Agro-economic assessment of the response of maize varieties to the prevailing moisture stress of late season planting in South Western Nigeria

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The growth, development and yield of two maize varieties: TZSR-W and TZESR-W were monitored in two agro-economic trials during the 2006 and 2007 late planting seasons in Nigeria. Results obtained, which were similar for both years showed that TZSR-W (a late maturing variety) was significantly superior to variety TZESR-W (early maturing) in terms of plant height and leaf area. In terms of grain yield and growth analysis parameters (LAR and RLGR), TZESR-W was superior to TZSR-W. The yearly dry season was observed to have set in at the time of tasselling and silking in cultivar TZSR-W, whereas cultivar TZESR-W was well into grain filling. The additional labour requirement for weeding of TZSR-W before full maturity was attained also made it costlier to produce. The value of yield advantage of TZESR-W averaged about N31, 440.00 (US$209.6) per hectare. Early maturing maize variety therefore appears to have the potentials for the development of high seed yield and economic value under the prevailing environmental condition that characterized the late season planting in South West Zone of Nigeria.

Key words: Agro-economic, yield advantage, economic value.

INTRODUCTION

Nigeria is plagued with various rainfall regimes during the cropping seasons. In the southern part of the country, rainfall is distributed bimodally while the northern part has only one pattern of rainfall. In the south, the first rains that characterize early planting season start from March/April to June/early July. A dry period of about one month occasionally follows, after which the second rains (that characterize late planting season) start from late July/August to late October/early November. Both seasons are suitable for maize production. Most experienced farmers prefer planting in the early season with the onset of the early rains while very few farmers plant during the late cropping season because the period is usually characterized with low rain intensity, duration and unsteady distribution (Alofe et al., 1986) Moreover, the period is usually noted for pest attacks on the crop, especially, the stem borer (Busseola fusca).

Most of the reported works on the agronomy and economics of maize production in Nigeria were done on the early planting season crop (Akinwumi, 1971; Norman et al., 1976; Remison and Kayode, 1982; Adesimi and Ladipo, 1983; Fakorede, 1985; Kalu and Norman, 1987; Ayoola, 1987; Kalu et al., 1987). Information on the agro-economic performance of maize in the late season planting period in Nigeria is scanty in literature and therefore a benchmark survey is needed to fill this gap in the existing data bank (Alimi et al., 2006). In view of this, two cultivars of maize obtained from National Seed Service, Ibadan, Nigeria and were grown in two field experiments during the 2006 and 2007 late season planting to assess their performances with a view to quantifying the agro-economic characteristics of production.

MATERIALS AND METHODS

Two experimental trials were carried out during the late planting season of 2006 and 2007 at the Agricultural Science Departmental
Two maize cultivars namely TZSR-W (late maturing, streak resistant, white grain with an average height of 225 cm, starts silking at 60-70 days after sowing, DAS) and TZESR-W (early maturing, streak resistant, white grain variety with an average height of 180 cm, starts silking at 50 DAS) were shown in a randomized complete block design with four replications on 22nd of July, 2006 and 20th of July, 2007 on the flat at a spacing of 60 x 45 cm to give a planting population of 37,000 plants per hectare.

Three seeds were sown per hole but were thinned to one plant per stand two weeks after sowing (WAS). Complete fertilizer (15-15-15) at the rate of 150 kg per hectare was applied four WAS. Hand weeding was done twice at 3 and 7 WAS for both cultivars and a third weeding became necessary for TZSR-W at 10 WAS. No pest infestation was noticed.

Some of the indicators of growth and development were monitored by means of measurements on samples of four plants per variety taken at two weeks intervals beginning from five WAS (Alofe et al., 1996). At each sampling, the plants were carefully uprooted and measurements were taken of the plant height, number of leaves and nodes and leaf area. Leaf area was determined by simple proportional method as described by Tayo (1977). From the data generated, two growth analysis parameters, leaf area ratio (LAR) and relative leaf growth rate (RLGR) were determined using the formula of Fitters and Hay (1981).

Data on yield attributes were collected at a time when 90% of the grains were dry on the field (Fajemisin, 1997). This was to prevent undue loss through insect attack. Sixteen plants per variety were
Table 1. Growth (at 12WAS) and seed yield (at final harvest) parameters of maize varieties in the late season planting in South Western Nigeria.

<table>
<thead>
<tr>
<th>Plant characters</th>
<th>TZSR-W</th>
<th>TZESR-W</th>
<th>LSD</th>
<th>TZSR-W</th>
<th>TZESR-W</th>
<th>LSD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Vegetative characters</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plant height (cm)</td>
<td>197.1</td>
<td>180.7</td>
<td>5.82**</td>
<td>206</td>
<td>178.1</td>
<td>2.14**</td>
</tr>
<tr>
<td>No of leaves plant⁻¹</td>
<td>8.3</td>
<td>9.0</td>
<td>0.57**</td>
<td>12.1</td>
<td>9.88</td>
<td>0.46**</td>
</tr>
<tr>
<td>No of nodes plant⁻¹</td>
<td>14.5</td>
<td>14.6</td>
<td>n.s.</td>
<td>14.5</td>
<td>14.17</td>
<td>0.29**</td>
</tr>
<tr>
<td>Leaf area plant⁻¹ (cm²)</td>
<td>3318</td>
<td>3091</td>
<td>147.8**</td>
<td>4545</td>
<td>3928</td>
<td>85.4**</td>
</tr>
<tr>
<td><strong>Seed yield characters</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ear number plant⁻¹</td>
<td>1.0</td>
<td>1.0</td>
<td>n.s.</td>
<td>1.0</td>
<td>1.20</td>
<td>0.05**</td>
</tr>
<tr>
<td>Ear dry weight (g)</td>
<td>135.4</td>
<td>131.4</td>
<td>n.s.</td>
<td>178.1</td>
<td>203.3</td>
<td>9.60**</td>
</tr>
<tr>
<td>Seed no plant⁻¹</td>
<td>441.8</td>
<td>417.6</td>
<td>20.52**</td>
<td>507.0</td>
<td>560.0</td>
<td>33.95**</td>
</tr>
<tr>
<td>Seed weight plant⁻¹ (g)</td>
<td>89.8</td>
<td>95.2</td>
<td>5.54</td>
<td>130.9</td>
<td>159.8</td>
<td>8.00**</td>
</tr>
<tr>
<td>100 seed weight (g)</td>
<td>21.5</td>
<td>25.4</td>
<td>0.58**</td>
<td>24.7</td>
<td>25.1</td>
<td>n.s.</td>
</tr>
<tr>
<td>Harvest index</td>
<td>0.35</td>
<td>0.38</td>
<td>0.02</td>
<td>0.49</td>
<td>0.57</td>
<td>0.03**</td>
</tr>
<tr>
<td>Shelling %</td>
<td>66.30</td>
<td>72.20</td>
<td>4.12</td>
<td>73.50</td>
<td>78.60</td>
<td>3.26**</td>
</tr>
<tr>
<td>Total grain yield (t ha⁻¹)</td>
<td>3.32</td>
<td>3.52</td>
<td>0.18</td>
<td>4.48</td>
<td>5.47</td>
<td>0.17**</td>
</tr>
</tbody>
</table>

n. s. = Not significant, * = significant at 0.05, ** = significant at 0.01. Source: Experimental results - Average of 2006/2007 planting seasons.

randomly selected from the middle of the plot for yield analysis. The following yield variables were measured: ear dry weight per plant, seed number per ear, ear seed weight per plant, seed weight per plant, 100 seed weight, harvest index, shelling percentage and total grain yield per hectare. Prevailing market prices for the fresh and dried corn were obtained through consumer panel approaches and National Bureau of Statistics Publications (FGN, 2007).

RESULTS

The growth performance of the two varieties during the two years was similar, thus the averages of the results obtained for the two-year periods are described. The two maize varieties increased rapidly in terms of growth and development within age 7 and 11 WAS, although there were no significant differences between them relatively. The growth of maize cultivar TZSR-W started becoming superior to that of maize cultivar TZESR-W as from nine WAS in terms of plant height, leaf area, leaf, stem, root and total dry weights till maturity.

The significant differences between the two varieties became noticeably evident at 12 WAS in which TZSR-W maize (Late vegetative stage) was taller with broader leaf area, heavier leaf and root dry weights and total shoot weight than TZESR-W maize at floral budding stage.

Maize cultivar TZESR-W had significantly more ear per plant and seed per ear, heavier ear dry weight and seed weight per plant, larger harvest index and shelling percentage and more total grain yield than cultivar TZSR-W in both years (Table 1).

DISCUSSION

As observed, maize cultivar TZSR-W grew significantly more superior to cultivar TZESR-W but yielded less. Although this might be genetical, it was noted that the period of grain filling in cultivar TZSR-W (mid-October to early November) coincided with the period when the rate of rainfall had dropped due to the onset of dry season of the cropping seasons. Denmead and Shaw (1980) reported that grain yield reductions were most severe when drought coincided with the silking and pollination periods in corn. The grains of TZSR-W were at these critical physiological stages of early grain filling when the yearly dry season set in during the month of October. On the other hand, the grains of cultivar TZESR-W were well filled before the moisture stress started.

The higher seed weight per plant, 100 seed weight and harvest index of the early maturing cultivar (TZESR-W) confirm less moisture stress during the grain fill in the cultivar. On the other hand, the smaller grain sizes in the late maturing cultivar (TZSR-W) tend to confirm water deficits effect during grain filling. This moisture stress might have critically reduced grain development by slowing assimilate transport from source to the sink. Hussain et al. (1988) found that moisture stress decreases growth efficiency of corn by slowing photosynthesis which consequently reduces the final grain yield.

The LAR and RLGR of cultivar TZESR-W were larger than those of TZSR-W. This shows that the rate of leaf development and dry matter accumulation per week are higher in TZESR-W than TZSR-W. Though the vegetative growth of TZSR-W was significantly superior to that of TZESR-W, not with-standing, it seems to be superfluous when compared with the final higher grain yield of the latter which is a more desirable characteristic of economic value. The earlier reproductive development of TZESR-W could have had beneficial effect on reducing
some of the vegetative dry weight and leaf area considered superfluous.

The ability of the late maturing maize to produce superior vegetative growth as witnessed in this study may be superfluous and a mirage especially under a situation when moisture seems to be a limiting factor of crop production. The realization of higher yield of production which is the ultimate of farmers in justifying their returns on investment seems to be more favoured by TZESR-W. In addition, early season (green) harvests of maize cobs tastes delicious and therefore has higher price advantage over those at other periods. This could also aid in enhancing the potential income realizable from maize farms.

At the average price of N52,840 (US$352.27) per tonne of maize during the period of study (FGN, 2007), the value of yield advantage of TZESR-W over TZSR-W ranged between N10,568 (US$70.45) and N52,312 (US$348.75) per hectare farm. Another economic consideration worthy of note was the fact that the third weeding regime which was only relevant for the TZSR-W made the late maturing cultivar costlier in terms of cost of production. Therefore, as evidenced in the study, the early maturing cultivar (TZESR-W) seems more suitable than TZSR-W in terms of development of those attributes of yield and economic value.

In conclusion, of the two maize cultivars tested in this study, the early maturing cultivar has the ability to complete the most critical growth phase of its life cycle within the limited available moisture content that characterizes the planting season in the South West Zone of Nigeria and therefore produce higher yields than the late maturing cultivar. It is also more economical to produce hence its recommendation for cultivation in the late season planting in the study area.

REFERENCES


