to timely sowing of sunflower which provides favourable climatic conditions in terms of temperature, humidity and bright sunshine hour during crop growth period have resulted in more cell division and enlargement which ultimately leads to more green forage yield. The minimum green forage yield in 30th November might be due to shortening the growth duration and reduction in the growth per day from sowing to harvest.

Numerically higher dry forage yield of forage sunflower was obtained by 15th October sowing, which was to the tune of 11.31 per cent higher over of 30th November sowing at harvest. This might be due tohigher green forage yield per hectare resulted in higher dry forage yield per hectare.

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| **Table 1**. Green forage yield, dry forage yield, head diameter and fibre content of forage sunflower as influenced by date of sowing and spacing. |
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| Treatments | Green forage yield (q/ha) | Dry forage yield (q/ha) | Head diameter(cm) | Fibre content(%) |
| Date of sowing (D) |  |  |
| D1 : 15th October | 677.09 | 102.40 | 15.41 | 26.13 |
| D2 : 1st November | 640.42 | 98.04 | 15.21 | 25.72 |
| D3 : 15th November | 629.04 | 95.01 | 15.09 | 25.54 |
| D4 : 30th November | 598.36 | 91.99 | 14.92 | 25.04 |
| S.Em. ± | 20.74 | 4.02 | 0.43 | 0.59 |
|  C.D. at 5 % | NS | NS | NS | NS |
|  C.V. % | 11.29 | 14.37 | 9.95 | 8.00 |
| Spacing (S) |  |  |
| S1 : 15 cm | 600.25 | 91.51 | 14.38 | 26.38 |
| S2 : 30 cm | 675.08 | 103.44 | 15.37 | 25.50 |
| S3 : 45 cm | 633.35 | 95.63 | 15.71 | 24.94 |
| S.Em. ± | 13.34 | 2.83 | 0.31 | 0.39 |
|  C.D. at 5 % | 38.94 | 8.27 | 0.91 | 1.14 |
| Interaction (D x S) |  |  |
| S.Em. ± | 26.68 | 5.66 | 0.62 | 0.78 |
|  C.D. at 5 % | NS | NS | NS | NS |
|  C.V. % | 8.39 | 11.70 | 8.27 | 6.12 |

*Effect of row spacing on yield*

Significantly the highest green forage yield (675.08 q/ha) was recorded by 30 cm row spacing. Significantly the lowest green forage yield (600.25 q/ha) was recorded by 15 cm row

spacing. The percentage increased in green forage yield by the 30 cm row spacing was to the tune of 12.47 per cent than that of 15 cm row spacing. Higher green forage yield with 30 cm row spacing might be due to the higher values of plant height, number of leaves per plant, leaf length, leaf width, green leaf weight per plant, green stem weight per plant and green forage yield per plant. These findings are in close conformity with those reported by Dar *et al*. (2014) and Mashreghi *et al*. (2014). The results of Dar *et al.* (2014) reported that higher green fodder yield of baby corn was recorded by 50 x 15 cm crop geometry than that of 40 x 15 cm, 40 x 20 cm, 50 x 20 cm and 60 x 15 cm crop geometry.

Sowing the forage sunflower crop by 30 cm row spacing produced significantly the highest dry forage yield (103.44 q/ha). Significantly the lowest dry forage yield (91.51 q/ha) was recorded by 15 cm row spacing. The percentage increased in dry forage yield by the 30 cm row spacing was to the tune of 13.04 per cent than that of 15 cm row spacing. This might be due to higher green forage yield per hectare (Table 1) resulted in higher dry forage yield per hectare. These results are in accordance with the finding of Farnia and Mansouri (2014), and Mashreghi *et al.* (2014). Farnia and Mansouri (2014) showed that the highest dry forage yield of maize was recorded at 25 cm row spacing than 10 cm, 15 cm and 20 cm row spacing.

*Interaction effect on yield*

The interaction effect of date of sowing and spacing on green forage yield and dry forage yield of forage sunflower was found non-significant.

*Effect of date of sowing on head diameter and fibre content*

The different dates of sowing did not exert their significant effect on head diameter and fibre content of forage sunflower. However, numerically higher head diameter (15.41 cm) and fibre content (26.13 %) was recorded by crop was sown on 15th October.

*Effect of row spacing on head diameter and fibre content*

Among the different row spacing, 45 cm row spacing recorded significantly higher head diameter (15.71 cm) as compared to other treatments but it was found statistically at par with 30 cm row spacing. The minimum head diameter (14.38 cm) was recorded by 15 cm row spacing. This might be due to more growth and development of sunflower plant at wider spacing. Similar results were also obtained by Mojiri and Arzani (2003) and Mohamed (2013). The results of Mohamed (2013) showed that the significantly maximum head diameter of sunflower was recorded at wider row spacing than narrow row spacing.

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| **Table 2.** Economics of forage sunflower as influenced by sowing dates and spacing |
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| --- | --- | --- | --- | --- | --- |
| Treatments | Forage yield (q/ha) | Gross realization(**C:\Documents and Settings\Ghanshyam\Desktop\File Indian_Rupee_symbol.svg_files\81px-Indian_Rupee_symbol.png**/ha) | Total cost ofcultivation(C:\Documents and Settings\Ghanshyam\Desktop\File Indian_Rupee_symbol.svg_files\81px-Indian_Rupee_symbol.png/ha) | Net realization(C:\Documents and Settings\Ghanshyam\Desktop\File Indian_Rupee_symbol.svg_files\81px-Indian_Rupee_symbol.png/ha) | BCR |
| Date of sowing (D) |
|  D1 : 15th October | 677.09 | 135418 | 44538 | 90880 | 3.04 |
| D2 : 1st November | 640.42 | 128084 | 44538 | 83546 | 2.88 |
| D3 : 15th November | 629.04 | 125808 | 44538 | 81270 | 2.82 |
| D4 : 30th November | 598.36 | 119672 | 44538 | 75134 | 2.69 |
| Spacing (S) |
|  S1 : 15 cm | 600.25 | 120050 | 52899 | 67151 | 2.27 |
| S2 : 30 cm | 675.08 | 135016 | 42538 | 92478 | 3.17 |
| S3 : 45 cm | 633.35 | 126670 | 38178 | 88492 | 3.32 |
| Selling price of forage sunflower @ ₹ 2 /kg |

Sowing of sunflower crop at 15 cm row spacing gave significantly higher fibre content (26.38 %) over rest of the treatments but it was at par with 30 cm row spacing. Significantly the lowest fibre content (24.94 %) was recorded by 45 cm

row spacing. The significant decrease in fibre content with increasing row spacing might be due to higher nitrogen availability. The more rapidly synthesized carbohydrates are converted in to proteins and to protoplasm and only smaller

portion is available for cell wall material. The leaves of a plant rich in nitrogen contain a relatively high proportion of water, low proportion of dry matter, more succulent and there by lower in crude fibre content. These results are in accordance with the finding of Patel and Patel (1983) and Palanjiya and Solanki (2019). Palanjiya and Solanki (2019) showed that the significantly higher fibre content of fodder sunflower was recorded at narrow row spacing (20 cm) than the wider row spacing (30 and 40 cm).

*Interaction effect on yield*

The interaction effect of date of sowing and spacing on green forage yield and dry forage yield of forage sunflower was found non-significant.

*Effect of date of sowing and row spacing on economics*

Sowing the forage sunflower crop at 15th October recorded maximum gross realization (₹135418 per hectare) and net realization (₹ 90880per hectare) and benefit cost ratio (3.04). Whereas minimum gross realization (₹119672 per hectare), net realization (₹ 75134 per hectare) and benefit cost ratio (2.69) was observed under 30th November sowing. The response of 1st November and 15th November sowing was found intermediate. These findings are in close conformity with those reported by Awasthi *et al.* (2007), Keerthi *et al.* (2017), Patel *et al.* (2017). The result of Awasthi *et al.* (2007) showed that the highest monetary return of Indian mustard was recorded by sowing of the crop on 15th October.

The maximum gross realization (₹135016 per hectare) and net realization (₹92478 per

hectare) was recorded by 30 cm row spacing. Minimum gross realization (₹120050 per

hectare), net realization (₹ 67151 per hectare) was observed by 15 cm row spacing. These findings are in close conformity with those reported by Sanmugapriya and Kalpana (2017). They found that higher gross return, net return and B:C ratio of forage sorghum was recorded by sowing the crop at 30 x 10 cm spacing.

***Conclusion:***

On the basis of one year experiment, it can be concluded that the forage sunflower crop should be sown on 15th October to 30th November having a row spacing of 30 cm to secure higher green forage yield and net realization under North Gujarat Agro- climatic conditions.

**Disclaimer (Artificial intelligence)**

Option 1:

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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