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## Influence of sowing dates and weed management practices on yield of summer sesame in New Alluvial Zone of West Bengal

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**Abstract**

A field experiment entitled “Effect of dates of sowing and weed management practices on summer sesame in the New Alluvial Zone of West Bengal” was conducted during the summer seasons of 2022 and 2023 at the Instructional Farm, Jaguli, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, West Bengal. The soil of the experimental site was clay loam in texture, nearly neutral in reaction (pH 6.5) and non-saline (EC 0.3 dS m<sup>-1</sup>). The soil contained medium organic carbon (0.68%), low available nitrogen (196.76 kg ha<sup>-1</sup>), and high available phosphorus (24 kg P<sub>2</sub>O<sub>5</sub> ha<sup>-1</sup>) and potassium (294.5 kg K<sub>2</sub>O ha<sup>-1</sup>).

The experiment was laid out in a split-plot design with three replications, where three sowing dates were allocated to the main plots, and eight weed management treatments were assigned to the sub-plots. The sowing dates were D<sub>1</sub>: 21<sup>st</sup> February, D<sub>2</sub>: 7<sup>th</sup> March, and D<sub>3</sub>: 22<sup>nd</sup> March. The weed management treatments comprised: W<sub>1</sub>-pendimethalin @ 1 kg a.i. ha<sup>-1</sup> applied at 2 DAS followed by hand weeding at 30 DAS; W<sub>2</sub>-butachlor @ 1 kg a.i. ha<sup>-1</sup> applied at 2 DAS followed by hand weeding at 30 DAS; W<sub>3</sub>-hand weeding at 15 DAS followed by quizalofop-ethyl @ 50 g a.i. ha<sup>-1</sup> at 30 DAS; W<sub>4</sub>-pendimethalin @ 1 kg a.i. ha<sup>-1</sup> at 2 DAS followed by quizalofop-ethyl @ 50 g a.i. ha<sup>-1</sup> at 30 DAS; W<sub>5</sub>-butachlor @ 1 kg a.i. ha<sup>-1</sup> at 2 DAS followed by quizalofop-ethyl @ 50 g a.i. ha<sup>-1</sup> at 30 DAS; W<sub>6</sub>-hand weeding twice at 15 and 30 DAS; W<sub>7</sub>-weedy check; and W<sub>8</sub>-weed-free check. The sesame variety ‘Savitri’ was used in the study.

**Keywords:** Weed, herbicide, yield, capsule, soil fertility

**Introduction**

Sesame (*Sesamum indicum* L.) is one of the oldest and most important oilseed crops cultivated in tropical and subtropical regions of the world. In India, it ranks next to groundnut, rapeseed, and mustard among the major oilseed crops. Owing to its high-quality oil rich in polyunsaturated fatty acids and its remarkable oxidative stability, sesame is popularly known as the “Queen of Oilseeds.” The crop is widely grown by small and marginal farmers in developing countries because of its adaptability to marginal lands and tolerance to drought conditions (Jefferson, 2003) [7]. Sesame also possesses unique chemical compounds such as sesamin and sesamol, which act as natural antioxidants and help protect the oil from oxidative rancidity, thereby improving its stability and shelf life (Boureima *et al.*, 2011) [3].

Sesame is a short-day plant and generally initiates flowering within 42-45 days when exposed to a 10-hour photoperiod. The crop is valued not only as a source of edible oil but also as a raw material for several food, pharmaceutical, and cosmetic industries, making it an important export commodity. Sesame seeds are nutritionally rich and contain approximately 50% oil, 25% protein, and 20% carbohydrates, along with essential vitamins, minerals, antioxidants, and amino acids. In addition, sesame seed meal contains 34-50% protein, which makes it a valuable component of livestock feed. Sesame oil cake is particularly rich in high-quality protein and contains considerable amounts of phosphorus and potassium, making it an excellent cattle feed. India is one of the leading producers, consumers, and exporters of sesame in the world. However, despite its importance, the productivity of sesame remains relatively low compared to its potential due to several agronomic and environmental constraints.

The yield potential of sesame is influenced by a number of factors, including climatic conditions, soil fertility, crop management practices, and cultivar selection. Among these factors, optimum sowing time and effective weed management play a crucial role in determining crop growth and productivity. The appropriate sowing date is an important agronomic practice that helps synchronize the crop growth stages with favorable environmental conditions such as temperature, moisture availability, and solar radiation. Sesame is generally cultivated as a dryland crop in many parts of the Indian subcontinent, where sowing time largely depends on the availability of soil moisture. Consequently, farmers often delay sowing until sufficient moisture is available to ensure proper crop establishment. Selecting the appropriate sowing date allows different growth stages of the crop to coincide with favorable environmental conditions, thereby improving photosynthetic efficiency and enhancing nutrient assimilation and accumulation in seeds, which ultimately results in higher productivity (Erhart *et al.*, 2005) [5]. Determining the optimum sowing time, along with the selection of suitable cultivars with high yield potential, is therefore a key factor for achieving profitable sesame production (Hamza and Abd El Salam, 2015) [6]. On the other hand, delayed sowing may reduce the growth duration of the crop, increase susceptibility to pests and diseases, and ultimately lead to lower yields. It may also discourage farmers from allocating more area to sesame cultivation.

Apart from sowing time, weed infestation is one of the major constraints limiting sesame productivity. The small size of sesame seeds makes sowing difficult and requires precise placement at an appropriate depth to ensure proper germination and establishment. Moreover, sesame seedlings are small, delicate, and exhibit slow initial growth compared to many other crops, which makes them highly vulnerable to weed competition during the early stages of growth. The magnitude of yield loss due to weeds depends on the type of weed flora, weed density, and the timing of weed infestation under specific agro-climatic conditions. Uncontrolled weed growth in sesame has been reported to cause yield losses of up to 50% (Dungarwal *et al.*, 2003) [4].

During the initial four weeks after sowing, sesame plants grow slowly and are poor competitors against weeds (Bennett *et al.*, 2003) [2]. Severe weed infestation during this period can significantly reduce crop growth and yield. In some cases, yield reductions due to weeds may reach 60%. Amare *et al.* (2009) [1] reported that the critical period of weed competition in sesame occurs between 15 and 30 days after seedling emergence, indicating that the crop should be maintained weed-free during this period to achieve maximum productivity. Although manual weeding is considered an effective and environmentally safe method for weed control, it is labor-intensive, time-consuming, and costly.

Hand weeding remains the most commonly adopted method for weed control by farmers. However, the scarcity of labor during peak agricultural operations and the rising cost of labor have made this practice increasingly difficult for farmers. Under such circumstances, chemical weed management through herbicides offers an effective and economical alternative for controlling weeds during the early stages of crop growth.

Therefore, an integrated approach combining chemical and manual weed management may provide an efficient,

economical, and environmentally sustainable solution for effective weed control in sesame cultivation. In view of the above considerations, the present investigation entitled “Effect of dates of sowing and weed management practices on summer sesame in the New Alluvial Zone of West Bengal” was undertaken to identify suitable sowing dates and effective weed management practices for improving sesame productivity and profitability in the region.

## Materials and Methods

A field experiment titled “Effect of dates of sowing and weed management practices on summer sesame in the New Alluvial Zone of West Bengal” was carried out during the summer seasons of 2022 and 2023 at the Instructional Farm, Jaguli, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, West Bengal. The experimental soil was clay loam in texture, nearly neutral in reaction with a pH of 6.5, and non-saline with an electrical conductivity of 0.3 dS m<sup>-1</sup>. The soil was characterized by medium organic carbon content (0.68%), low available nitrogen (196.76 kg ha<sup>-1</sup>), and high levels of available phosphorus (24 kg P<sub>2</sub>O<sub>5</sub> ha<sup>-1</sup>) and potassium (294.5 kg K<sub>2</sub>O ha<sup>-1</sup>).

The study was conducted using a split-plot design with three replications, in which three sowing dates were assigned to the main plots and eight weed management treatments to the sub-plots. The sowing date treatments consisted of D<sub>1</sub>-21<sup>st</sup> February, D<sub>2</sub>-7<sup>th</sup> March, and D<sub>3</sub>-22<sup>nd</sup> March. The weed management treatments included W<sub>1</sub>-Pendimethalin @ 1 kg a.i. ha<sup>-1</sup> applied at 2 days after sowing (DAS) followed by hand weeding at 30 DAS; W<sub>2</sub>-Butachlor @ 1 kg a.i. ha<sup>-1</sup> at 2 DAS followed by hand weeding at 30 DAS; W<sub>3</sub>-Hand weeding at 15 DAS followed by Quizalofop-ethyl @ 50 g a.i. ha<sup>-1</sup> at 30 DAS; W<sub>4</sub>-Pendimethalin @ 1 kg a.i. ha<sup>-1</sup> at 2 DAS followed by Quizalofop-ethyl @ 50 g a.i. ha<sup>-1</sup> at 30 DAS; W<sub>5</sub>-Butachlor @ 1 kg a.i. ha<sup>-1</sup> at 2 DAS followed by Quizalofop-ethyl @ 50 g a.i. ha<sup>-1</sup> at 30 DAS; W<sub>6</sub>-Hand weeding at 15 DAS and 30 DAS; W<sub>7</sub>-Weedy check; and W<sub>8</sub>-Weed-free check. The sesame variety ‘Savitri’ was used in the experiment.

All recommended cultural practices and plant protection measures were followed uniformly throughout the crop growth period. Observations on plant height, dry matter accumulation, leaf area index, number of branches per plant, number of capsules per plant, number of seeds per capsule, seed yield, and stalk yield were recorded following standard procedures from five randomly selected and tagged plants in each plot. The crop was harvested at maturity according to the treatments. Threshing was performed separately for each plot, and the seed yield obtained from the net plot area was converted into kg ha<sup>-1</sup>, including the yield from the tagged plants. Economic parameters such as gross returns, net returns, and benefit-cost (B:C) ratio were computed based on the prevailing market price of sesame.

## 1. Seed yield

Seed yield was the functions of several yield attributing and yield associate characters viz., number of branches plant<sup>-1</sup>, number of capsule plant<sup>-1</sup>, number of seeds capsule<sup>-1</sup>, number of seeds plant<sup>-1</sup> and 1000 seed weight (g). The cumulative effect of all growth, physiological and yield attributing characters were reflected on seed yield.

From pooled data of two years, it was stated that D<sub>2</sub> (March 7<sup>th</sup> sowing) recorded significantly the highest seed yield of sesamum (771.10 kg ha<sup>-1</sup>). Whereas, 21<sup>st</sup> February sowing

(D<sub>1</sub>) obtained significantly the lowest seed yield (686.06 kg ha<sup>-1</sup>) (table 1 and Fig 1).

The higher seed yield is attributed to the yield attributes and yield associate characters viz., number of branches plant<sup>-1</sup>, number of capsule plant<sup>-1</sup>, number of seeds capsule<sup>-1</sup>, number of seeds plant<sup>-1</sup> and 1000 seed weight (g). etc. and also higher dry matter accumulation which results in better translocation of assimilates from source to the sink which were due to favorable weather conditions. These results corroborated the findings of Sujithra *et al.* (2018) [10].

Among the weed management practices, W<sub>8</sub> (weed free) recorded significantly higher seed yield (808.58 kg ha<sup>-1</sup>) which was significantly superior over other weed management practices and it remained statistically at par with the treatments W<sub>1</sub> (Pendimethalin @ 1 kg a.i ha<sup>-1</sup> (2

DAS) + one hand weeding (HW) at 30 DAS (791.88 kg ha<sup>-1</sup>) and W<sub>6</sub> (Hand weeding (HW) at 15 DAS and 30 DAS (784.69 kg ha<sup>-1</sup>). While, W<sub>7</sub> (weedy check) recorded significantly the lowest seed yield of sesamum (408.04 kg ha<sup>-1</sup>). Among interactions maximum seed yield was recorded under March 7<sup>th</sup> sowing (D<sub>2</sub>) with W<sub>8</sub> (weed free plot) i.e. D<sub>2</sub>W<sub>8</sub> (851.90 kg ha<sup>-1</sup>) followed by treatments D<sub>2</sub>W<sub>1</sub> (836.57 kg ha<sup>-1</sup>). The higher seed yield under the weed management treatments, W<sub>8</sub>, W<sub>1</sub> and W<sub>6</sub> might be due to least competition offered by weeds for nutrients and moisture at crucial growth stages ultimately improved all yield attributes it results increased seed yield of sesame. These results were in close conformity with the findings of Mruthul *et al.* (2015) [8].

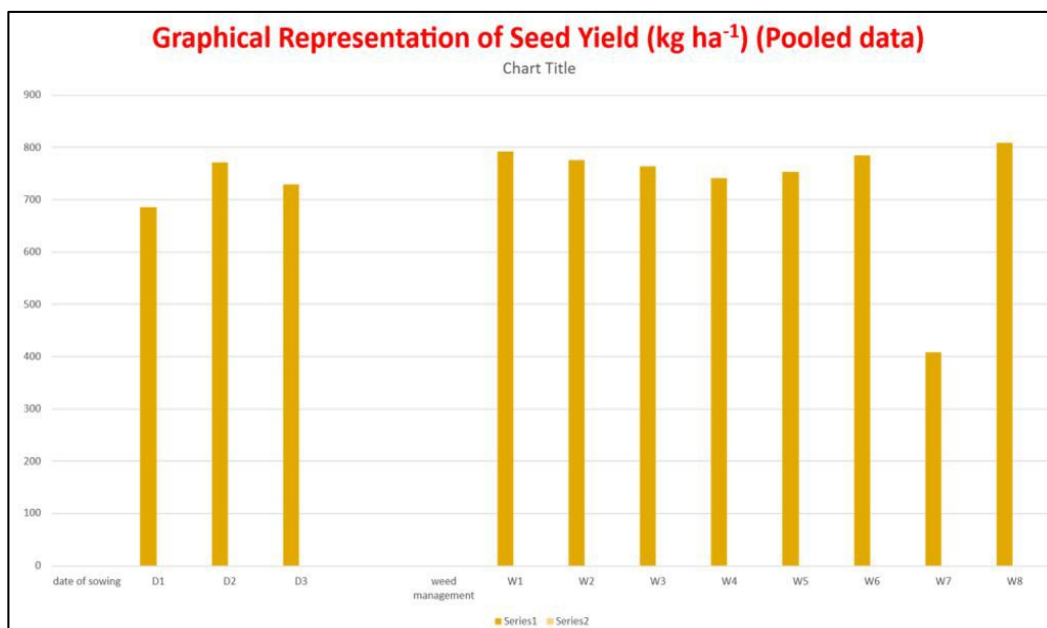


Fig 1: Graphical representation of seed yield (kg ha<sup>-1</sup>)

## 2. Stalk Yield

The results revealed that from different sowing dates, (D<sub>2</sub>) March 7<sup>th</sup> sowing recorded significantly the highest stalk yield (2312.55 kg ha<sup>-1</sup>). (Fig 2) Whereas, 21<sup>st</sup> February sowing (D<sub>1</sub>) noted significantly the lowest stalk yield (1877.48 kg ha<sup>-1</sup>). The positive influence of production of stalk yield under the sowing date D<sub>2</sub> (March 7<sup>th</sup> sowing) might be due to favourable weather conditions, harnessing of more solar radiation which results in better growth parameters like plant height, dry matter production and number of branches plant<sup>-1</sup>.

Significantly higher stalk yield observed at W<sub>8</sub> (Weed free plot) (2397.28 kg ha<sup>-1</sup>) which was statistically at par with W<sub>1</sub> (Pendimethalin @ 1 kg a.i ha<sup>-1</sup> (2 DAS) + one hand weeding (HW) at 30 DAS (2343.35 kg ha<sup>-1</sup>) and W<sub>6</sub> (Hand weeding (HW) at 15 DAS and 30 DAS (2296.04 kg ha<sup>-1</sup>). Whereas, W<sub>7</sub> (Weedy check) reported significantly the lowest stalk yield (1401.14 kg ha<sup>-1</sup>) (Table. 1). The higher stalk yield of sesamum under the weed management treatments W<sub>8</sub>, W<sub>1</sub> and W<sub>6</sub> might be due to effective weed control obtained by these weed management treatments which improved growth parameters, yield attributes it leads to higher stalk yield.

Interaction between dates of sowings and weed management practices was found to be significant. These results were in tune with the findings of Rajesh *et al.* (2024) [9].

## 3. Biological yield

Among the main plots, treatment (D<sub>2</sub>) confirmed significantly the highest biological yield (3083.64 kg ha<sup>-1</sup>), whereas, (D<sub>1</sub>) noted significantly the lowest biological yield (2563.54 kg ha<sup>-1</sup>).

Maximum biological yield (3205.86 kg ha<sup>-1</sup>) was noticed at W<sub>8</sub> (Weed free plot) which was statistically at par with W<sub>1</sub> (Pendimethalin @ 1 kg a.i ha<sup>-1</sup> (2 DAS) + one hand weeding (HW) at 30 DAS (3135.24 kg ha<sup>-1</sup>) and W<sub>6</sub> (Hand weeding (HW) at 15 DAS and 30 DAS (3080.73 kg ha<sup>-1</sup>). While, W<sub>7</sub> (Weedy check) recorded significantly minimum biological yield (1809.18 kg ha<sup>-1</sup>).

## 4. Harvest Index

Among the dates of sowing, 21<sup>st</sup> February sowing (D<sub>1</sub>) recorded maximum harvest index (26.61%) it was significantly superior over other dates of sowing. Lowest harvest index (24.93%) was noticed in March 7<sup>th</sup> sowing (D<sub>2</sub>).

Among the weed management practices, the highest harvest index (26.82%) was observed by W<sub>1</sub> (Pendimethalin @ 1 kg a.i ha<sup>-1</sup> (2 DAS) + one hand weeding (HW) at 30 DAS when compared to other treatments. W<sub>7</sub> (weedy check) recorded lowest harvest index (22.60 %)). Interaction between dates of sowing and weed management practices found to be non-significant.

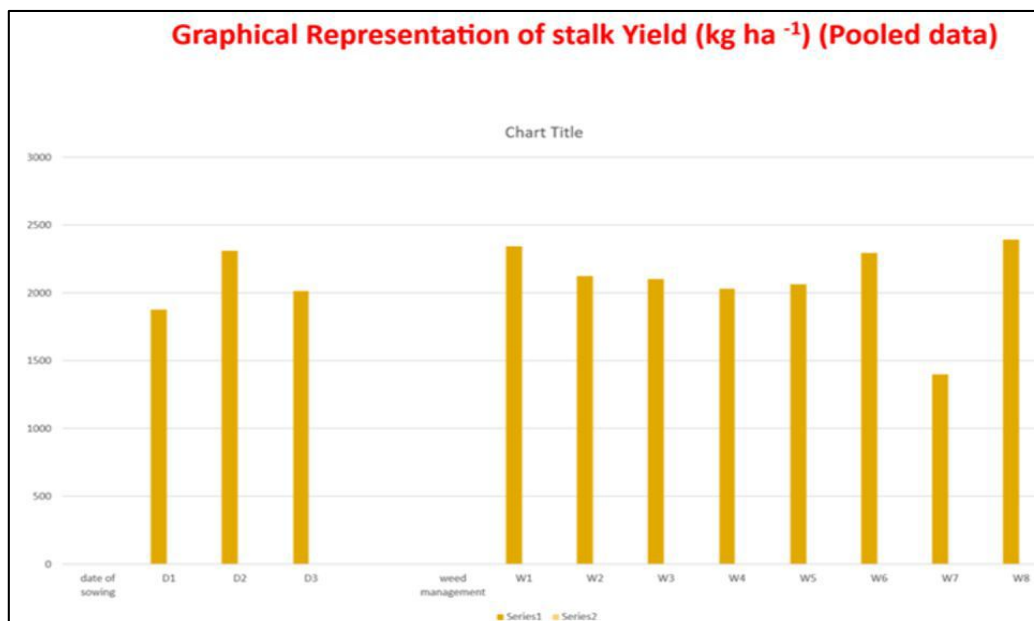
Fig 2: Graphical representation of stalk yield (kg ha<sup>-1</sup>)

Table 1: Effect of dates of sowing and weed management practices on yield of summer sesame

|                     | Seed yield (kg ha <sup>-1</sup> ) |        |        | Stalk yield (kg ha <sup>-1</sup> ) |         |         | Biological yield (kg ha <sup>-1</sup> ) |         |         | Harvest index (%) |        |        | Test weight(g) |       |        |
|---------------------|-----------------------------------|--------|--------|------------------------------------|---------|---------|-----------------------------------------|---------|---------|-------------------|--------|--------|----------------|-------|--------|
|                     | 2022                              | 2023   | pooled | 2022                               | 2023    | Pooled  | 2022                                    | 2023    | Pooled  | 2022              | 2023   | Pooled | 2022           | 2023  | Pooled |
| D1                  | 674.45                            | 697.68 | 686.06 | 1873.86                            | 1881.10 | 1877.48 | 2548.31                                 | 2578.78 | 2563.54 | 26.20             | 27.02  | 26.61  | 2.27           | 2.50  | 2.38   |
| D2                  | 759.61                            | 782.59 | 771.10 | 2238.03                            | 2387.06 | 2312.55 | 2997.63                                 | 3169.65 | 3083.64 | 25.29             | 24.58  | 24.93  | 2.52           | 2.71  | 2.62   |
| D3                  | 725.00                            | 732.56 | 728.78 | 2045.36                            | 1990.88 | 2018.12 | 2770.36                                 | 2723.43 | 2746.90 | 26.03             | 26.74  | 26.39  | 2.46           | 2.60  | 2.53   |
| SE (m ±)            | 9.654                             | 7.325  | 8.444  | 22.001                             | 26.864  | 24.129  | 25.310                                  | 20.897  | 19.009  | 0.258             | 0.245  | 0.064  | 0.009          | 0.020 | 0.014  |
| C.D.at 5%           | 28.271                            | 21.757 | 25.372 | 81.374                             | 78.799  | 75.470  | 88.365                                  | 70.041  | 61.627  | 0.724             | 0.700  | 0.192  | NS             | NS    | NS     |
| W1                  | 786.03                            | 797.74 | 791.88 | 2307.80                            | 2378.91 | 2343.35 | 3093.83                                 | 3176.65 | 3135.24 | 25.58             | 25.01  | 25.25  | 2.53           | 2.72  | 2.99   |
| W2                  | 768.39                            | 783.14 | 775.77 | 2110.14                            | 2142.36 | 2126.25 | 2878.53                                 | 2925.50 | 2902.02 | 26.74             | 26.87  | 26.81  | 2.47           | 2.65  | 6.83   |
| W3                  | 756.06                            | 773.32 | 764.69 | 2086.76                            | 2118.98 | 2102.87 | 2842.81                                 | 2892.30 | 2867.56 | 26.64             | 26.84  | 26.74  | 2.43           | 2.62  | 7.22   |
| W4                  | 734.35                            | 749.84 | 742.09 | 2012.77                            | 2051.66 | 2032.22 | 2747.12                                 | 2801.50 | 2774.31 | 26.79             | 26.87  | 26.83  | 2.40           | 2.58  | 9.67   |
| W5                  | 745.17                            | 761.66 | 753.41 | 2044.81                            | 2087.03 | 2065.92 | 2789.97                                 | 2848.68 | 2819.33 | 26.79             | 26.84  | 26.81  | 2.41           | 2.59  | 8.27   |
| W6                  | 778.89                            | 790.49 | 784.69 | 2298.82                            | 2293.26 | 2296.04 | 3077.71                                 | 3083.75 | 3080.73 | 25.36             | 25.67  | 25.47  | 2.51           | 2.70  | 3.90   |
| W7                  | 379.53                            | 436.56 | 408.04 | 1364.30                            | 1437.97 | 1401.14 | 1743.83                                 | 1874.53 | 1809.18 | 21.77             | 23.43  | 22.60  | 2.03           | 2.34  | 55.47  |
| W8                  | 809.06                            | 808.11 | 808.58 | 2393.94                            | 2400.61 | 2397.28 | 3203.01                                 | 3208.72 | 3205.86 | 25.31             | 25.26  | 25.22  | 2.57           | 2.75  | 0.00   |
| SEm ±               | 9.924                             | 7.256  | 7.990  | 31.771                             | 34.452  | 32.088  | 45.074                                  | 40.369  | 46.090  | 0.332             | 0.534  | 0.247  | 0.027          | 0.013 | 0.234  |
| C.D.at 5%           | 28.235                            | 21.723 | 24.094 | 91.661                             | 107.356 | 91.761  | 124.233                                 | 112.686 | 137.476 | 0.948             | 1.522  | 0.706  | NS             | NS    | 0.742  |
| Interaction (D x W) |                                   |        |        |                                    |         |         |                                         |         |         |                   |        |        |                |       |        |
| DIW1                | 717.76                            | 738.60 | 728.18 | 2624.94                            | 1933.85 | 1920.52 | 2624.94                                 | 2672.45 | 2648.70 | 27.344            | 27.640 | 27.492 | 2.463          | 2.648 | 2.556  |
| DIW2                | 734.55                            | 745.95 | 740.25 | 2635.97                            | 1964.75 | 1933.08 | 2635.97                                 | 2710.70 | 2673.33 | 27.868            | 27.524 | 27.696 | 2.397          | 2.581 | 2.489  |
| DIW3                | 710.72                            | 728.78 | 719.75 | 2604.52                            | 1910.47 | 1902.13 | 2604.52                                 | 2639.25 | 2621.88 | 27.290            | 27.614 | 27.452 | 2.363          | 2.548 | 2.456  |
| DIW4                | 684.57                            | 705.30 | 694.93 | 2501.05                            | 1843.15 | 1829.82 | 2501.05                                 | 2548.45 | 2524.75 | 27.379            | 27.674 | 27.526 | 2.327          | 2.511 | 2.419  |
| DIW5                | 709.05                            | 717.12 | 713.08 | 2554.23                            | 1878.52 | 1861.85 | 2554.23                                 | 2595.63 | 2574.93 | 27.762            | 27.627 | 27.695 | 2.338          | 2.523 | 2.431  |
| DIW6                | 734.55                            | 745.95 | 740.25 | 2635.97                            | 1964.75 | 1933.08 | 2635.97                                 | 2710.70 | 2673.33 | 27.868            | 27.524 | 27.696 | 2.445          | 2.629 | 2.537  |
| DIW7                | 338.97                            | 428.90 | 383.93 | 1783.31                            | 1255.58 | 1349.96 | 1783.31                                 | 1684.48 | 1733.90 | 19.055            | 25.522 | 22.288 | 1.320          | 1.867 | 1.593  |
| DIW8                | 764.83                            | 763.57 | 764.20 | 2970.27                            | 2192.10 | 2198.77 | 2970.27                                 | 2955.67 | 2962.97 | 25.764            | 25.844 | 25.804 | 2.502          | 2.686 | 2.594  |
| D2W1                | 828.55                            | 845.18 | 836.87 | 3430.97                            | 2592.42 | 2597.42 | 3430.97                                 | 3437.60 | 3434.28 | 26.088            | 25.275 | 25.681 | 2.580          | 2.764 | 2.672  |
| D2W2                | 810.62                            | 830.58 | 820.60 | 3109.82                            | 2455.87 | 2377.53 | 3109.82                                 | 3286.45 | 3198.13 | 25.872            | 25.205 | 25.539 | 2.532          | 2.716 | 2.624  |
| D2W3                | 800.80                            | 820.77 | 810.78 | 3073.28                            | 2432.48 | 2352.48 | 3073.28                                 | 3253.25 | 3163.27 | 26.080            | 25.230 | 25.655 | 2.498          | 2.683 | 2.591  |
| D2W4                | 774.65                            | 797.28 | 785.97 | 2966.48                            | 2365.17 | 2278.50 | 2966.48                                 | 3162.45 | 3064.47 | 26.153            | 25.211 | 25.682 | 2.462          | 2.646 | 2.554  |
| D2W5                | 782.47                            | 809.10 | 795.78 | 3036.33                            | 2400.53 | 2327.20 | 3036.33                                 | 3209.63 | 3122.98 | 25.795            | 25.207 | 25.501 | 2.473          | 2.658 | 2.566  |
| D2W6                | 814.63                            | 837.93 | 826.28 | 3151.40                            | 2486.77 | 2411.77 | 3151.40                                 | 3324.70 | 3238.05 | 24.225            | 24.588 | 24.407 | 2.532          | 2.716 | 2.624  |
| D2W7                | 416.88                            | 464.28 | 440.58 | 1783.75                            | 1649.17 | 1508.02 | 1783.75                                 | 2113.45 | 1948.60 | 23.304            | 21.927 | 22.616 | 2.417          | 2.601 | 2.509  |
| D2W8                | 848.25                            | 855.55 | 851.90 | 3429.03                            | 2714.12 | 2647.45 | 3429.03                                 | 3569.67 | 3499.35 | 24.776            | 23.967 | 24.371 | 2.637          | 2.821 | 2.729  |
| D3W1                | 684.57                            | 794.83 | 794.62 | 3048.32                            | 2173.92 | 2213.92 | 3048.32                                 | 2968.75 | 3008.53 | 26.795            | 27.691 | 27.243 | 2.535          | 2.719 | 2.627  |
| D3W2                | 776.80                            | 780.23 | 778.52 | 2900.83                            | 2037.37 | 2080.70 | 2900.83                                 | 2817.60 | 2859.22 | 26.841            | 27.581 | 27.211 | 2.517          | 2.701 | 2.609  |
| D3W3                | 717.76                            | 770.42 | 763.53 | 2850.63                            | 2013.98 | 2053.98 | 2850.63                                 | 2784.40 | 2817.52 | 26.560            | 27.667 | 27.113 | 2.435          | 2.619 | 2.527  |
| D3W4                | 734.55                            | 746.93 | 743.38 | 2773.83                            | 1946.67 | 1988.33 | 2773.83                                 | 2693.60 | 2733.72 | 26.846            | 27.727 | 27.287 | 2.398          | 2.583 | 2.491  |
| D3W5                | 710.72                            | 758.75 | 751.37 | 2779.35                            | 1982.03 | 2008.70 | 2779.35                                 | 2740.78 | 2760.07 | 26.799            | 27.681 | 27.240 | 2.410          | 2.594 | 2.502  |
| D3W6                | 787.48                            | 787.58 | 787.53 | 2935.75                            | 2068.27 | 2108.27 | 2935.75                                 | 2855.85 | 2895.80 | 26.075            | 26.776 | 26.425 | 2.517          | 2.701 | 2.609  |
| D3W7                | 709.05                            | 416.50 | 399.62 | 1664.43                            | 1409.17 | 1345.43 | 1664.43                                 | 1825.67 | 1745.05 | 22.959            | 22.853 | 22.906 | 2.353          | 2.538 | 2.446  |
| D3W8                | 735.13                            | 805.20 | 809.65 | 3209.72                            | 2295.62 | 2345.62 | 3209.72                                 | 3100.82 | 3155.27 | 25.395            | 25.975 | 25.685 | 2.573          | 2.758 | 2.666  |
| SE (m ±)            |                                   |        |        |                                    |         |         |                                         |         |         |                   |        |        |                |       |        |
| D*W                 | 8.92                              | 9.13   | 9.02   | 26.001                             | 31.864  | 28.93   | 25.310                                  | 20.897  | 19.009  | 0.301             | 0.205  | 0.0253 | 0.009          | 0.020 | 0.014  |
| W*D                 | 10.14                             | 9.82   | 9.98   | 29.91                              | 36.81   | 33.36   | 40.41                                   | 46.93   | 43.67   | 0.332             | 0.534  | 0.247  | 0.027          | 0.013 | 0.017  |
| C.D.at 5%           |                                   |        |        |                                    |         |         |                                         |         |         |                   |        |        |                |       |        |
| D*W                 | 25.77                             | 30.12  | 25.977 | 76.81                              | 88.88   | 79.84   | 86.054                                  | 64.96   | 52.82   | NS                | NS     | NS     | NS             | NS    | NS     |
| W*D                 | 34.17                             | 27.59  | 28.04  | 104.69                             | 102.89  | 107.08  | 121.23                                  | 139.32  | 125.76  | NS                | NS     | NS     | NS             | NS    | NS     |

## Conclusion

The seed yield, stalk yield, biological yield and harvest index were significantly influenced by main and sub plot treatments. The interactions were also found to be statistically significant.

Among the sowing dates, March 7th sowing registered significantly higher seed yield ( $771.10 \text{ kg ha}^{-1}$ ), stalk yield ( $2312.55 \text{ kg ha}^{-1}$ ) and biological yield ( $3083.64 \text{ kg ha}^{-1}$ ). Maximum harvest index (26.61) was observed in  $D_1$ . Among the weed management practices,  $W_8$  (weed free condition) and  $W_1$  [application of Pendimethalin @  $1 \text{ kg a.i. ha}^{-1}$  (2 DAS) + Hand weeding (30 DAS)] recorded significantly higher seed yield ( $808.58$  and  $791.88 \text{ kg ha}^{-1}$  respectively), stalk yield ( $2397.28 \text{ kg ha}^{-1}$  and  $2343.35 \text{ kg ha}^{-1}$  respectively) and biological yield ( $3205.86$  and  $3135.24 \text{ kg ha}^{-1}$  respectively), however, treatment  $W_4$  [Pendimethalin @  $1 \text{ kg a.i. ha}^{-1}$  (2 DAS) + Quizalofop ethyl @  $50 \text{ g a.i. ha}^{-1}$  (30 DAS)] recorded significantly higher HI (26.83%). Among interactions, maximum seed yield, stalk yield and biological yield were recorded under sowing on March 7th ( $D_2$ ) with  $W_8$  (Weed free plot) i.e.  $D_2W_8$  followed by treatments  $D_2W_1$ .

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