Effect of pollination time on seed set in short glume sorghum in Yola, Nigeria

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Abstract

Studies on the effect of time of pollination on seed set and viability in short glume sorghum were conducted on the Teaching and Research Farm of the Department of Crop Production and Horticulture, Federal University of Technology (FUT), Yola, Nigeria. Two sorghum cultivars were used. The treatments were six different timings on which controlled pollination was carried out, after emasculating the female flowers. These timings included 24, 27, 30, 48, 51 and 54 h. Data were collected on seven parameters, namely number of seed set per time, weight of 30 F1 seeds, percentage germination, vigor score, time to 50% flowering, time to maturity and yield per plant to further establish seed viability. The data were subjected to analysis of variance based on randomized complete block design. Results showed that pollination conducted within 27–48 h out-performed others conducted at other timings suggesting therefore that 27–48 h as the right time to perform crosses on sorghum in Yola environment.

Materials and methods

Experimental materials comprised two mid-maturing short glume (3–4 mm long) sorghum cultivars collected during the 2006 rainy season from sorghum farmers in Girei and Gulak towns (of Girei and Madagali local government areas of Adamawa state, respectively) in Nigeria. Seeds of these genotypes were stagger planted in an already prepared nursery field. Sowing was done in the ratio of 2:2 male to female rows as described by Murty et al. (1994). This was done in 3 replications in the dry season of 2006/07. At anthesis, controlled pollination was carried out on 50 florets in each replication based on the various treatments by hand emasculation technique as described by House (1985). The F1 seeds so obtained were planted in a trial during the rainy season of 2007/08. The experimental treatments were 24, 27, 30, 48, 51 and 54 h after emasculating the female flowers, at which controlled pollination was carried out. Germination test was carried out after harvest of the F1 seeds in the laboratory of the Department of Crop Production and Horticulture, Federal University of Technology (FUT), Yola, Nigeria, following methods described by Agromisa and Technical Centre for Agriculture and Rural Cooperation (2004) and based on each treatment for each replication, while vigor test was carried out on the experimental field of the Department of Crop Production and Horticulture, FUT, Yola on the basis of visual scoring on a 1–5 scale, where 1 = poor and 5 = good as described by House (1985). Five tagged F1 plants per replication were sampled for measurements on the following parameters: number of seed set/time, seed weight, percentage germination, vigor score, time to 50% flowering, time to maturity and yield per plant. Data generated from all measured parameters were subjected to a 2-factor analysis of variance as described by Akindele (1996), using the PROC. GLM procedures of the SAS Statistical Software Package for Windows (SAS...
1999). Mean separation was performed using DMRT (Duncan Multiple Range Test) ranking of the same software package. The linear statistical model assumed for the ANOVA was as follows:

\[ Y_{ij} = U + t_i + r_j + e_{ij} \]

where

- \( Y_{ij} \) = Effect of the \( i^{th} \) treatment in the \( j^{th} \) replication;
- \( U \) = Overall mean performance of all treatments;
- \( t_i \) = Effect of the \( i^{th} \) treatment (1, 2, 3...6);
- \( r_j \) = Effect of the \( j^{th} \) replication (1, 2, 3); and
- \( e_{ij} \) = Residual error as a result of the \( i^{th} \) treatment in the \( j^{th} \) replication.

### Results and discussion

Results from the analysis of variance (Table 1) for the seven parameters measured showed that the mean square values for number of seed set/time and weight of 30 F₁ seeds showed highly significant variation for different periods of pollination after emasculation of female flowers. Other parameters, however, except germination (%) and time to 95% maturity showed no significant variation in their mean square values. Results from the mean performance indicated that in terms of number of seed set/time, crosses carried out 48 h after emasculation of the female flowers out-performed all others, having

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>df</th>
<th>Number of seed set/time</th>
<th>Weight of 30 F₁ seeds (g)</th>
<th>Percentage germination of F₁ seeds</th>
<th>Vigor score</th>
<th>Time to 50% flowering (days)</th>
<th>Time to maturity (days)</th>
<th>Yield per plant (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Replication</td>
<td>2</td>
<td>15.16</td>
<td>0.0016</td>
<td>40.22</td>
<td>4.38</td>
<td>6.72</td>
<td>0.50</td>
<td>69.41</td>
</tr>
<tr>
<td>Timing (h)</td>
<td>5</td>
<td>162.90**</td>
<td>0.0784**</td>
<td>59.38*</td>
<td>1.52NS</td>
<td>1.55NS</td>
<td>6.53*</td>
<td>86.86NS</td>
</tr>
<tr>
<td>Error</td>
<td>10</td>
<td>16.36</td>
<td>0.0063</td>
<td>17.55</td>
<td>0.58</td>
<td>3.45</td>
<td>2.03</td>
<td>38.33</td>
</tr>
</tbody>
</table>

1. ** = Highly significant (\( P = 0.01 \)); * = Significant (\( P = 0.05 \)); NS = Not significant.

### Table 2. Mean performance for the seven characters measured on sorghum cultivars.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Number of seed set/time</th>
<th>Weight of 30 F₁ seeds (g)</th>
<th>Percentage germination of F₁ seeds</th>
<th>Vigor score</th>
<th>Time to 50% flowering (days)</th>
<th>Time to maturity (days)</th>
<th>Yield per plant (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>24 hours after emasculation of female flower</td>
<td>10.00 bc</td>
<td>0.80 c</td>
<td>89.7 a</td>
<td>3.67 ab</td>
<td>37.67 a</td>
<td>82.00 c</td>
<td>81.87 ab</td>
</tr>
<tr>
<td>27 hours after emasculation of female flower</td>
<td>15.66 b</td>
<td>0.97 ab</td>
<td>85.6 ab</td>
<td>4.00 ab</td>
<td>37.33 a</td>
<td>86.00 a</td>
<td>82.47 a</td>
</tr>
<tr>
<td>30 hours after emasculation of female flower</td>
<td>6.27 c</td>
<td>0.83 bc</td>
<td>88.00 a</td>
<td>2.67 b</td>
<td>36.67 a</td>
<td>84.67 abc</td>
<td>85.83 a</td>
</tr>
<tr>
<td>48 hours after emasculation of female flower</td>
<td>24.00 a</td>
<td>1.06 a</td>
<td>83.33 ab</td>
<td>4.33 a</td>
<td>37.33 a</td>
<td>85.00 ab</td>
<td>81.83 ab</td>
</tr>
<tr>
<td>51 hours after emasculation of female flower</td>
<td>16.00 b</td>
<td>0.70 cd</td>
<td>79.66 b</td>
<td>3.00 ab</td>
<td>36.67 a</td>
<td>83.00 abc</td>
<td>80.47 ab</td>
</tr>
<tr>
<td>54 hours after emasculation of female flower</td>
<td>8.67 bc</td>
<td>0.63 d</td>
<td>78.00 b</td>
<td>2.67 b</td>
<td>35.67 a</td>
<td>83.00 bc</td>
<td>70.06 b</td>
</tr>
</tbody>
</table>

1. Means followed by the same letters do not differ significantly from each other according to Duncan Multiple Range Test (DMRT).
scored the highest mean, closely followed by crosses conducted 51 h and 27 h after emasculation of the female flowers (Table 2). While the same crosses conducted 48 h after emasculation scored the highest mean in terms of weight of 30 F1 seeds and vigor score, crosses made 24 h after emasculation had the highest viability (percentage germination) and were closely followed by crosses performed at 30 h after emasculation. Yield per plant and seed weight were poor in those crosses performed 54 h after emasculation. Most parameters measured showed appreciable level of significance between treatments. Generally, crosses showed some degree of earliness in flowering and maturity than parents. The number of seed set/time varies significantly with the different timings, with those set 48 h after pollination resulting in higher seed set/time. Similar observations were made by House (1985); he observed that crosses performed within 48 to 51 h after emasculation were highly receptive and set more seeds. However, where crosses are delayed further, less success is recorded and even in these cases the seeds set are usually non-viable. This is because the flowers are usually more receptive within the first three days after emasculation, although receptivity continues up to about 7 days after emasculation (House 1985). Further, Espinoza and Quarin (2002) and Byron et al. (2002) showed that more normal seed are set by female flowers pollinated 0–3 days after emasculation. Findings of these studies also showed that the qualities displayed could be inherited among generations depending on the breeding objectives.

Conclusion

From the results obtained it can be concluded that:

- The right time for pollination of sorghum in Yola environment is within 27–48 h for viable seed set.
- Seeds obtained from crosses 48 h after emasculation displayed excellent results indicating that this is the best time for the pollination of sorghum in Yola environment.

References


