Effect Of Heat Stress On Seed Production Of Some Sorghum Varieties Under Irrigation In Northern Nigeria

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ABSTRACT

Exposure of sorghum (*sorghum bicolor*) during flowering time for a period of 10-15 days to high temperature stress (>36-38ºC) reduced pollen germination, failure of fertilization and flower abortion. A number of improved varieties of sorghum have recently been released for the Sudan and Sahel zones of Nigeria, with their dissemination limited by seed availability. To improve the supply of Breeder and Foundation seeds for production of certified, these varieties; SAMSORG 45 and SAMSORG 46 with two old but popular varieties SAMSORG 41 and SAMSORG 17 were grown under irrigation at Dadinkowa (10.18N, 11.27S) to assess their productivity during the dry season at two planting dates (October and January) for 2 seasons (2015 & 2016). Result showed that October planting which flowering and seed set coincided with the average maximum temperature of 27ºC recorded in January produced good seed while December/January planting which flowering and seed set coincided with average maximum temperature of 42ºC recorded in April had poor or no seed set on panicles especially in 2016. Rise in the average maximum temperature (2016) in the month of March (35^{0}C) and April 2016 (41^{0}C) resulted to 90-100% no seed set on SAMSORG 17, SAMSORG 45 and SAMSORG 46 as it coincided with the flowering time thus producing sterile panicle. This suggest that planting date and temperature significantly affect seed production of sorghum in the dry season.

Key words: Sorghum, seed, temperature, stress sporogensis, pollen germination

1. INTRODUCTION

Sorghum (*Sorghum bicolor* L. Moench) is a major crop in dryland farming system of Northern Nigeria, where farmers are increasingly becoming aware of the benefits using improved varieties. However, this is limited by seed production and supply, consequently their promotion and adoption. To improve the supply of Breeder and Foundation seeds for production of certified, there is need to explore opportunities for seed production during the dry season period of October-May. Among the factors that could be a challenge during this period is the frequency of high temperature occurrences. Heat stress as reported by many authors can cause sterility in sorghum and the anticipated increased frequency of high temperature events implying increasing risk to sorghum productivity. According to Vijaya, et al., (2015), Sorghum seed set was reduced by high temperature effects (>36-38ºC) on pollen germination around flowering, but genotypes differed in their tolerance to high temperature stress. Exposure of sorghum (*sorghum bicolor*) during flowering time for a period of 10-15 days to high temperature stress (>36-38ºC) reduced pollen germination, failure of fertilization and flower abortion (Prasad et al. 2008; Nguyen et al. 2013; Singh et al. 2015). To enhance seed supply, the objective of this study was to assess the productivity of newly released sorghum varieties during the dry season.

2. MATERIALS & METHODS

Four sorghum varieties comprising of 2 new; SAMSORG 45 and SAMSORG46 and two old but popular varieties; SAMSORG 41 and SAMSORG 17 were grown under irrigation at Dadinkowa (10.18N, 11.27S) to assess their productivity during the dry season at two planting dates October and January) for 2 seasons (2015 & 2016). Materials were planted on 8 row plot of 5m long spaced at 30cm and 75cm intra and inter-row spacing respectively. Plants were thinned to 2stands/hill 2 weeks after planting. Micro dosing of 15:15:15: NPK and 46% Urea fertilizer at 6g/hill were applied at 2weeks and 8 weeks after planting respectively. Estimated water requirement of 0.64cm/day/acre at weekly irrigation schedule of 4.45cm/acre for 16 weeks was applied to meet the total requirement of 72cm/acre/growth cycle (Jenny,2012). Meteorological data, for average maximum temperature readings for the months of January – April for each year were undertaken. Observation on pollen viability and shading was carried out.

3. RESULTS & DISCUSSION

Result from Meteorological station showed that average maximum temperature, was higher in the months of March (35^0C) and April 2016 (42^0C) with some days recording as high as 46^0C in April, which coincided with the flowering time of January planting especially in 2016, against that of 2015 (Figure 1). This is critical above the conducive average maximum temperature of < 35^0C for effective fertilization and seed set. This result is in consonance with the finding of several authors (Prasad et al. 2008; Nguyen et al. 2013; Singh et al. 2015) that exposure of sorghum (*sorghum bicolor*) during flowering time for a period of 10-15 days to high temperature stress (>36-38^{o}C) reduced pollen germination, failure of fertilization and flower abortion. This because as experienced by Prasad et al., 2008, in Australia, early reproductive processes particularly those of micro- and mega-sporogensis, pollen and stigma viability, anthesis, pollination, pollen tube growth, fertilization, and early embryo development are all highly susceptible to drought and/or heat stress. Failure of any of these processes decreases fertilization or increases early embryo abortion, leading to lower number of seeds or grains, thus limiting crop yield. Irrespective of the varieties, all florets had dry and sterile anthers resulting to poor or no seed set (Figure 2). On the other hand, October plantings which flowering coincided with average maximum of <30^{o}C in months of January and February had good set (Figure 3).

4. SUMMARY AND CONCLUSION

Result from this work suggests that planting date and temperature significantly affect seed production of sorghum in the dry season. Thus, for effective sorghum seed production in the dry it is recommended to plant in October at the onset of dry season which flowering period could coincide with low average maximum

temperature of <30°C. Research effort should be geared towards improving sorghum varieties that can withstand heat stress under irrigation in dry season.

ACKNOWLEDGEMENT

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6. FIGURES

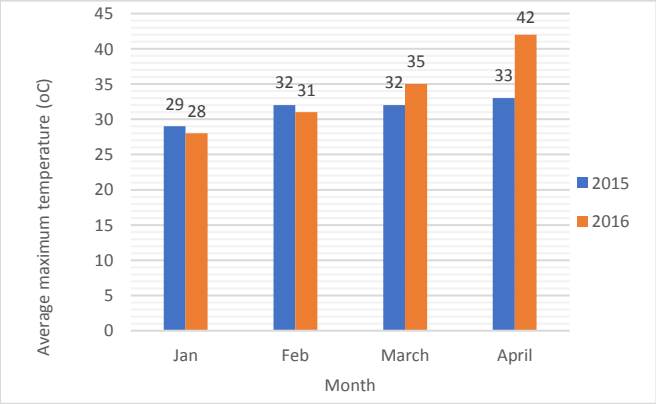

Figure 1. Average maximum temperature for January to April in 2015 and 2016

Figure 2. Sterile anthers (left) as affected by heat stress as compared to viable anthers with pollen grains (right).

Figure 3. Seed set on SAMSORG 41 sorghum variety for October and January plantings when average maximum temperature of <30°C and above >35°C at flowering/grain filling stage respectively