

SOWING-DATE ON STUDIES ON MAIZE (*ZEAMAYS* L.) UNDER RAINFOREST CONDITIONS: EFFECT OF SOWING DATE ON GRAIN YIELD AND YIELD COMPONENTS.

S.A.A. Abasi and O.A. Aofolajuwonlo

Department of Plant Science,
Obafemi Awolowo University,
Ile-Ife, Nigeria.

Abstract

This study was conducted to determine the influence of sowing date in the tropical rainforest location of the study on grain yield and yield components of maize (*zea mays* L.). Two maize cultivars, FARZ 7 and FARZ 34 were sown on five dates over a two-year period, 1983 and 1984. Sowing date had a highly significant effect on grain yield. Its effects on ear number, kernel weight and grain number were also highly significant. Of all the yield components, number of grains was most highly related to yield. It accounted for 83.3% of the variation in yield. It was followed by ear number and kernel weight which had coefficients of determination of 0.738 and 0.571, respectively. Date 3 recorded the highest grain yield among the sowing dates. It also had the greatest influence on grain number, ear length and kernel weight.

INTRODUCTION

Yield in maize (*Zea mays* L.) is affected by a number of factors which include seed viability and the environment. The effects obtained from planting date tests are caused by the differences in environmental conditions encountered by the plants from the time of planting until the death of the plant (Bilbiri and Ray, 1973).

Jones *et al.* (1981) reported abortion of kernels and shortening of grain filling period at higher than optimum temperatures as a possible mechanism by which temperature mediates kernel growth and development, and ultimately grain yield. Also the distribution of precipitation was found to be a major factor influencing grain yield (Hadjichristodudu, 1972). Cross (1977) reported that kernel depth and kernel rows per ear seemed to influence general stability for yield. Bunting (1971) found that low light and temperature conditions towards the end of the growing season were factors that affected incomplete filling of grains. Early *et al.* (1967) found that shade exerted reduction in all components measured.

Adelana *et al.* and Milbourn (1972) reported a close relationship between final yield and number of grains in maize. They noted further that this could be obtained from a high number of grains per unit area, a high number of grains number per ear or by an increase in

ear number per unit area. Barrenness in maize was found to lead to decrease in yield components. Smith *et al.* (1982) reported that barrenness was a major limitation to efficient conversion of light energy into grain in maize grown at high plant densities. Hawkins *et al.* and Cooper (1981) reported that yield of cereals was the product of two principal components viz: grain number and grain weight. They also noted that environmental stress at various stages affected grain number and resulted in poor yield. The objectives of this study were to determine (i) the effects

of sowing date on yield and yield components, and (ii) the relationship between yield components and grain yield.

MATERIALS AND METHODS

The study was conducted at the Obafemi Awolowo University Teaching and Research Farm, Ile-Ife, Nigeria in 1983 and 1984. Ife is located on latitude 7° 28' N and longitude 4° 33' E, at 244 m elevation. Two maize cultivars, FARZ 7 and FARZ 34 were chosen for the study. The sowing dates were 27th April and 23rd May, 1983; 15th and 30th May, and 11th July, 1984. There were two replications of the experiment and each plot consisted of four rows which were 10 m long. The plots were disc-ploughed and harrowed prior to planting on each date. Two seeds were planted per hole at a spacing of 1.0 m between rows and 0.5 m along the rows. Thinning was done at three

weeks to obtain one plant per stand. Weeding and fertilizer application were carried out at four weeks. A compound fertilizer 15:15:15 N.P.K. was applied at the rate of 60 kg/ha of Nitrogen, Phosphorus and Potassium.

Harvesting was done when the leaves were dry. The two middle rows of each plot were harvested. At harvest, records of stand count, ear number per plot, ear length, ear diameter, kernel row number and grain weight were taken for each plot. Kernel row number was determined by counting the number of rows of five random ear samples from each plot. After shelling, five random cobs were also chosen for the determination of cob diameter. Also, grain yield for each plot was obtained. The weight of 300-kernels was used to estimate kernel weight. The kernels were weighed before and after oven-drying. Oven-drying was done to constant weight at 80°C. Grain yield was converted to per hectare basis at 15 % moisture.

Analysis of variance was carried out to determine the effect of sowing date and cultivar on yield and its components. Correlation and regression analyses were carried out to determine the relationship between yield and the various yield components.

RESULTS AND DISCUSSION

The results of the analysis of variance are presented in Table 1. Sowing date had a highly significant effect on some of the grain yield components, e.g. ear number, grain number and kernel weight. In like manner, the effect of sowing date on grain yield was highly significant. This implied that there were differences in the environmental conditions encountered by the plants from the time of planting to the death of the plants in the various sowing dates, as reported by Bilbiri and Ray (1973).

The effect of cultivar was only significant on kernel row number. Its effect was not significant for the other characters probably because only two cultivars were used. The two cultivars might also have been similar in performance with regard to yield and yield components. Date x Cultivar interactions were not significant for grain yield and yield components, which implied that the cultivars did not perform differently at the various sowing

dates.

Table 2 shows the results of the correlation and regression analyses between the yield and yield components. Grain number exhibited the highest relationship with yield. It accounted for 83.3% of the variation in yield. Ear number and 300-kernel weight also had highly significant relationship with yield. They accounted for 73.8% and 57.1%, respectively of variation in grain yield. Ear length explained 36.4% of the variation in yield. The high relationship between yield and yield components, grain number and kernel weight agrees with the work of Hawkins and Cooper (1981) who reported grain number and grain weight as the principal components of yield. The results also agree with the work of Adelana and Milbourn (1972) who reported a close relationship between final yield and grain number. They noted further that this could be obtained from high grain number per unit area, high grain number per ear or by an increase in ear number per area. Otegui *et al.* (1995) also reported that grain yield was strongly associated with number of grains per square meter.

The means of the yield and yield components in the five sowing dates are shown in Table 3. Ear number in Date 3 was significantly higher than ear number in any of the other dates. It was also significantly lower in Date 5 relative to Date 1. Ear length was significantly longer in Dates 1 and 3 than in Date 5. This might have been as a result of the variation in the planting season. Dates 1 and 3 were in the early part of the season, while Date 5 fell in the later part of the early season. Ear diameter was significantly higher in Dates 1 and 2 than in Dates 3, 4 and 5. However, it was noted in the regression analysis that the contribution of ear diameter to yield was rather low ($r^2 = 0.059$). Thus, differences in ear diameter might not have been appreciably reflected in the yield. Kernel row number showed no significant differences in Dates 1, 4 and 5, it was significantly higher in Dates 2 and 3 than in the other dates. The highest 300-kernel weight was recorded in Date 3. Dates 3 and 4 significantly differed in kernel weight from Dates 2 and 5. Kernel weight was also significantly greater in Date 1 than in Date 5. Grain number was highest in Date 3 in comparison to the other dates. Date 3 also produced significantly higher

Table 1: Mean square values of grain yield and yield components for maize at five sowing dates

Source	Df	Ear number	Ear Length	Ear diameter	Kernel row number	300-Kernel Weight	Grain number
Date	4	436.05**	80.50	11.43	57.81	341.28**	94094912**
11.84**							
Cultivar	1	1.80	57.75	3.20	224.50**	43.44	10401024
0.24							
Replication	1	7.29	33.79	0.70	4.05	1.08	118.64
0.17							
Date							
x							
Cultivar	4	29.05	25.31	1.32	33.65	5.66	4686784
0.22							
Error	9	48.42	22.58	1.69	18.27	50.17	4861895
0.20							

*, ** Significant at 5 and 1 % probability levels, respectively.

Table 2: Relationships between grain yield and yield components for the maize cultivars at the various sowing dates.

Yield components	r	r ²	b ₀	b ₁	F
Ear number	0.589	0.738	-1.293	0.127	50.769**
Ear length	0.604	0.364	-10.945	0.160	10.317**
Ear diameter	0.243	0.059	6.749	-0.206	1.129
Kernel depth	0.260	0.068	3.926	-0.222	1.304
Kernel row number	0.331	0.110	-3.691	0.084	2.215
300-kernel weight	0.756	0.571	-7.437	0.124	23.954**
Grain number	0.913	0.833	0.724	0.0003	89.978**

*, ** Significant at 0.05 and 0.01 levels of probability, respectively.

r = correlation coefficient

r² = coefficient of determination

b₀ = intercept and b₁ = slope

Table 3: Mean maize grain yield and yield components as affected by sowing date.

Sowing date	Ear number	Ear length	Ear diameter	Kernel row number	Kernel weight (g)	Grain number '000	Yield t/ha
1	29.75	83.00	24.00	68.00	78.75	10,368.75	1.58
2	20.75	81.00	24.25	74.00	70.25	7,701.25	1.05
3	43.75	88.50	21.50	73.00	89.75	17,285.00	5.15
4	25.00	81.00	20.75	65.75	82.75	7,341.25	2.02
5	16.75	76.00	21.00	66.50	67.02	4,514.50	1.00
LSD _(0.05)	12.96	5.58	2.11	4.72	11.46	6,021.28	2.41

yield than any other date.

Hence, Date 3 provided the best environment of all the five dates, with four of the yield components having their highest values in the environment. It also gave the highest yield. This might have been as a result of the time of sowing which occurred at the early part of the planting season. Adequate rainfall during the early part of the season coupled with high insolation, as the sky was still relatively clear must have accounted for good crop performance in that environment. Conversely, the latter part of the planting season is usually characterized by heavy cloud cover and decreased sunshine. Date 5 fell in this period and the environment gave the lowest grain yield and the lowest values for most of the yield components.

The results agree with the work of Swanson and Wilhelm (1996) who reported that the predicted optimum planting date in their study was 7 May in 1986 and 10 May in 1987. Incidentally Date 3 which seemed to have provided the optimum environmental conditions in the study was planted on 15 May 1984. Furthermore, Swanson and Wilhelm (1996) reported that the yield components, kernels per ear, kernels per plant and kernel weight had a similar response to planting date as the yield. The planting dates that maximized the yield components were found to range from 2 to 10 May. In the present study it was found that Date 3 gave the maximum values for four of the yield components.

Thus the influence of sowing date on yield as found in this study agrees with the work of Bilbiri and Ray (1973) who reported that the effects obtained from planting date tests are caused by differences in environmental conditions encountered by the plants from the time of planting until the death of the plant. Jones *et al.* (1981) found temperature as mediating kernel growth and development and ultimately grain yield in maize; while Hadjichristodudu (1982) found the distribution of precipitation as a major factor affecting maize grain yield. Also, Bollero *et al.* (1996) reported that grain yield was affected significantly by main effects of date of planting and soil temperature but there were no significant interactions. Thus, differences in environmental conditions in the various sowing dates might have explained the influence of sowing date on the performance of the maize cultivars in this study.

References

Adelana, B. O., and G. M. Milbourn. 1972. Effects of plant density on yield of digestible dry matter and grain. *J. Agric. Sci. Camb.* 78:65-71

Bilbiri, J. D., and L. L. Ray. 1973. Effect of planting date on the yield and fiber properties of three cotton cultivars. *Agron. J.* 65:606-609.

Bollero, G. A., D. G. Bullock, and S. E. Hollinger. 1996. Soil temperature and planting date effects on corn yield, leaf area and plant

