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Abstract

Field experiments were conducted during the 2009/10 and 2010/2011 dry seasons at the *Fadama* Teaching and Research Farm of the Usmanu Danfodiyo University, Sokoto, in the Sudan Savanna ecological zone of Nigeria, the farm is located on latitude $13^{0}01^{1}$N; longitude $5^{0}15^{1}$E and at an altitude of about 350 m above sea level. The study investigated the response of bread wheat to different sowing date. The treatments consisted of four sowing dates laid out in a split plot design with three replications. Result revealed that early sown wheat significantly differs from the late sown in both seasons and combined. Grain yield decreased with delay in sowing date and it was highest at 21st November and 5th December and lowest at other sowing dates. Delay in sowing resulted in reduction in grain yield of wheat, Wheat should be sown in November or at least first week of December.

Keywords: Response, Wheat, Sowing date, Sudan Savannah, Sokoto, Nigeria.

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Introduction

Wheat belongs to the tribe *Triticeae* which is one of the largest and most important tribes in the grass *Poaceae* family (Dewey, 1984). Wheat (*Triticum aestivum L.*) is one of the important cereal staple food crops of the world (Akbar, 2001). It is grown on 200 million hectares with an average total production of 600 million metric tons. Global average yield is around 2.7 t ha^{-1} with high variability among countries and regions. The highest average yields are obtained in Western Europe, with more than 8 t ha^{-1}, in contrast to less than 1 t ha-^{1} in several countries in Central/West Asia and North Africa (Rajaram and Braun, 2009).

According to Singh *et al.* (2011) time of planting is one of the most important non-monetary inputs for optimizing the growth according to prevailing agro-climatic conditions and genotypes. The relation between yield and planting time was quadratic, best described by $y=a+bx-ex^2$ where y is grain yield and x is planting time. The penalty in terms of crop yield associated with delayed planting is in the order of 1 percent yield loss per day (Acevedo *et al*., 1998b). Hussain *et al*. (1998) observed that late planting affects the growth, yield and quality of wheat, because early sowing produces higher yields than late sowing due to longer duration. Delay in sowing of wheat after 20th November onward resulted in decreased grain yield at the rate of 36 kg ha-^{1} day-^{1}. Yield reduction as a result of late planting is linear, 8, 16, 32 and 50% reduction each fortnight after 10th November (Kant *et al.*, 2003). Heat stress affects the production of wheat by causing reduction in duration of grain filling phase, kernel size, biomass, tiller number, etc. heat stress adversely affected days to appearance of first node, tiller per plant and spikelet's per plant, thereby resulting in reduction of sink capacity and future sources capability of the plant (Sharma and Tandon, 1997), while Ishag and Mohamed (1996) reported that an increase in 10 ^{0}C can cause decrease of 4 mg in grain weight. Abrol and Ingram (2010) and Acevedo *et al*. (1998b) observed that for every 1°C rise in temperature, there is a depression in grain yield by 8 to 10%, mediated through 5 to 6% fewer grains and 3 to 4% smaller grain weight. Wheat production has been shown to be limited by a number of factors such as moisture stress (Mark and Antony 2005), variety and weed (Sellaries, 1975), soil fertility and sowing date (Falaki, 1994). High temperature is a major environmental constraint that limits wheat production in the Sudan nonetheless, considerable variability in bread wheat performance under heat stress conditions has been reported (Ageeb, 1994).

The objective of the study was to evaluate the effect of sowing date on grain yield of the two wheat varieties.

Materials and Methods

The trials were conducted during the 2009/2010 and 2010/2011 dry seasons at the Fadama Teaching and Research Farm, Usmanu Danfodiyo University, Sokoto, (Latitude 13^{0} 01'N. longitude 15^{0} 13E) at Kwalkwalawa village in Sokoto. The farm is located within the Sudan Savanna Zone of Nigeria (Kowal and Knabe, 1972). The area has a long dry season that is characterized by cool dry air during harmattan from November to February and hot dry air during hot season from March to May. Relative humidity ranged from 26-39 % in the dry season. Minimum and maximum temperatures ranged between 18 to 29 ^{0}C and 30 to 40 ^{0}C while wind speed ranged between 1.9 to 5 M/S [(Sokoto Energy Resource Center) (SERC, 2011)]. The soil is hydromorphic. In 2010, the area was seriously inundated with flood water which may be as a result of climate change and global warming which resulted in high rainfall. The area was previously used for the cultivation of vegetables and cereals crops.

Prior to planting, soil samples were collected from nine randomly selected points within the experimental site at 0-30 cm depth using soil auger, which were bulked to form a composite sample and subsampied using coning and quatering, air-dried and sieved. The sub sample was used for physico-chemical analysis. The particle size analysis was conducted using hydrometer method (Boyoucous, 1951). Textural classes were USDA determined using textural triangle. Total nitrogen was determined by regular Macro-Kjeldhal digestion technique (Jackson, 1964), while available phosphorus was determined using Bray No.1 method (Bray and Kurtz, 1945). Potassium and Sodium were determined using a flame photometer method, while Magnesium and Calcium were determined by EDTA titration method. Cation Exchange Capacity (CEC) was determined using ammonium acetate method.

The treatments consisted of four sowing dates (21st November, 5th December, 19th December and 2nd January). The experiment was laid out in a split plot design with three replications. The land was cleared, ploughed, harrowed, leveled, which was followed by construction of basins and water channels. Gross plot size was 3m x 3m ($9m^{-2}$) while the net plot was ($4.5m^{-2}$). One meter (1m) lee-way was left between blocks and 0.5m between plots. The seeds were treated with Apron star 42 WS (20% w/w thiamethoxam, 20% w/w metalaxyl-M and 2 % w/w difenoconazole) at the rate of 4 kg of seed to 10 g before sowing. The seeds were sown by hand drilling at 20 cm intra row spacing at 2-3 cm depth and at the rate of 120 kg/ha. The date of sowing was as prescribed by the treatments. The method of irrigation used was check basin irrigation; water was applied to soil saturation at 5 days interval. Weeds were controlled manually with hoe at 3 and 6 WAS which ensured weed free plots. Fertilizer was broadcast at the recommended rate of 120, 60 and 60 kg N, P_2O_5 and K_2O per ha^{-1} respectively. Half of nitrogen and full dose of phosphorous and potassium was worked in to the soil during seedbed preparation using NPK 15: 15: 15: while, the second dose of 60 kg N ha^{-1} was applied prior to tillering using urea (46% N) as source of nitrogen. Birds were controlled by scaring while rodents were controlled by using baits and traps. No disease outbreak was recorded.

The crop was manually harvested from the net plot at physiological maturity using sickles when 50% of the peduncles have turned brown. The plants were cut at ground level and sun dried for a period of 4 days. The spikes were beaten out with sticks to expose the grain, which was winnowed in open air with the help of wind current. Harvested spikes from each net plot area was threshed using sticks and winnowed. The grain weight from each plot was recorded and extrapolated to t ha^{-1}. Grain yield was subjected to regression analysis to determine the response curve with respect to sowing date.

Results and discussion

The regression line on effect of sowing date on grain yield of two bread wheat varieties in 2009/10, 2010/11 dry seasons and combined is presented in figures 1 and 2. The result depicts that in both seasons and combined, sowing date resulted to significant reduction in grain yield. Sowing date decreased grain yield by 0.049 t ha^{-1}, 0.034 t ha^{-1} and 0.034 t ha^{-1} in 2009/10, 2010/11 dry seasons and combined. The regression equation model explained that 88% of variation in yield was attributed to sowing date in both seasons and combined. The reduction of yield due to delay in sowing is as a result of late season increase in temperature in the month of March and April, as a result of decrease in photosynthesis and translocation of photosyhthase, because delay in sowing retard development of plant organs and transfer from source to sink and this is reflected by overall decrease in growth components such as LAI, NAR, CGR and plant height; yield components such as spike m^{-2}, spikelets per spike, spike length, grain per spike, 1000-grain weight and thus the grain yield.

Rawson (1988) stated that upon exposure to heat stress, development of various growth stages is accelerated to such a degree that the environment cannot supply necessary inputs (radiation, water and nutrient) fast enough. In wheat, period from onset of spike ignition to flowering is very sensitive to temperature acceleration in this phase seems to be the main reason for reduction in sink size under high temperature conditions. Heat stress affects the production of wheat by causing reduction in duration of grain filling phase, kernel size, biomass, tiller number, etc. heat stress adversely affected days to appearance of first node, tiller per plant and spikelet's per plant, there by resulting in reduction of sink capacity and future sources capability of the plant (Sharma and Tandon, 1997), while Ishag and Mohamed (1996) reported that an increase in 10 ^{0}C can cause decrease of 4 mg in grain weight. Abrol and Ingram (2010) observed that for every 1°C rise in temperature, there is a depression in grain yield by 8 to 10%, mediated through 5 to 6% fewer grains and 3 to 4% smaller grain weight. Similarly Acevedo *et al*. (1998b) observed that the penalty in terms of crop yield associated with delayed planting is in the order of 1 percent yield loss per day.

Conclusions

Delay in sowing resulted in reduction in yield, Therefore November or at least first week of December is the best time for planting wheat in Sokoto

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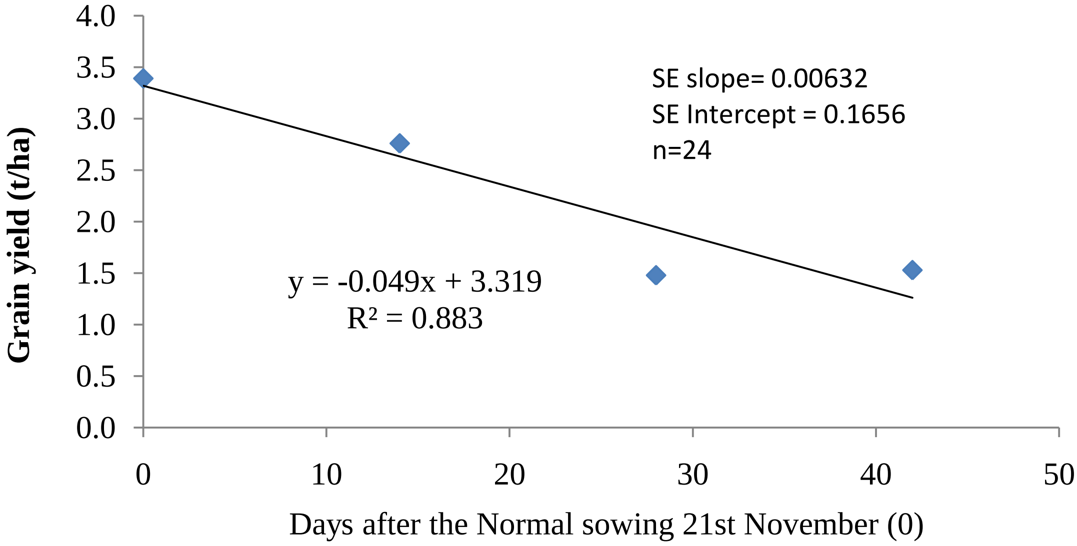
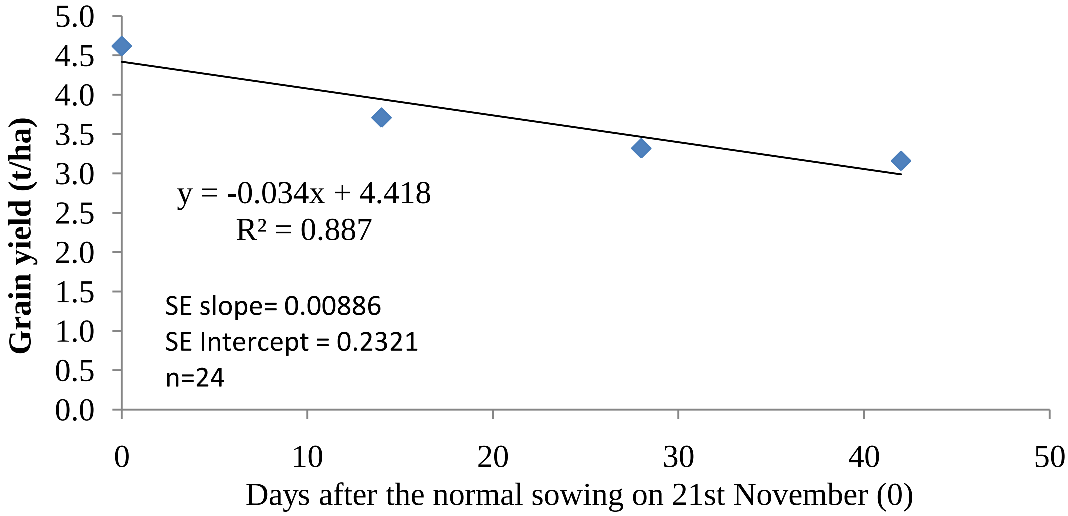
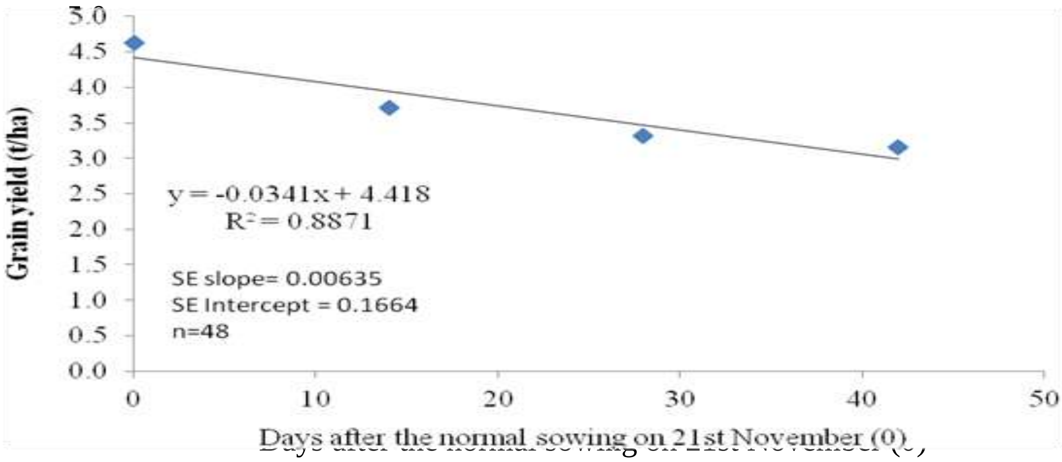




2010/11 dry season

Figure 1: Grain yield of bread wheat as influenced by sowing date in 2009/10 and 2010/11 dry seasons at Sokoto



Combined

Figure 2: Grain yield of bread wheat as influenced by sowing date in 2010/11 dry season and combined at Sokoto