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## Influence of different sowing windows on growth of *kharif* cowpea varieties

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### Abstract

The field experiment was conducted at Mulegaon Agricultural Farm, Zonal Agricultural Research Station, Solapur. Experiment was laid out in split plot design with four sowing windows *viz.* 25 MW (18-24 June), 27 MW (02-08 July), 29 MW (16-22 July) and 31 MW (30 July – 05 August) as main plot treatments and three varieties *viz.*, Phule Vithai, Phule Rakhumai and Phule Sonali as sub plot treatments. The recommended cultural practices and plant protection measures were followed. The crop sown in S<sub>1</sub>-25 MW (18-24 June) produced significantly more plant height (68.56cm), number of branches plant<sup>-1</sup> (10.46), leaf area index (2.68) and total dry matter (17.19 gm) than other sowing windows and it decreases significantly in delayed sowing windows in 27 MW (02-08 July), 29 MW (16-22 July) and 31 MW (30 July – 05 August) respectively during the period of experimentation. From this experiment, it was concluded that *kharif* cowpea sown during S<sub>1</sub>-25 MW (18-24 June) favorably influenced growth contributing characters.

**Keywords:** Cowpea, sowing window, variety, growth contributing characters

### 1. Introduction

The United Nations' Food and Agriculture Organization recognized pulses as important crops in the endeavor to achieve global food security. In particular, cowpea (*Vigna unguiculata*) integrates into the social, economic and environmental aspects of sustainable development. It is a heat and drought resistant legume that is abundant in vital plant nutrients including carbohydrates, fiber, minerals and vitamins as well as a low-cost substitute for animal protein. Its capacity to fix atmospheric nitrogen into the soil reduces the requirement for fertilization and promotes the use of crop rotation and intercropping techniques (Graham and Vance, 2003)<sup>[5]</sup>. Despite the crop's significance for the rural livelihood, seed yields have always been low and variable. The key ecological elements that affect yield are the soil, climate, pests and diseases. Therefore, any changes to these variables could result in changes in yield, which would then contribute to inter-annual variations in crop. Low cowpea output has also been attributed to poor production practices such as cultivar selection, adaptation and a lack of information on the best planting date for new genotypes. Cowpea is typically grown in *rainfed* conditions. The amount and distribution of rainfall, which is controlled by the planting period affects both the quality and quantity of cowpea seed (Morakinyo and Ajibade, 1998)<sup>[7]</sup>. Identifying the optimal sowing time for a crop in any location is a critical agronomic requirement for high and sustained productivity (Akande *et al.* 2012)<sup>[3]</sup>. The year, location, planting dates and climatic factors of a location frequently influence crop production by interacting with cultivars and their traits. With these consideration in view, the investigation was planned to find out suitable sowing window for *kharif* season as well as to find out suitable cowpea variety and interaction effect between sowing windows and varieties in *kharif* season.

### 2. Materials and Methods

A field experiment was conducted on growth and yield parameters of *kharif* cowpea at Mulegaon Agricultural Farm, Zonal Agricultural Research Station, Solapur during *kharif*, 2021. A total of three varieties *viz.*, Phule Vithai, Phule Rakhumai and Phule Sonali were evaluated on four sowing dates (25 MW, 27 MW, 29 MW and 31 MW) at 12 days interval starting from 24 DAS in split plot design with four main plots as sowing windows and three sub-plots as varieties. Recommended practices were followed. All the observations on growth parameters were recorded at different growth stages of plant and observations on yield and yield components of *kharif* cowpea were recorded after harvesting of the crop.

### 3. Results and Discussion

#### 3.1 Plant height (cm)

The data in respect of periodical plant height as influenced by different sowing windows and varieties are presented in Table 1 and graphically depicted in Figure 1. The initial mean plant height was 16 cm during growing season. It was increased with advancement in crop age and reached maximum up to 65.21 cm at harvest.

##### 3.1.1 Effect of sowing windows

The data presented in Table 1 revealed that the mean plant height of cowpea was affected significantly in all growth stages due to sowing windows except 24 DAS. It was increased gradually up to 60 DAS later it remains same. The plant height was significantly higher at S<sub>1</sub> (25 MW) during the growth stages 36, 48, 60 DAS and at harvest i.e. 40.14 cm, 48.83 cm, 68.56 cm and 68.56 cm respectively. However the values were statistically at par with S<sub>2</sub> (27 MW) at 36, 48, 60 DAS and at harvest i.e. 38.89 cm, 46.71 cm, 66.15 cm, and 66.15 cm respectively and S<sub>3</sub> (29 MW) at 60 DAS and at harvest i.e. 64.08 cm and 64.08 cm respectively. Further the plant height was significantly lower in case of S<sub>4</sub> (31 MW) during the growth stages 36, 48, 60 DAS and at harvest i.e. 34.49 cm, 41.55 cm, 62.04 cm and 62.04 cm respectively. It

showed that the mean plant height increased with increase in age of crop. Similar results were reported by Kumar and Singh (1998) [6].

##### 3.1.2 Effect of varieties

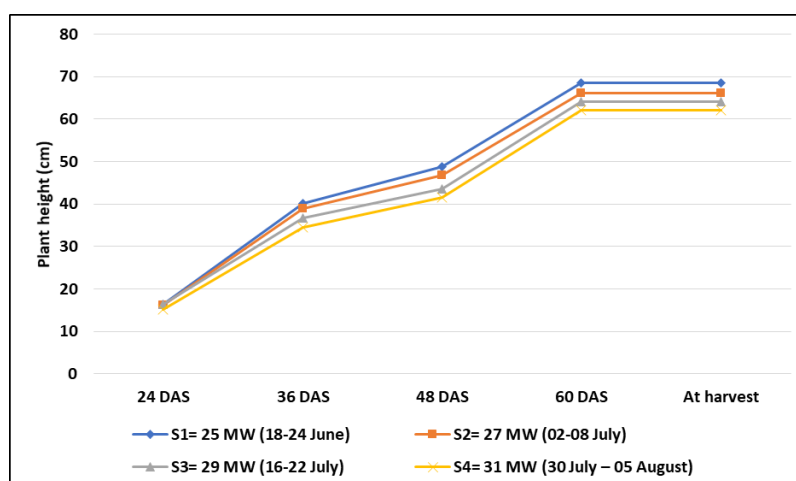
The data presented in Table 1 revealed that the mean plant height of cowpea was affected significantly in all growth stages in all varieties except 24 DAS. The variety V<sub>1</sub>-Phule Vithai was found significantly superior over other varieties in producing maximum plant height during all crop growth period except 24 DAS. The mean plant height of Phule Vithai was 46.27 cm, 56.37 cm, 77.97 cm and 77.97 cm at 36, 48, 60 DAS and at harvest respectively. It was followed by varieties V<sub>2</sub>-Phule Rakhumai and V<sub>3</sub>-Phule Sonali respectively. The lowest plant height was observed with variety V<sub>3</sub>-Phule Sonali which was 25.40 cm, 29.01 cm, 43.56 cm and 43.56 cm at growth stages 36, 48, 60 DAS and harvest respectively. It might be due to genetic potential. These results support earlier research by Birari *et al.* (1993) [4].

##### 3.1.3 Effect of interaction

Mean number of plant height was not significantly influenced by the interaction of sowing windows and varieties during different crop growth stages.

**Table 1:** Periodical mean plant height (cm) as influenced by various treatment

| Treatment                                    | Mean plant height (cm) |       |       |       |            |
|--|------------------------|-------|-------|-------|------------|
|  | Days after sowing      |       |       |       |            |
|  | 24                     | 36    | 48    | 60    | At harvest |
| <b>Sowing windows (S)</b>                    |                        |       |       |       |            |
| S <sub>1</sub> = 25 MW (18-24 June)          | 16.31                  | 40.14 | 48.83 | 68.56 | 68.56      |
| S <sub>2</sub> = 27 MW (02-08 July)          | 16.22                  | 38.89 | 46.71 | 66.15 | 66.15      |
| S <sub>3</sub> = 29 MW (16-22 July)          | 16.27                  | 36.69 | 43.58 | 64.08 | 64.08      |
| S <sub>4</sub> = 31 MW (30 July – 05 August) | 15.19                  | 34.49 | 41.55 | 62.04 | 62.04      |
| S.Em±  | 0.35                   | 0.87  | 1.04  | 1.42  | 1.42       |
| C.D. at 5%                                   | NS                     | 2.78  | 3.32  | 4.53  | 4.53       |
| <b>Varieties (V)</b>                         |                        |       |       |       |            |
| V <sub>1</sub> = PhuleVithai                 | 16.24                  | 46.27 | 56.37 | 77.97 | 77.97      |
| V <sub>2</sub> = Phule Rakhumai              | 15.83                  | 40.98 | 50.12 | 74.09 | 74.09      |
| V <sub>3</sub> =Phule Sonali                 | 15.94                  | 25.40 | 29.01 | 43.56 | 43.56      |
| S.Em±  | 0.26                   | 0.47  | 0.78  | 1.04  | 1.04       |
| C.D. at 5%                                   | NS                     | 1.38  | 2.27  | 3.04  | 3.04       |
| <b>Interaction (SXV)</b>                     |                        |       |       |       |            |
| S.Em±  | 0.51                   | 0.95  | 1.55  | 2.08  | 2.08       |
| C.D. at 5%                                   | NS                     | NS    | NS    | NS    | NS         |
| General mean                                 | 16.00                  | 37.55 | 45.17 | 65.21 | 65.21      |



**Fig 1:** Mean plant height (cm) as influenced by different sowing windows.

### 3.2 Mean number of branches plant<sup>-1</sup>

The data in respect of mean number of branches plant<sup>-1</sup> as influenced by different sowing windows and varieties are presented in Table 2 and graphically depicted in Figure 2. The mean number of branches plant<sup>-1</sup> at 24, 36, 48, 60 DAS and at harvest were 2.86, 5.39, 7.22, 9.43 and 9.43 respectively. It showed that the mean number of branches increased with increase in age of crop.

#### 3.2.1 Effect of sowing windows

The data presented in Table 2 revealed that the mean number of branches plant<sup>-1</sup> of cowpea was affected significantly in all growth stages due to sowing windows except 24 DAS. The mean number of branches plant<sup>-1</sup> at harvest was significantly higher at S<sub>1</sub> 25 MW (10.46). It was followed by the sowing windows S<sub>2</sub> 27 MW (9.33), S<sub>3</sub> 29 MW (9.23) and S<sub>4</sub> 31 MW (8.71). Similar results were found by Saraf and Upadhyay (1994) [8].

#### 3.2.2 Effect of varieties

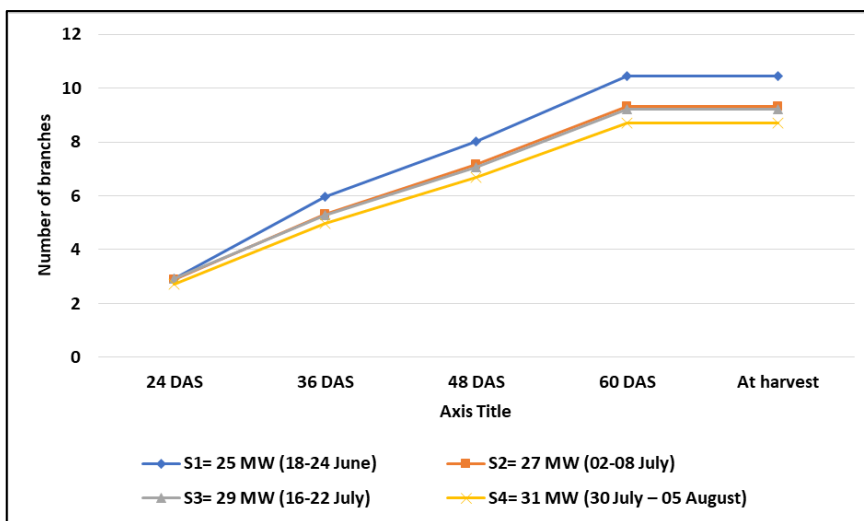
The Variety V<sub>1</sub>-Phule Vithai was found significantly superior over other varieties in producing maximum number of branches plant<sup>-1</sup> during all crop growth period except 24 DAS. The mean number of branches plant<sup>-1</sup> at harvest of V<sub>1</sub>-Phule Vithai was 11.01. The less number of branches plant<sup>-1</sup> at harvest was observed with V<sub>3</sub>-Phule Sonali i.e. 7.05.

### 3.2.3 Interaction effect

The number of branches produced plant<sup>-1</sup> did not differ significantly due to the interaction of sowing windows and varieties.

**Table 2:** Periodical number of branches as influenced by various treatments.

| Treatment                                    | Mean number of branches |             |             |             |             |
|--|-------------------------|-------------|-------------|-------------|-------------|
|  | Days after sowing       |             |             |             |             |
|  | 24                      | 36          | 48          | 60          | At harvest  |
| <b>Sowing windows (S)</b>                    |                         |             |             |             |             |
| S <sub>1</sub> = 25 MW (18-24 June)          | 2.91                    | 5.98        | 8.01        | 10.46       | 10.46       |
| S <sub>2</sub> = 27 MW (02-08 July)          | 2.90                    | 5.33        | 7.15        | 9.33        | 9.33        |
| S <sub>3</sub> = 29 MW (16-22 July)          | 2.91                    | 5.28        | 7.07        | 9.23        | 9.23        |
| S <sub>4</sub> = 31 MW (30 July – 05 August) | 2.71                    | 4.98        | 6.67        | 8.71        | 8.71        |
| S.Em±  | 0.06                    | 0.11        | 0.15        | 0.19        | 0.19        |
| C.D. at 5%                                   | NS                      | 0.34        | 0.48        | 0.61        | 0.61        |
| <b>Varieties (V)</b>                         |                         |             |             |             |             |
| V <sub>1</sub> = PhuleVithai                 | 2.90                    | 6.36        | 8.53        | 11.01       | 11.01       |
| V <sub>2</sub> = Phule Rakhumai              | 2.83                    | 5.85        | 7.84        | 10.24       | 10.24       |
| V <sub>3</sub> =Phule Sonali                 | 2.85                    | 3.96        | 5.30        | 7.05        | 7.05        |
| S.Em±  | 0.05                    | 0.10        | 0.15        | 0.16        | 0.16        |
| C.D. at 5%                                   | NS                      | 0.30        | 0.45        | 0.47        | 0.47        |
| <b>Interaction (SXV)</b>                     |                         |             |             |             |             |
| S.Em±  | 0.09                    | 0.21        | 0.31        | 0.32        | 0.32        |
| C.D. at 5%                                   | NS                      | NS          | NS          | NS          | NS          |
| <b>General mean</b>                          | <b>2.86</b>             | <b>5.39</b> | <b>7.22</b> | <b>9.43</b> | <b>9.43</b> |



**Fig 2:** Mean number of branches as influenced by different sowing windows.

### 3.3 Leaf area index

The data in respect of leaf area index as influenced by different sowing windows and varieties are presented in Table 3 and graphically depicted in Figure 3. The mean leaf area index at 24, 36, 48, 60 DAS and at harvest were 0.30, 0.77, 2.55, 2.34 and 2.05 respectively. It showed that the leaf area index increased with increase in age of crop up to 48 DAS then it decreases towards harvest.

#### 3.3.1 Effect of sowing windows

The data presented in Table 3 revealed that the leaf area index of cowpea was affected significantly in all growth stages due to sowing windows except 24 DAS. The leaf area index was significantly higher at S<sub>1</sub>-25 MW during the growth stages 36, 48, 60 DAS and at harvest i.e. 0.83, 2.68, 2.51 and 2.24

respectively but it is at par with the sowing windows S<sub>2</sub>-27 MW i.e. 2.67, 2.47 and 2.22 and S<sub>3</sub>-29 MW i.e. 2.64, 2.41 and 2.12 during the growth stages 48 DAS, 60 DAS and at harvest respectively. The lowest leaf area index is found in the sowing window S<sub>4</sub>-31 MW at the growth stages 36 DAS, 48 DAS, 60 DAS and at harvest i.e. 0.71, 2.21, 1.99 and 1.61 respectively.

#### 3.3.2 Effect of varieties

The variety V<sub>3</sub>-Phule Sonali was found significantly superior over other varieties in producing maximum leaf area index during all crop growth period except 24 DAS. The leaf area index of V<sub>3</sub>-Phule Sonali was 0.87, 2.88, 2.72 and 2.42 at 36 DAS, 48 DAS, 60 DAS and at harvest respectively. The Phule Rakhumai produced less leaf area index during all crop

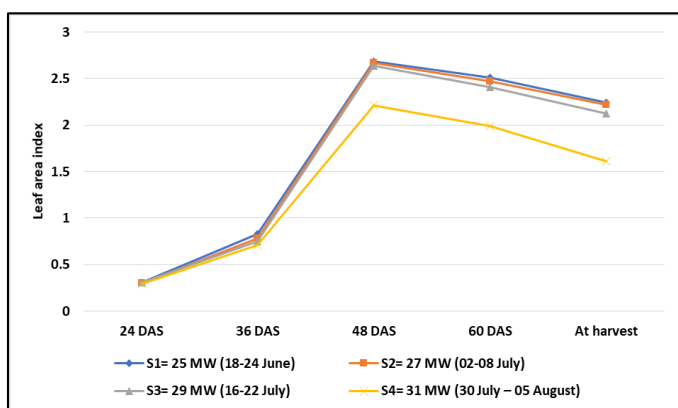
growth period except 24 DAS. The leaf area index of Phule Rakhumai was 0.65, 2.20, 1.96 and 1.74 at 36 DAS, 48 DAS, 60 DAS and at harvest respectively. Similar results were found by Ahmed *et al.* (2010) [2].

### 3.3.3 Effect of interaction

The leaf area index was not significantly influenced by the interaction of sowing windows and varieties during different crop growth stages.

**Table 3:** Periodical leaf area index as influenced by various treatments

| Treatment                                    | Leaf area index   |      |      |      |            |
|--|-------------------|------|------|------|------------|
|  | Days after sowing |      |      |      |            |
|  | 24                | 36   | 48   | 60   | At harvest |
| <b>Sowing windows (S)</b>                    |                   |      |      |      |            |
| S <sub>1</sub> = 25 MW (18-24 June)          | 0.31              | 0.83 | 2.68 | 2.51 | 2.24       |
| S <sub>2</sub> = 27 MW (02-08 July)          | 0.30              | 0.78 | 2.67 | 2.47 | 2.22       |
| S <sub>3</sub> = 29 MW (16-22 July)          | 0.31              | 0.75 | 2.64 | 2.41 | 2.12       |
| S <sub>4</sub> = 31 MW (30 July – 05 August) | 0.29              | 0.71 | 2.21 | 1.99 | 1.61       |
| S.Em±  | 0.01              | 0.02 | 0.06 | 0.05 | 0.07       |
| C.D. at 5%                                   | NS                | 0.05 | 0.18 | 0.17 | 0.22       |
| <b>Varieties (V)</b>                         |                   |      |      |      |            |
| V <sub>1</sub> = PhuleVithai                 | 0.30              | 0.78 | 2.57 | 2.36 | 1.99       |
| V <sub>2</sub> = Phule Rakhumai              | 0.30              | 0.65 | 2.20 | 1.96 | 1.74       |
| V <sub>3</sub> =Phule Sonali                 | 0.30              | 0.87 | 2.88 | 2.72 | 2.42       |
| S.Em±  | 0.00              | 0.01 | 0.03 | 0.03 | 0.05       |
| C.D. at 5%                                   | NS                | 0.04 | 0.10 | 0.09 | 0.14       |
| <b>Interaction (SXV)</b>                     |                   |      |      |      |            |
| S.Em±  | 0.01              | 0.03 | 0.07 | 0.06 | 0.10       |
| C.D. at 5%                                   | NS                | NS   | NS   | NS   | NS         |
| <b>General mean</b>                          | 0.30              | 0.77 | 2.55 | 2.34 | 2.05       |



**Fig 3:** Mean leaf area index as influenced by different sowing windows.

### 3.4 Dry matter accumulation plant<sup>-1</sup>

The periodical dry matter accumulation plant<sup>-1</sup> as influenced by different sowing windows and varieties are presented in

Table 4 and graphically depicted in Figure 4.

The plant had accumulated hardly 0.74 g mean dry matter plant<sup>-1</sup> on initial stage of 24 DAS during the period of experimentation. The mean dry matter accumulation increased rapidly thereafter and reached maximum of 15.83 g dry matter plant<sup>-1</sup> at 60 DAS then it decreases slightly at harvest i.e. 13.81 g dry matter plant<sup>-1</sup>.

### 3.4.1 Effect of sowing windows

The data presented in Table 4 revealed that the dry matter accumulation plant<sup>-1</sup> of cowpea was affected significantly in all growth stages due to sowing windows except 24 DAS. It was increased gradually up to 60 DAS later it decreases slightly at harvest. The cowpea sown in S<sub>1</sub> (25 MW) accumulated significantly more dry matter plant<sup>-1</sup> at 60 DAS i.e. 17.19 g. However, dry matter plant<sup>-1</sup> of S<sub>1</sub> (25 MW) was at par with sowing window S<sub>2</sub> (27 MW) i.e. 16.22 g which was followed by S<sub>3</sub> (29 MW) i.e. 15.51 g and S<sub>4</sub> (31 MW) i.e. 14.39 g respectively.

### 3.4.2 Effect of varieties

The cowpea variety V<sub>3</sub>-Phule Sonali was found significantly higher dry matter accumulation plant<sup>-1</sup> at 60 DAS i.e. 17.06 g. However the values were statistically at par with V<sub>1</sub>-Phule Vithai at 60 DAS i.e. 16.28 g. The less dry matter production was recorded with V<sub>2</sub>-Phule Rakhumai i.e. 14.15 g. Similar results we re found by Addo-Quaye *et al.* (2011) [1]

### 3.4.3 Effect of interaction

The dry matter was not significantly influenced due to interaction effects between sowing windows and varieties at all growth stages.

**Table 4:** Periodical dry matter accumulation plant<sup>-1</sup> as influenced by various treatments

| Treatment                                    | Mean number of branches |      |      |       |            |
|--|-------------------------|------|------|-------|------------|
|  | Days after sowing       |      |      |       |            |
|  | 24                      | 36   | 48   | 60    | At harvest |
| <b>Sowing windows (S)</b>                    |                         |      |      |       |            |
| S <sub>1</sub> = 25 MW (18-24 June)          | 0.76                    | 3.44 | 9.70 | 17.19 | 15.15      |
| S <sub>2</sub> = 27 MW (02-08 July)          | 0.75                    | 3.31 | 9.20 | 16.22 | 14.29      |
| S <sub>3</sub> = 29 MW (16-22 July)          | 0.76                    | 3.10 | 8.69 | 15.51 | 13.46      |
| S <sub>4</sub> = 31 MW (30 July – 05 August) | 0.71                    | 2.94 | 8.25 | 14.39 | 12.35      |
| S.Em±  | 0.02                    | 0.08 | 0.17 | 0.38  | 0.38       |
| C.D. at 5%                                   | NS                      | 0.27 | 0.53 | 1.21  | 1.22       |
| <b>Varieties (V)</b>                         |                         |      |      |       |            |
| V <sub>1</sub> = PhuleVithai                 | 0.75                    | 3.22 | 9.19 | 16.28 | 14.30      |
| V <sub>2</sub> = Phule Rakhumai              | 0.73                    | 2.86 | 8.01 | 14.15 | 12.12      |
| V <sub>3</sub> =Phule Sonali                 | 0.74                    | 3.50 | 9.67 | 17.06 | 15.02      |
| S.Em±  | 0.01                    | 0.07 | 0.20 | 0.26  | 0.28       |
| C.D. at 5%                                   | NS                      | 0.20 | 0.57 | 0.76  | 0.83       |
| <b>Interaction (SXV)</b>                     |                         |      |      |       |            |
| S.Em±  | 0.02                    | 0.13 | 0.39 | 0.52  | 0.57       |
| C.D. at 5%                                   | NS                      | NS   | NS   | NS    | NS         |
| <b>General mean</b>                          | 0.74                    | 3.20 | 8.96 | 15.83 | 13.81      |

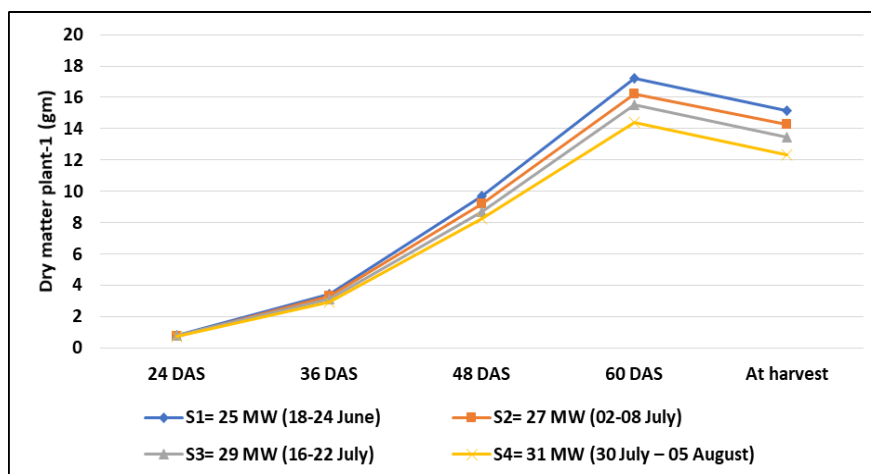


Fig 4: Dry matter plant<sup>-1</sup> as influenced by different sowing windows

#### 4. Conclusions

The crop sown in S<sub>1</sub>-25 MW (18-24 June) produced significantly more plant height (68.56cm), number of branches plant<sup>-1</sup> (10.46), leaf area index (2.68) and total dry matter (17.19 gm) than other sowing windows and it decreases significantly in delayed sowing windows in 27 MW (02-08 July), 29 MW (16-22 July) and 31 MW (30 July – 05 August) respectively at all the growth stages during period of experimentation. The important plant growth attributes viz. plant height (77.97 cm) and number of branches plant<sup>-1</sup> (11.01) was recorded highest in V<sub>1</sub>-Phule Vithai and significantly decreased in V<sub>2</sub> Phule Rakhumai and V<sub>3</sub>-Phule Sonali respectively. The leaf area index (2.72) and dry matter plant<sup>-1</sup> (17.06 gm) was found highest in Phule Sonali during 60 DAS and it was significantly decreased in Phule Vithai and Phule Rakhumai respectively. The lower plant height and number of branches plant<sup>-1</sup> of V<sub>3</sub>-Phule Sonali is due to its determinate growth character where, there is single flush of flowers and picking. In contrast V<sub>1</sub>-Phule Vithai and V<sub>2</sub> Phule Rakhumai having higher plant height and number of branches plant<sup>-1</sup> due to its indeterminate growth character where, there is multiple flush of flowers and picking.

#### 5. Acknowledgments

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