INFLUENCE OF SOWING PERIOD ON FLORAL CHARACTERS OF MAIZE (ZEA MAYS L.) DURING RAINY AND SPRING SEASONS

*V Sandeep Varma, K Kanaka Durga, K Keshavulu and N Sunil

Seed Research and Technology Centre, Rajendranagar, Hyderabad.

*Corresponding Author’s Email: sandeepvunnam81@gmail.com

Abstract

Studies on “Influence of sowing period on floral characters of Maize (Zea mays L.) during rainy and spring seasons” was carried out under field conditions at SRTC, Hyderabad, India during the year 2012. Female (BML 6) and male (BML 7) parents of DHM 117 were sown at fortnightly intervals (from first fortnight of June to second fortnight of December) in 4:1 row ratio in RBD with three replications. During rainy season, first pollen shed (57 days), 50 % pollen shed (61 days), first silking (54 days) and 50 % silking (60 days) were early when Maize was sown during August second fortnight, while high pollen viability (97.5 %) was recorded during June second fortnight. With respect to tassel characters, long tassels (36.5 cm) during September first fortnight sowing, more number of pollen shedding spikelets tassel$^{-1}$ (758) and total spikelet branches tassel$^{-1}$ (13.3) during first fortnight of june were observed. Sowing in June first fortnight resulted in tall female plants (128.4 cm), while tall male plants (162.3 cm) were observed during September first fortnight sowing. During spring season, first pollen shed (66 days), 50 % pollen shed (70 days), first silking (64 days) and 50 % silking (68 days) were early when Maize was sown during September second fortnight. High pollen viability (98.1 %) at 9 AM and at 2 PM (94.4 %) was recorded during September second fortnight sowing. Among tassel characters, long tassels (34.1 cm), more number of pollen shedding spikelets tassel$^{-1}$ (801) and total branches tassel$^{-1}$ (15.2) were observed during September second fortnight and October first fortnight sowing.

Keywords: Maize, Sowing date, Pollen and Floral characters

Introduction

Maize (Zea mays L., 2n=20) occupies third position among the cereal crops after rice and wheat in the world. It is the most versatile crop with wide adaptability to varied agro-ecologies. The most contributing factor for its success is the highest genetic yield potential among the food grain crops. The crop is cultivated in different parts of the country throughout the year for various purposes like grain, fodder, green cobs, sweet corn, baby corn, popcorn etc. Nonfood products of commercial importance such as starch, alcohol and dextrins are also manufactured from Maize. Ethanol is produced from Maize which is a substitute for petroleum based fuels. The United States of America is the largest producer, contributing 20 % of the world’s Maize production. The other important Maize growing countries are China, Brazil, Mexico, India and Indonesia. The time of sowing is one of the basic agronomic practices which have a greater and a very important role on seed productivity particularly in India where the optimum time of sowing varies considerably due to widely varying agro-climatic conditions and due to the intricate crop weather relationship especially in Maize.

With the development of hybrids, the yield has been enhanced to a greater extent. But a bottle neck comes in this way is the difference in the flowering time of the parental lines, which has drastic effect on the seed set. The most important determining factor for the hybrid seed production of Maize is the synchronization of flowering of male and female parents.

To achieve the effective seed set, the stage of stigma receptivity and the stage of anthesis of the seed parent and pollinator parent should coincide. These relationships with climate can also be useful for estimating planting dates in regions where there are no observations. With
this background, the present investigation on effect of sowing date on floral behavior in Maize was undertaken.

Materials and Methods

A field experiment was conducted at Seed Research and Technology Centre, Acharya N.G. Ranga Agricultural University, Rajendranagar, Hyderabad and was laid out in a Randomized Block Design (RBD) with three replications. Planting of female (BML 6) and male (BML 7) parents of DHM 117 was taken up in ratio of 4:1 in a plot size of 49.25 m² per each plot with a spacing of 60 x 25 cm. Fortnightly sowings were taken up during first fortnight of June to second fortnight of December with a total of seven sowings for rainy season and seven sowings for spring season as treatments.

Observations like days to first pollen shed, days to 50 % pollen shed, days to first silking, days to 50 % silking, tassel length (cm), number of pollen shedding spikelets tassel¹, total number of silks cob¹, and pollen viability (%) were taken on male and female parents. The data collected from the experiment was analyzed statistically as per the procedure given by Panse and Sukhatme (1985). Critical differences were calculated at 5 % level.

Results and Discussion

Table 1: Influence of planting window on flowering behavior of the parental lines (BML 6 and BML 7) of Maize hybrid, DHM 117 during Rainy season, 2012

<table>
<thead>
<tr>
<th>Dates of sowing</th>
<th>Days to first pollen shed</th>
<th>Days to 50 % pollen shed</th>
<th>Days to first silking</th>
<th>Days to 50 % silking</th>
<th>Tassel length (cm)</th>
<th>No. of pollen shedding spikelets tassel¹</th>
<th>No. of pollen shedding days</th>
<th>Total spikelet branches tassel¹</th>
<th>Pollen viability (%) 9 AM 2 PM</th>
</tr>
</thead>
<tbody>
<tr>
<td>01-06-2012</td>
<td>66</td>
<td>68</td>
<td>59</td>
<td>71</td>
<td>31.1</td>
<td>758</td>
<td>4.3</td>
<td>13.3</td>
<td>96.7</td>
</tr>
<tr>
<td>15-06-2012</td>
<td>61</td>
<td>65</td>
<td>57</td>
<td>72</td>
<td>30.2</td>
<td>618</td>
<td>4.3</td>
<td>11.2</td>
<td>97.5</td>
</tr>
<tr>
<td>01-07-2012</td>
<td>65</td>
<td>70</td>
<td>67</td>
<td>70</td>
<td>33.2</td>
<td>675</td>
<td>4.3</td>
<td>12.1</td>
<td>93.2</td>
</tr>
<tr>
<td>15-07-2012</td>
<td>66</td>
<td>68</td>
<td>62</td>
<td>69</td>
<td>33.1</td>
<td>504</td>
<td>4.0</td>
<td>9.0</td>
<td>90.7</td>
</tr>
<tr>
<td>01-08-2012</td>
<td>63</td>
<td>75</td>
<td>60</td>
<td>71</td>
<td>32.3</td>
<td>670</td>
<td>5.3</td>
<td>12.8</td>
<td>95.4</td>
</tr>
<tr>
<td>15-08-2012</td>
<td>57</td>
<td>61</td>
<td>54</td>
<td>60</td>
<td>29.0</td>
<td>665</td>
<td>4.7</td>
<td>10.9</td>
<td>97.3</td>
</tr>
<tr>
<td>01-09-2012</td>
<td>63</td>
<td>66</td>
<td>59</td>
<td>64</td>
<td>36.5</td>
<td>559</td>
<td>4.7</td>
<td>12.4</td>
<td>95.2</td>
</tr>
</tbody>
</table>

Sowing in September first fortnight produced significantly long tassel (36.5 cm), mainly due to the expansion of the tassels under favorable weather conditions like moderate rainfall coupled with adequate relative humidity and proper sunshine hours. June first fortnight sowing recorded significantly more number of pollen shedding spikelets tassel¹ (758) compared to July first fortnight sowing (675). Sowing in June second fortnight recorded higher pollen viability (97.5 %) followed by August second fortnight (97.3 %) sowing and Pollen viability was more in early plantings (June) and slowly decreased for July sowings and further increased during late sowing (August and September) (Fig 2). The decrease in pollen viability might be due to the changes that occurred in the weather conditions i.e., high rainfall of 16.6 mm coupled with low sunshine hours (6.3) which might have contributed to the low pollen viability for July sowings. Lower pollen viability at high temperatures could be related to degeneration of

During Rainy season

The first pollen shed was early in August second fortnight sowing (57 days) and first silking was early in August second fortnight sowing (54 days) which was due to the prevailing moderate temperatures (26.35 ºC) and relatively high relative humidity (87.27 %) at the time of sowing, favouring the crop growth (Tab. 1). August first fortnight sowing recorded 75 days for 50 % pollen shed whereas delay in sowing to August second fortnight recorded 61 days for 50 % pollen shed which was early by two weeks. This was in conformity with the findings of Sangoi (1993) who reported that the period between emergence and anthesis of Maize hybrids planted earlier in the season can be up to two weeks longer when the same cultivar is planted later. Days to 50 % silking were early in August second fortnight sowing (60 days) followed by September first fortnight (64 days) (Fig. 1). This was in conformity with the findings of William et al. (1977) who reported that differences in development rate from planting to half-silk (when 50 % of plants have silked) varied with location and with planting date within a location.
tapetum layer in snap bean (Suzuki et al., 2001), and/or decreased carbohydrate metabolism (Datta et al., 2001 and Karni and Aloni, 2002), all of which could significantly influence nourishment of pollen mother cells there by leading to infertile pollen.

![Graph](image)

**Fig. 1**: Days to 50 % pollen shed and silking at different planting windows during *Rainy*, 2012

![Graph](image)

**Fig. 2**: Influence of planting window on pollen viability during *Rainy Season*, 2012

**During spring season**

The first pollen shed was early in September second fortnight sowing (66 days) followed by October first fortnight (69 days) and this could be due to prevailing moderate temperatures (26.6 °C) coupled with relatively high relative humidity (88.9 %) at the sowing time, which favored the crop growth (Tab. 2). The appearance of first tassel was late in December first fortnight sowing (79
days) followed by November second fortnight sowing (78 days) and December second fortnight sowing (74 days).

**Table 2: Influence of planting window on flowering behavior of the parental lines of Maize hybrid, DHM 117 during Spring, 2012**

<table>
<thead>
<tr>
<th>Dates of sowing</th>
<th>Days to first pollen shed</th>
<th>Days to 50 % pollen shed</th>
<th>Days to first silking</th>
<th>Days to 50 % silking</th>
<th>Tassel length (cm)</th>
<th>No. of pollen shedding spikelets tassel</th>
<th>No. of pollen shedding days</th>
<th>Total spikelet branches tassel</th>
<th>Pollen viability (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>01-06-2012</td>
<td>66</td>
<td>70</td>
<td>64</td>
<td>68</td>
<td>34.1</td>
<td>801</td>
<td>5.3</td>
<td>15.2</td>
<td>98.1</td>
</tr>
<tr>
<td>15-06-2012</td>
<td>69</td>
<td>74</td>
<td>66</td>
<td>72</td>
<td>33.4</td>
<td>737</td>
<td>4.7</td>
<td>14.3</td>
<td>94.2</td>
</tr>
<tr>
<td>01-07-2012</td>
<td>69</td>
<td>75</td>
<td>66</td>
<td>74</td>
<td>28.7</td>
<td>671</td>
<td>4.7</td>
<td>14.2</td>
<td>93.8</td>
</tr>
<tr>
<td>15-07-2012</td>
<td>73</td>
<td>76</td>
<td>71</td>
<td>74</td>
<td>30.5</td>
<td>668</td>
<td>5.0</td>
<td>13.9</td>
<td>93.6</td>
</tr>
<tr>
<td>01-08-2012</td>
<td>78</td>
<td>82</td>
<td>73</td>
<td>81</td>
<td>31.3</td>
<td>625</td>
<td>4.3</td>
<td>14.0</td>
<td>92.8</td>
</tr>
<tr>
<td>15-08-2012</td>
<td>79</td>
<td>82</td>
<td>73</td>
<td>82</td>
<td>30.0</td>
<td>630</td>
<td>4.3</td>
<td>13.9</td>
<td>92.5</td>
</tr>
<tr>
<td>01-09-2012</td>
<td>74</td>
<td>79</td>
<td>73</td>
<td>77</td>
<td>26.7</td>
<td>591</td>
<td>4.0</td>
<td>13.6</td>
<td>92.3</td>
</tr>
</tbody>
</table>

Delay in shedding of pollen on the male parent during December could be attributed to low temperature (21.5 °C), low relative humidity (79.8 %), zero rain fall coupled with more sunshine hours (8.5 hours) which might have led to poor growth of the plants. These findings were in general agreement with the results of Matzenauer et al. (1998), who reported that early planted Maize flowers earlier in the growing season when the atmospheric evaporative demand is usually smaller, thus decreasing the probability of moisture stress.

Days to 50% pollen shed varied from 70 to 82 days (Fig 3). However, the 50% pollen shed was early in September second fortnight sowing (70 days) and significantly different from October first fortnight sowing (74 days) and other sowing dates. The appearance of tassel in 50% of plants was late in December first fortnight sowing (82 days) followed by November second fortnight sowing (82 days). Matzenauer et al. (1998) opined that early planted Maize flowers earlier in the growing season when atmospheric evaporative demand is usually smaller, thus decreasing the probability of moisture stress.
The first silking was early in September second fortnight sowing (64 days) followed by October first fortnight (66 days). During September second fortnight sowing, the temperatures were optimum (26.6 °C), comparatively high relative humidity (88.9 %) and high rainfall (3.2 mm), which enhanced the crop vegetative growth, so that the plants might reach the reproductive phase very quickly. This was supported by Tamura et al. (1989) who reported that environmental parameters like temperature and rainfall had a significant effect on flowering behaviour of Maize where in development of silk and air temperature followed a sigmoid curve and days to flowering had a negative correlation with temperature. Tollenaar and Bruulsema (1988) found that the time from silking to physiological maturity lengthened with delay in planting date.

The 50 % silking was early in September second fortnight sowing (68 days) and during this time, Maize crop was subjected to optimum temperature, comparatively high relative humidity (88.9 %) and high rainfall (3.2 mm), which enhanced the crop vegetative growth, so that the plants may reach the reproductive phase very quickly. This was in accordance with Jong et al., 1982, who reported that increase in temperature by 1 °C decreased the time to silking by 4.3 days. William et al. (1977) reported that differences in development rate for time from planting to 50 % silking varied by location and by planting date within a location. The difference between days to 50 % pollen shed and days to 50 % silking was very low i.e., either one day or two days, throughout all the sowing dates. This difference might be minor for good pollen–silk synchrony in seed production, especially if time to silking is modified to the same extent, detasselling efforts become easier to manage across many fields when the time to pollen shed is most accurately predicted.

Sowing in September second fortnight produced significantly long tassel (34.1 cm) and it could be mainly due to the expansion of the tassels under favorable weather factors like moderately rainfall with adequate relative humidity and proper sunshine hours. September second fortnight sowing recorded significantly more number of pollen shedding spikelets tassel\(^1\) (801) followed by October first fortnight sowing (737). As the total length of the tassel during September first fortnight increased, the production of total number of pollen shedding spikelets tassel\(^1\) also increased to a similar extent at the same sowing date which leads to more number of pollen shedding spikelets during that sowing period. Sowing in September second fortnight recorded higher pollen viability (98.1 %) followed by October first fortnight (94.2 %) sowing. Pollen viability was more in early plantings (September and October) and slowly decreased for later sowings (November and December) (Fig. 4). The decrease in pollen viability in November and December sowings might be due to the changes that occurred in the weather conditions i.e., low temperatures of 20.0 °C, no rainfall (0.0 mm) coupled with high sunshine hours (8.8 hours) which might have contributed to low pollen viability in December sowings. Due to the presence of cool climatic conditions, generally dehiscence of pollen will be prolonged and this could be one reason for low pollen viability at 9 A.M. In contrast, Schoper et al. (1986) reported that high temperatures had negative effect on pollen viability in Maize. Similarly, Vara Prasad et al. (2006) also reported that growing grain sorghum at temperatures beyond 36 °C significantly decreased pollen production and pollen viability.

**Fig. 3:** Days to 50 % pollen shed and silking at different planting windows during Spring, 2012
Fig. 4: Influence of planting window on pollen viability during Spring season, 2012

Conclusion

To get the perfect synchronization of male and female lines of maize hybrids and also to get high pollen viability maize was sown during August second fortnight during rainy season and September second fortnight during spring season.

References


