EFFECT OF SOWING DATE AND WEED INFESTATION ON THE PERFORMANCE OF TWO VARIETIES OF IRRIGATED WHEAT *(Triticum aestivum L).*

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A Thesis submitted to the Postgraduate School, Ahmadu BelloUniversity, Zaria in partial fulfillment of the requirements for the Degree of Master of Science in Agronomy

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DECLARATION

I hereby declare that this thesis has been written by me and that it is a record of my own research work. It has not been presented before in any previous application for a higher degree.

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CERTIFICATION

This thesis entitled "Effect of sowing date and weed infestation on the performance of two varieties of irrigated wheat (Triticum aestivum L.)" by Adamu, Shuaibu Ubosharu meets the requirements governing the award of the degree of Master of Science of the Ahmadu Bello University and is approved for its contribution to Scientific knowledge and literary presentation.

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DEDICATION

To my children Abdurrahman and Abdullahi who were at their tender age during the period of the Programme and their mother, Amina who endured my absence when my presence and care were most needed.

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ABSTRACT

A field trial to study the effect of sowing date and weed infestation on the performance of two varieties (Siete cerros (Samwhit-5) and (Florence Aurore 8193 (Samwhit-2) of wheat (Triticum aestivum L.) Sown under irrigation was conducted on the Farm of the Institute for Agricultural Research, Ahmadu Bello University, Samaru - Zaria during the 1994/95 and 1995/1996 dry seasons. The growth and performance of the two varieties of wheat sown at ten dates (S1-S10) and kept weedy or weed free were evaluated in the two dry seasons. In each dry season, the ten sowing dates were spaced at ten days interval begining from November 18 to February 16.

Delay in sowing date, significantly increased weed population and dry weight. The highest weed dry weight was generally recorded at the last sowing date at all the sampling periods in the two dry seasons. Unchecked weed, significantly reduced plant count, Leaf Area Index, plant height, effective tillers per m^2 length of spike, spikelet/spike, grain/spike, grain weight/spike straw weight and hence the grain yield of wheat. The growth and yield attributes of wheat such as plant count, tiller count. LAI, plant height effective tillers, length of spike, spikelet/spike grain/spike grain weight/spike, 1000-grain weight straw weight, were also significantly depressed as the sowing date was delayed. The grain yield of the crop was consequently depressed by later sowing. However, the grain yield obtained with the first three sowing dates 18/11, 28/11 and 8/12 did not differ significantly in the two dry seasons. Delay to the third sowing date, caused a yield reduction of 9.8% and 11.5% for 1994/95 and 1995/96 dry seasons respectively while further delay to the last date caused 81.4% and 94.9% yield reduction for 1994/95 and 1995/96 dry seasons respectively. It is therefore recommended that sowing of wheat should not be beyond 8th December to avoid weed problems and reduction in grain yield.

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CHAPTER ONE

INTRODUCTION

Wheat (Triticum aestivum L.) belongs to the family graminea. Although wheat is an annual temperate crop, there are varieties of spring types which can be cultivated in some tropical and subtropical environments where temperatures are cool enough during certain period of the year to support their growth. The current center for commercial wheat production in Nigeria is in the north, in the area lying between latitude 10 - 14 degree north during the harmattan (November - February) period when the temperature is cool enough for growth and development of the crop. Because this period falls within the dry season, production presently in the country is by irrigation (Olugbemi et al., 1991).

Wheat is a free tillering crop about 0.3 - 0.8m tall. It has about 3-6 seminal roots which grow to a depth of about 1m or more and with adventitious roots found at the basal nodes of the main axis and tillers. It is an erect plant with 5-7 nodes. Most types have hollow internodes which are shortened at the base. Leaf sheath inserted at the node encircling the stem entirely at the base and split higher up. The flat leaf blade is about 20 - 37cm long and 1-2cm wide with parallel veins. The inflorescence or ear is a terminal cylindrical compound spike, 5-10cm long with 2 rows of spikelets and a single terminal spikelet, bearded or beardedless (Purseglove, 1976). Fundamental distinction is based on the botany of the crop. Percival (1921) described 18 species of which only few are grown commercially. The various forms of the genus Triticum are:

Triticum	vulgare	Common wheat
Triticum	turgidum	Poulard wheat
Triticum	durum	Durum wheat
Triticum	spelta	Spelt wheat
Triticum	polonicum	Polish wheat
Triticum	monococum	Erkorn wheat

For commercial purposes, the common wheat was classified by other characteristics such as hard or soft types, red or white and spring or winter.

Although, the origin of wheat is not known, it is believed to have been under cultivation in the middle east as far back as 10,000 BC (Vavilov) 1950; Leonard and Martin, 1963 and Waterbolk, 1968). Wheat was introduced to West Africa probably by the Arabs in the 12th century. The cultivation of the crop in Nigeria dated many centuries and was grown in low lying poorly drained soils of the Fadama along river banks and irrigated by Shaduf system (Andrews 1970). Research work on wheat in Nigeria started in 1959 (Olugbemi, et al., 1991).

It is an economic crop and is second to none in the current world cereal production out put (FAO, 1997). It is harvested in each month of the year in some part of the world (Nuttonsson, 1955). The world wheat acreage and production are concentrated in the northern hemisphere notably the U.S.S.R., Asia, European countries and north America. These Areas encompass 90% of the world's wheat lands (Quisenberry and Reitz, 1967). In Nigeria, the contribution of the domestic production to the national economy has been insignificant until the ban on its importation in 1986. Wheat importation rose rapidly from about 407,500tons in 1975 to 1.83million tons in 1985 (Anon, 1990). Since the ban on wheat importation, the Federal Government embarked on a programme of wheat cultivation under

irrigation in the northern part of the country. The Chad basin under the South Chad Irrigation Project, the Sokoto Rima Basin under the Bakolori Irrigation Project and the Hadejia-Jama'are River Basin under the Kano Irrigation Project have therefore been mandated to emphasize on wheat production to cover 345,000 hectares when fully developed. With the Accelerated Wheat Production Programme, (AWPP), the production went up to 140,000 tons in 1987/88, 492,000 tons in 1988/89 and 550,000 tons in 1989/90 (Anon, 1990).

Wheat is nutritious, readily stored and transported and easily processed. The products are bland, fit into countless recipes and suit many tastes. It contains starch (68.7%), protein (13.3%), Vitamins (7.6%) fat (2.0%) and minerals (1.7%) (Quisenberry and Reitz, 1967).

Dependence on wheat varies with geographical regions, for example, in Europe and U.S.S.R., over 30% of their calories come from wheat while in most other regions, it is less than 20%. The per capita consumption of wheat in the United States of American exceed that of any other single staple food (Quisenberry and Reitz, 1967).

The demand for wheat in Nigeria is increasing largely in respond to the increasing demand of bread. Bread is nutritionally superior and cheaper than other staple food. The consumption of wheat in the form of bread was introduced to Nigeria on a modest scale during the colonial period.

The average consumption of bread in Nigeria was 26.3gm/head/day in 1977 ranging from a maximum of 160gm/day in Lagos to a negligible level in the rural area. The locally produced wheat was mainly used in making luxury products such as alkaki, pate, barabusko, tuwo, danwake and taliya (Anon, 1979). In addition to making bread, it is used for making semovita, macaroni, spaghetti, biscuit, chapaties, pizza, bulgar, rolled flake, many hot and ready to eat breakfast, baby foods and etc. It is a common thicker in soups, gravies and sauce

and occurs in candies and beverages. Wheat germ, brans and malt are additional forms of wheat products (Quisenberry and Reitz, 1967).

The uses of wheat also include feeding the straw as roughage for ruminants and extensively used for livestock bedding. The green forage may be grazed as silage. The straw may also be used for news print, paper board, packing and art objects. The ripe unthreshed heads make decorative sheeves and bouquets.

Wheat production has been shown to be limited by factors such as available soil moisture (Quisenberry and Reitz, 1967), fertility status of the soil (Sale, 1971) and seed rate or plant population per unit area (Darwinkle, 1978). Yield loss of 60 - 70% due to weeds in wheat has been reported (Pande, 1956 and Verma, 1962) . However, it has been reported that the time of planting wheat does not coincide with the optimum period of weed seed germination and growth. It was observed that weed infestation and biomass increased as the season warms up from February to March (Singh, 1980). Choudhary and Ndahi, (1980) have also reported 500kg/ha as the highest weed dry weight obtained in wheat trials at Kadawa.

Wheat has a fairly wide climatic adaptation as can be seen to be grown in most parts of the world. However, date of sowing is an important factor limiting its yield (Falaki, 1994).

In Nigeria, the wheat season is characterized by wide fluctuation of day and night temperatures. The temperature decreases from October to January and increases from February and this increase limits the growing season and the wheat yield (Kumar and Mayaki, 1982).

Although, the optimum date of sowing wheat as recommended by I.A.R. is mid-November, Abdulmumuni and Owonubi (1990) using the Degree Day concept in determining the optimal time of sowing wheat based on ambient temperature at Kadawa, observed 1st December to be the optimal date. Despite the recommended optimum period of sowing wheat in Nigeria, some wheat farmers still fail to sow at the recommended time. They sow late with the likely consequences of obtaining reduced yield. It is proposed that the reductrion in yield is due to increase in temperature and more profuse weed growth which interfere with the crop. Therefore the purpose of this trial was to determine the effect of sowing date and weed infestation on the performance of two varieties of wheat.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Varietal variations

Plants vary in their capacity to react to environment and in their need for precise dose of one or more factors before they can proceed to produce. Thus the current different strains of economic plants are expression of the degree to which these are found for the purpose of optimal growth and development (Mathar et al ., 1967). Sikka and Jain (1960) opined that the yield in wheat as in other crops, is the expression of the interactions between the genetic constitution and the environmental factors in which it is grown. Hence, they noted that the yield is at its best when the plants of a particular variety are in harmony with the environment.

Olugbemi et al ., (1981) have reported significant differences in yields among four varieties of wheat in their response to growth factors on comparison. On the average, Siete cerros (awned) yielded best while Florence Aurore 8193 (awnless) was the lowest yielder. They attributed the varietal differences due to production of more spikelets and grains/spike, higher floret fertility and grain/straw ratio by Siete cerros despite the fact that Florence Aurore 8193 produced bigger grains, but could not compensate for its other undersirable yield characteristics which result in its lower grain weight per ear. Siete cerros is generally tolerant to insect pest and diseases while Florence Aurore 8193 is moderately resistant to insect pests and diseases. (Olugbemi *et al* 1991).

2.2 Effect of sowing date on weed infestation in wheat field

The rate of seed germination, shoot and root growth depends on the soil temperature. For each crop there is optimum temperature for seed germination and growth (Russell, 973).

The interference between wheat and weeds appears to occur at the time when soil temperature is greater than 10°C (Osman, 1971).

Singh (1980) indicated that the time of planting irrigated wheat does not coincide with the optimum period of weed seed germination and growth. As a result, wheat does not under normal circumstances suffer from early weed infestation as often suffered by rain fed crops. Weed infestation was observed to increase and becomes thicker as the season was warming up from February to March. This observation is in agreement with the works of Dadari (1988), who however, observed more broad leaved weeds than grassly weeds species. Nekendawira (1989) who in addition to broadleaved weeds observed also sedges than grassly weeds species and Falaki (1994) obtained similar result in Kadawa. Dadari (1985) observed that unquestionable competition from several weed species lower yields of wheat crop. He found that the soil type, temperature, water condition and proceeding crops were the primary influence on the distribution of 304 weed species in wheat fields. But Adigun (1984) reported that the precise time and duration of period of maximum weed competition depends on factors such as relative rate of growth of the crop grown and the time of moisture and nutrient stress. Some other workers have reported other factors apart from sowing date that influence weed infestation in wheat fields. Viter and Chenenkor (1983) in the Voronezh region showed that weed infestation in wheat and barley was affected by the proceeding crops and full crop rotation. They assessed that best proceeding crops for winter wheat were fallow, peas and maize for early silage. The best rotation they concluded was peas/winter wheat/barley and maize for early silage/winter wheat/barley. Reports by Nekendawiri (1989)

shows that the type and rate of fertilizer applied and even seed rate which may fail to grow and cover the ground earlier than the weeds could be the factor of weed infestation. He added water being an agent of weed seed dispersal, could also enhance weed infestation. He observed more weeds in the irrigation channels and some depressed parts of the wheat plots. More weed density was observed at the end of the irrigation plots where the excess water collects and drains than at the head of the channel.

2.3 Effect of sowing date on growth and development of irrigated wheat

It is commonly recognized that a definite amount of heat is required to bring a crop from planting to maturity, and there are certain restricted time limit within which crop must be planted for best result defined by the temperature of the locality (Nuttonson, 1955).

The various agronomic practices employed during growth and development of a crop determine the type and yield obtained from the crop. Date of sowing particularly in wheat is an important agronomic factor limiting yield obtained (Falaki, 1994). In Nigeria there is wide night and day temperature fluctuation which decreases from October and increases from February. This limits the wheat production within this period (Kumar and Mayaki, 1982). Leonard and Martin (1963) have identified minimum growth temperature for wheat as 3 - 4°C, maximum 30-32°C and optimum 25°C. Warm temperature during early growth may retard heading and daily maximum above 90°F (32°C) during 3 - 4 weeks after flowering may ripen the grain prematurely. Area of frost-free season of less than 100 days or with sub-polar climate when there are less than three months with average temperature of 50°F wheat is seldom grown. They thus concluded wheat to be a cool season crop with somewhat higher and minimum heat requirement than do the other small grains. It has been found in India that high day temperature during October and early November retards the vegetative growth of wheat while late-sown crop does well in the beginning, but from February onwards, it gets

hotter which brings about early maturity resulting in low yields (Gupta et al, 1968 and Singh and Ramdhawa, 1970). Abu-El-Bar (1968) in Egypt found plant height to increase with delaying the seeding of wheat from 24th October to 21st November and delaying after 21st November, decreased this characteristic due to increase in temperature. Plant population, period taken from spike emergence to ripening and leaf area Index have also been found to be affected by both early and late sowing of wheats (Ibrahim et al ., 1976). In a three season work at Kadawa on different dates of sowing (November to December), there was no serious effect of sowing date on plant height, dry matter accumulation and tiller/ m^2 which was due to low temperature prevailing during the phases (Falaki, 1994). High-temperature may retard plant growth by inactivating indigenous growth hormones or by enzyme, (Cambridge, 963) or by rendering various metabolites deficient (Bonner, 1957 and Ketallapper, 1963).

In another development, although complete chemical fertilizer apparently does not have any consistent effect on the length of growing period, but some other Russian data indicate that phosphorus fertilizers usually speed up the ripening by one or two days. It was also found that higher osmotic pressure of the soil solution seems to shorten the growing period of wheat (Nuttonson, 1955).

Moisture has also been reported to have influence on the length of the growing period of wheat. In Ben Zenchuk experimental station with soil moisture level of 20, 40 and 60% of the absolute soil moisture holding capacity demonstrated that, an increase of period by 2-3 days and headed to ripe period by 6-8 days. Transition from 40% to 60% moisture level caused further

lengthening of the season of the growing period (headed to ripe) is especially considerable as explained by the retarding effect on ripening when the soill moisture content is higher (Nuttonsson 1955).

2.4 Effect of sowing date on yield and yield components of wheat.

Bhardwaj et al ., (1971) have identified two factors to be responsible for wheat yield differences under different dates of sowing as temperature at sowing and tillering, and available growing season. Very high temperature may affect germination by encouraging diseases like root-rot while low temperature at sowing delays emergence by slowing down the rate of physiological activities related to germination.

Temperature has been reported to have a pronounced effect on the rate and duration of grain filling (Compbell and Read, 1968). In experiment of Assana and Williams (1965), the main effect was due to day temperature, but Peters et al ., (1971) found that a rise in night temperature shortened the period of grain filling drastically, Zhaq (1986) observed grain yield to depend on the rate, but not the duration of grain filling and filling period. Phytotron experiments have shown, that daily temperature has a predominant effect on duration of grain filling (Sofield et al ., 1974; Spiertz, 1974 and Warrington et al ., 1977).

It has been generally observed that there is a reduction in total number of tillers, spike bearing tillers to total number of tillers produced with late sowing (Singh and Alam, 1944). Abd-El-Bar,(1968) in Egypt found in addition to tiller, length of spike, spike grain weight and 1000-grain weight to increase with delaying the seeding of wheat from 24th October to 21st November and delaying seeding after November, decrease these characteristics. Similarly Vijay Kumar and Yayock (1980) working in Samaru on two sowing dates 10th November and 15th December , obtained wheat yield of 4,640kg/ha of grain and 59% less for timely sown and late sown, respectively. They also observed decrease of 35,24 and 23% for number of grains per head, 1000-grain weight and the number of productive shoots per unit area respectively in the December sown crop. Ansari et al ., (1989) have given similar report when sowing was delayed from November 1, 10, 20, to December 10 and 20th. Other

workers that have reported similar results are Larter et al ., 1971; Anonymous, 1979; 1978; Habib and Mayaki, 1979; Prasal 1979 Kumar and Mayak, 1982; Palmer Jones, 1978; Sain et al , 1992 and Falaki, 1994.

In 1993, Kumar reported that every 1° increase in air temperature during reproductive phase between the range of 24 - 28°C at Kadawa-Kano, decreased the grain yield of wheat by 633kg/ha/day. Similarly, reduction in grain yield has been reported by 1.3% or about 68kg/ha/day for each day later sowing of wheat after 15th November which is attributed to rising temperature rather than moisture stress (Cooper, 1992). However, Winter and Musick (1993) attributed the reduction in grain yield with later sowing of wheat to insufficient rooting to fully extract soil water from below the root zone. Ford et al., (1976) has found that high temperature reduced crop growth and therefore lowered dry matter accumulation.

2.5 Effect of weeds on wheat yield and yield components.

Kataria (1981) has reported that the severity of weed infestation and degree of grain yield reduction in wheat depend on planting density, soil type, cultural practices and available soil moisture. However, Sellerie (1975) is of the view that losses incurred in wheat vary depending on the variety of wheat, weed species, the density of the infestation and the rainfall. He further emphasized that the use of cultural techniques which eliminates the infestation can help in solving the weed problem. Wheat density in adjacent quadrant of $1m^2$ varied by an average of 25 plants in the farmers' fields and Research plots examined. Yield/plant, and DW/plant and tillers/plant decreased with increasing weed density (Hume, 1962).

Yield losses of 60 to 70% due to weeds in wheat has been reported (Pande, 1956 and Verma, 1962). The quality of harvested crop can be reduced especially when infested with weeds shortly before or during harvesting which is expressed in grain weight. Weed

infestation play an important role in increasing grain humidity especially in moist region, thus storage life of the grain is also increased (Sieberhein, 1979). Losses caused by weed result in quantitative reduction in yield of and an estimated loss of nearly ten percent (10%) of the potential harvest due to weed competition seems correct on world wide basis (Cramer, 1967).

Some of the weeds that are known to cause serious problem in wheat fields include wild oats (Avena fatua L.); wild mustard (Brassica sp DC); Cyperus sp and wild sorghum (Sorghum eathipieum) (Bell and Nalewaje, 1968). Under favourable weather condition, wheat survives the competition of weeds due to its vigorous and fast growth, of which reduction in yield due to weeds may be very little, but if conditions are less favourable for the crop growth and development the loss in yield due to weeds may be 50% or more (Vermer and Bharadwaji, 1957). Blackshaw et al ., (1981) have found that "Turkey red" wheat was more competitive than "big frame" to weeds and tall spring cultivar "Sinton" was a better weed competitor than the semi-dwarf cultivar "Norquary" due to their ability to shade the weeds more effectively. Reeves and Broke (1977) have suggested that differences in early root development may have caused the differences in competitiveness whatever the cause, such genotypic effect deserve more attention.

Weeds compete with the wheat crop for water, light, air, mineral nutrients and space which cause losses in yield and quality. Weed seeds in grain reduce its commercial and farm use values, impact objectional odour and flavours and also weeds cause reduction in crop vigor, tillering, head size and kernel weight (Zindahl, 1980).

However,Singh (1980) has reported that the time of sowing irrigated wheat does not coincide with the optimum period of weed infestation and biomass increase as the season was warming up from February to March. Dadari, (1988); Nekendawiri, (1989) and Falaki,

(1994) have reported similar findings. The mean yield of crops with uncontrolled weed growth relative to that of weed free crops and the critical period of crop-weed competition were calculated for 26 different crops, the wheat was at the top and carrot and onion at the bottom (Heemst, 1985). The highest weed dry weight found in the wheat trials at Kadawa was 500kg/ha (Chaudhary and Ndahi, 1980). This was exceedingly low as compared with 8037kg/ha of dry weed weight observed in the wet season in groundnut at the same location (Anon, 1979). Low temperature, dry condition, lack of adaptation of weeds to new environment, quicker crop growth with profuse tillering and closer spacing of the crop are some of the reasons which may account for the differences in weed growth in the two seasons (Anon. 1979).

CHAPTER THREE

3.1 MATERIALS AND METHODS

3.1.1. Experimental site.

The experiment was conducted under irrigation during the dry seasons (November to April) of 1994/95 and 1995/96 at the Institute for Agricultural Research, Ahmadu Bello University, Samaru, Zaria (11° 11' and 07° 08'E) which is located in the savanna ecological zone of Nigeria.

Soil samples from the experimental site were taken and bulked and analysed for physical and chemical properties using standard procedures as described by Black (1965). The soil was clay-loam and almost neutral. Details of soil analysis are presented in appendixes 3 and 4. The meteorological data for Samaru during the 1994/95 and 1995/96 dry seasons are presented on appendixes 1 and 2. The period was without rain with relative humidity ranging from 20.45 to 51.75 and 18.80 to 58.75 for 1994/95 and 1995/96 dry seasons, respectively. The minimum temperatures ranged between 10.27°C to 19.85°C and 9.80°C to 23.70°C, while the maximum temperatures ranged between 25.91°C to 37.40°C and 27.60°C to 38°C for the 1994/95 and 1995/96 dry seasons, respectively.

3.1.2 Treatments and experimental design

The treatments were made up of the combinations of two wheat varieties (Siete cerros and Florence Aurore 8193) weed free and weedy check and ten sowing dates. The treatments were laid out in a split plot design with the sowing dates as the main plot treatments and varieties and weed free and weedy check assigned to the sub-plots. The treatments were replicated three times. The gross and net plots sizes were 3m x 2m and 2m x 1m respectively.

A border of 0.5m wide was left between the main plot. The sowing dates were: S_1 = 18/11;S_2 = 28/11 S_3 = 8/12; S_4 = 18/12; S_5 = 28/12; S_6 = 7/1; S_7 = 17/1; S_8 = 27/1; S_9 = 6/12 and S_{10} = 16/2.

3.1.3 Description of the varieties used.

Siete cerros (Samwhit-5) variety-1

This is a semi-dwarf variety (72-80cm) with brown spike borne on kinky neck. The awns are long, brown and arranged mostly parallel to one another. The kernel is fat and light brown in colour. It is medium in maturity (110 - 120 days). Its potential yield is 4,500-5,00kg/ha. It is tolerant to insect pests and diseases and resistant to lodging . It is adapted within latitude 10 - 14°N in Nigeria. It was introduced into Nigeria from Mexico (Olugbemi et al., 1991).

Florence Aurore 8193 (Samwhit-2) variety 2

It is a tall variety (99 - 115cm) with thick culm: It has long, lax spike cream in colour with a potential yield of 4,500-4700kg/ha. The kernal is long and fat. It is medium in maturity (110-120days), moderately resistant to insect pests and disease, but susceptible to lodging. The variety has very good bread-making qualities and perform well within latitude 10 - 14°N. (Olugbemi et al. , 1991).

3.2 Cultural Practices.

3.2.1 Land preparation.

The experimental site was ploughed and harrowed to a fine tilth and then divided into the required plot size with channels provided for irrigation and drainage. Final leveling and raising were made using hoe and rake.

3.2.2. Fertilizer application.

The recommended single superphosphate at 45kgP_2 0_5 /ha and muriate of potash at 30kg/ K_20/ha were broadcast and incorporated into the soil at sowing. Nitrogen fertilizer at the rate of (120kgN/ha) was applied in two equal split doses at sowing and at 4 weeks after sowing (4 WAS) using area.

3.2.3 Seed rate:

The IAR recommended seed rate of 100kg/ha was sown by hand drilling at 2.5cm depth and 25cm inter row spacing and solid row. The seeds were dressed with insecticide and fungicide (Apron plus).

3.2.4 Irrigation

Irrigation was carried out at weekly intervals until two weeks to harvest for the various dates of sowing. Furrow irrigation was used.

3.2.5 Weeding.

Weeding was carried out manually using hand hoe as often as it was necessary to keep the plots free of weeds. However, the plots for weed sampling were kept weedy.

3.2.6 Harvesting.

Harvesting was done at full mature stage when the heads and leaves turned brown using hand sickle. The crop was cut out as close to the ground as possible and tied in bundle sheeves for further drying. Threshing was done manually using sticks to beat the grains out of the heads. The grains were separated from the chaffs by winnowing.

3.3 Data collection

3.3.1 Growth characters.

Ten plants were randomly selected from each sub-plot and tagged for data collection on growth and yield attributes.

3.3.2 Plant count/m^2

For each plot, four rows were randomly picked and in each row, one meter length was marked out. The plants from these four rows were counted two weeks after sowing and plant count/m^2 determined.

3.3.3 Plant height (cm)

The plant height was measured from the ten tagged plants using meter rule from the ground level to the tip of the spikes after heading and average shoot height determined.

3.3.4 Tiller count/m^2

The tillers were counted from four linear row of each plot taken at random and expressed as tiller count/m^2.

3.3.5 Leaf Area Index (LAI)

The leaf area index was obtained by picking randomly plants from 0.5m row length in each sub-plot. The leaves from each plant were removed, their length and width (from the widest point) were multiplied with a conversion factor of 0.72 to obtain the leaf area /plant (Hassan, 1983) from which average of leaf area/plant was determined for each treatment. The LAI was thus determined by multiplying the total number of plant/m^2 by the average leaf area/plant and dividing this product by 10,000cm^2.

3.4 Yield components and yield.

3.4.1 Number of effective tiller/m^2

The number of effective tiller/m^2 was determined by counting the number of spikes in a four linear rows of one meter length for each plot which was later expressed as number of effective tiller/m^2.

3.4.2 Length of spikes(cm).

From the ten tagged plants in each plot treatment, the length of each spike was measured from the basal node to the spike tip (excluding awns) using a ruler, from which the average length of spike was obtained.

3.4.3 Number of spikelet/spike.

From the ten tagged plants in each plot, the number of spikelets/spike was counted and average number of spikelet/spike determined.

3.4.4 Number of grain/spike.

The number of grain/spike was obtained by counting from the spikes after drying and threshing of ten tagged plants.

3.4.5 Grain weight/spike(g).

This was determine by weighing the clean grains obtained from the spikes of the ten tagged plants.

3.4.6 1000-grain weight (g).

This was obtained by counting 1000-grains at random from the plants of each plot treatment and then weighed.

3.4.7 Straw weight (kg/ha).

At harvest, the crop was cut as close to the ground as possible, bundled and weighed before threshing to get the total dry weight for each plot. The straw weight was determined from the difference between the total dry weight at harvest and the grain yield of individual sub-plots.

3.4.8 Grain yield (kg/ha)

The grain yield was determined by weighing the clean grains from individual plots and the weight expressed as grain yield per hectare.

3.5.1 Weed sampling.

This was obtained by taking weed sample randomly from a quadrant of 25cm x 25cm from the unweeded plots throughout the sampling periods of 3, 6 and 9 weeks after sowing (WAS) for each sowing date. The weeds found within the quadrant were counted and expressed as weed population/m^2.

3.5.2 Weed dry weight (kg/ha).

The weeds from the quadrant were oven dried at 75°C for two days. The oven dried weeds were then weighed and expressed in kg/ha.

3.5.3 Weed classification

The weeds collected were classified into grasses, broadleaf and sedges.

3.5.4 Dominant weed species.

The dominant weed species in the experimental field were obtained and recorded.

3.6. Statistical analysis.

The data collected were subjected to statistical analysis of variance and where 'F' test showed significant difference, the means of such treatments were then compared using the

Duncan Multiple Range Test (Duncan, 1955). Correlation coefficients were worked out as described by Snedecor and Cochran (1967) to determine relationship between growth characters, yield components and grain yield.

CHAPTER FOUR

RESULTS

4.1.0. Effect of sowing date and wheat varieties on weed infestation

4.1.1 Total Weed Infestation.

The influence of sowing date on weed population was significant at 3, 6 and 9 WAS in 1994/95 and 1995/96 dry seasons (Table 1). In all cases, except at3 WAS in the 9th sowing date in 1994/95 and at 6 WAS with the 10th sowing date in 1995/96 seasons,wheat sown on the last three sowing dates had higher weed population than the appropriate least obtained.

In 1994/95, weed population at 3 WAS in the wheat sown at 4th, 5th and 10th sowing dates were comparable to the maximum while in 1995/96, the corresponding weed population were lower in wheat sown at the first seven sowing dates. In the two dry seasons, with the exception of the third sowing date in 1994/95 season, the first seven sowing dates caused lower weed population at 6 WAS compared with appropriate maximum.

Similar trend was observed for the weed population at 9 WAS with the exception of the first sowing date in 1994/95 and 1995/96 as well as the sixth and seventh sowing dates of 1995/96 dry season which caused similar weed population to the maximum.

Both the effect of wheat varieties and their interaction with sowing date on the total weed population were not significant in 1994/95 and 1995/96 dry seasons.

Table 1: Total weed population as affected by sowng date in two wheat varieties at Samaru during the 1994/95 and 1995/96 dry seasons.

Treatment	Total weed population/m²					
	1994/95			1995/96		
	Weeks after sowing			Weeks after sowing (WAS)		
	3	6	9	3	6	9
Sowing date(s)						
Nov.18	49.51bc	34.3bc	356.7abc	445.1bc	779.0bc	891.00a
Nov. 28	84.51c	164.3c	263.5bc	203.0c	315.0d	331.d
Dec. 8	157.2c	462.5ab	224.0bc	240.0c	363.0d	451.0cd
Dec. 18	297.5ab	290.3bc	237.0bc	304.0bc	283.0d	555.0bcd
Dec. 28	298.3ab	216.5bc	285.3bc	243.0c	536.0cd	413.0cd
Jan. 7	140.8c	160.8c	207.8c	245.0c	293.0d	664.0abc
Jan. 17	86.8c	220.2bc	232.8bc	264.0c	448.0d	690.0abc
Jan. 27	438.5a	410.7ab	568.7a	763.0a	247.0a	714.0abc
Feb. 6	258.3bc	444.0ab	442.8ab	648.0ab	888.0b	909.0a
Feb.16	326.7ab	579.30a	521.0a	763.0a	587.0bcd	875.0ab
SE ±	56.8	76.1	66.7	109.7	93.6	96.8
Wheat variety(V)						
Siete cerros	223.5	324.8	333.8	489.0	580.0	634.0
Florence Aurore 8193	224.2	329.2	334.1	489.0	568.0	664.0
SE ±	2.0	4.1	5.6	26.0	31.7	15.9
Interaction						
S x V	NS	NS	NS	NS	NS	NS

NS = Not significant
Means followed by the same letter(s) within a treatment group are not significantly different at 5% level of significance using DMRT.

4.1.2 Total weed dry weight

Throughout the sampling period of 3, 6 and 9 WAS in the two dry seasons, there was a significant effect of sowing date on total weed dry weight (Table 2). In all cases, with the exception of total weed dry weight at 3 WAS with the 8th sowing date in 1995/96, the last sowing date (10th) resulted in significantly higher total weed dry weight than earlier dates. The other sowing dates, however, resulted in similar total weed dry weight at 3 WAS in the two dry seasons. While total weed dry weight at 6 WAS was significantly lower with the first to seventh sowing dates compared with the 9th in 1995/96, the 8th and 9th sowing dates caused higher total weed dry weight than 2nd, 3rd, 5th and 6th sowing dates in 1994/95 dry season. In 1994/95, the total weed dry weight of 9 WAS was higher with 8th and 9th sowing dates than in the earlier dates.

The effect of wheat varieties on the total weed dry weight was not significant in the two dry seasons. The interaction between sowing date and wheat varieties on total weed dry weight was also not significant in the two dry seasons.

4.1.3 Population of broadleaved and grass weeds.

Sowing date significantly influenced the population of broadleaved and grass (bg) weeds throughout the sampling periods in 1994/95 dry season (Table 3). The highest bg population was obtained with eighth sowing date at 3 WAS and the tenth at 6 WAS and 9WAS, respectively. Comparable bg population to the corresponding highest were obtained with the fourth sowing date at 3 WAS, 3rd, 8th and 9th dates at 6 WAS and 1st, 3rd, 8th and 9th at 9 WAS.

The influence of the wheat varieties and their interaction with sowing date on bg weeds population were not significant.

Table 2: Total dry weight of weeds as effected by sowng date in two varieties of wheat at Samaru during the 1994/95 and 1995/96 dry seasons.

Treatment	Total weed dry weight (kg/ha) 1994/95			995/96		
	Weeks After Sowing 3	6	9	Weeks After Sowing 3	6	9
Sowing date(s)						
Nov.18	3.0b	16.7c	11.9c	60.8b	322.0c	421.0e
Nov. 28	1.6b	12.6c	17.7c	98.6b	108.0c	319.0e
Dec.8	1.6b	5.9c	5.5c	18.1b	124.0c	214.0e
Dec.18	3.0b	14.6c	22.1c	71.1b	83.0c	383.0e
Dec.28	2.90b	7.81c	27.6c	35.6b	149.0c	1079.0de
Jan.7	3.70b	12.1c	28.9c	79.8b	182.0c	504.0e
Jan.17	2.4b	14.9c	45.5c	91.5b	198.0c	1650.0a
Jan.28	9.6b	65.9b	246.0b	348.7a	811.0bc	2966.0c
Feb.6	8.9b	67.3b	258.6b	101.6b	1659.0b	5962.0b
Feb.16	36.7a	294.4a	876.8a	433.6a	4542.0a	6929.0a
SE ±	3.5	15.8	25.1	55.2	330.2	280.0
Wheat variety (V)						
Siete cerros	7.3	51.0	154.0	129.6	805.0	2169.0
Florence Aurore 8193	7.5	51.3	154.1	124.4	829.0	1917.0
SE ±	0.2	0.2	0.2	8.8	41.0	163.5
Interaction						
S x V	NS	NS	NS	NS	NS	NS

NS = Not significant
Means followed by the same letter(s) within a treatment group are not significantly different at 5% level of significance using DMRT.

4.1.4 Dry weight of broadleaved and grass weeds

Sowing date significantly affected the dry weight of bg weeds in 1994/95 dry season with the last sowing date causing the highest dry matter production (Table 3). The ninth sowing date only caused comparable bg weed dry matter production to the higher at 3 WAS. The first sowing date only caused lower bg weed dry matter production at 3 WAS than the eighth sowing date while both the eighth and ninth sowing dates caused higher weed dry matter production at 6 and 9 WAS than the earlier sowing dates.

The effect of the wheat varieties and the interaction with sowing dates were not significant in the 1994/95 dry season.

4.1.5 Grass weed population.

The influence of sowing date on number of grass weeds at 3, 6 and 9 WAS in 1995/96 dry season was significant (Table 4).The second to the seventh sowing dates caused lower grass weed population at 3 WAS compared with the maximum obtained. All the other sowing dates caused lower weed population at 6 WAS compared with the eighth date of sowing although only the second, third, fifth and sixth sowing dates caused weeds population comparable to the lowest observed with the fourth sowing date.

The influence of the wheat varieties and the interaction with sowing dates on the grass weed population in the1995/96 dry season were not significant.

4.1.6 Grass weed dry weight.

Significant variation was observed in grass weed dry weight as the sowing date was varied (Table 4). The highest grass weed dry weight in 1995/96 dry season was recorded at the last sowing date although the ninth sowing date resulted in a comparable weed dry weight to the maximum at 9 WAS. Higher dry matter production than the least were also obtained with eighth and ninth sowing dates at 3 WAS, ninth at 6 WAS and eighth sowing date of 9 WAS.

Table 3: Population and dry weight of broadleaved and grass weeds as affected by sowing date in two wheat varieties at Samaru during the 1994/95 and dry season.

Treatment	Population/m²			Dry weight (kg/ha)		
	Weeks After Sowing			Weeks After Sowing		
	3	6	9	3	6	9
Sowing date(S)						
Nov.18	86.0de	256.0bcd	333.0ab	0.3c	5.3c	5.0c
Nov.28	58.0e	132.0d	170.0ab	0.5bc	1.3c	8.0c
Dec.8	112.0cde	303.0abc	301.0ab	1.2bc	2.3c	3.0c
Dec.18	279.0ab	184.0d	203.0bc	0.5bc	9.1c	17.0c
Dec.28	209.0bc	211.0cd	203.0bc	1.3bc	4.6c	21.0c
Jan.7	128.0cde	150.0d	148.0d	1.8bc	2.5c	25.0c
Jan.17	66.0e	168.0d	171.0cd	0.5bc	10.8c	31.0c
Jan.27	351.0a	357.0bc	430.0a	2.3b	56.0b	221.0b
Feb.6	170.0cd	404.0ab	403.0a	4.50a	57.9b	237.0b
Feb.16	201.0bc	465.0a	441.0a	5.3a	229.7a	849.0a
SE ±	29.1	50.7	41.6	0.5	4.38	14.3
Wheat variety (V)						
Siete cerros	167.0	245.0	283.0	1.8	40.3	144.0
Florence Aurore 8193	164.0	281.0	274.0	1.8	35.6	139.0
SE ±	16.2	26.2	26.9	0.1	4.0	15.5
Interaction S x V	NS	NS	NS	NS	NS	NS

NS= Not significant

Means followed by the same letter(s) within a treatment group are not significantly different at 5% level of significance using DMRT.

Table 4: Population and dry weight of grass weeds as affected by sowing date in two wheat varieties at Samaru during the 1995/96 dry season.

Treatment	Population/m²			Dry weight (kg/ha)		
	Weeks After Sowing			Weeks After Sowing		
	3	6	9	3	6	9
Sowing date						
Nov.18	392.0a-d	667.0b	795.0a	13.2c	200.0c	330.0c
Nov.28	149.0d	256.1cde	237.0e	12.5c	51.0c	215.0c
Dec. 8	131.0d	265.0cde	357.0cd	6.5c	63.0c	227.0c
Dec.18	216.0bcd	195.0e	397.0de	15.8c	35.0c	172.0c
Dec.28	176.0cd	359.0cde	336.0de	9.7c	70.0c	602.0c
Jan..7	112.0dde	237.0de	604.0bcd	6.3c	107.0c	402.0c
Jan.17	195.0cd	482.0bcd	656.0abc	46.5bc	96.0c	1213.0c
Jan.27	591.0ab	1135.0a	629.0abc	174.3b	687.0bc	2557.0b
Feb.6	539.0abc	748.0b	797.0a	170.4b	1282.0b	6067.0a
Feb.16	672.0bc	517.0bc	755.0a	353.8a	3930.0a	6051.0a
SE ±	111.44	81.0	85.3	38.9	255.9	355.2
Wheat variety (V)						
Siete cerros	337.0	498.0	551.0	72.3	644.0	1786.0
Florence Aurore 8193	287.0	472.0	561.0	68.5	660.0	1781.0
SE ±	26.6	36.5	16.1	0.1	28.4	39.7
Interaction						
S x V	NS	NS	NS	NS	NS	NS

NS= Not significant .

Means followed by the same letter(s) within a treatment group are not significantly different at 5% level of significance using DMRT.

Table 5: Population, and dry weight of broadleaved weeds as affected by sowing date in two wheat varieties at Samary during the 1995/96 dry season.

Treatment	Population/m² Weeks After Sowing			Dry weight (kg/ha) Weeks After Sowing		
	3	6	9	3	6	9
Sowing date(S)						
Nov.18	32.90	50.7	61.3bc	1.6	20.8b	77.0c
Nov.28	21.3	16.0	37.3bc	2.6	29.7b	83.0c
Dec.8	16.0	29.3	62.3bc	1.7	6.5b	49.0c
Dec.18	32.0	32.0	40.0bc	3.8	7.3b	62.0c
Dec.28	16.0	61.3	40.0bc	0.9	5.9b	528.0c
Jan.7	45.3	29.3	32.0c	8.3	68.7b	78.0c
Jan.17	16.0	69.3	45.3bc	4.3	88.9b	427.0c
Jan.27	32.0	82.7	85.3ab	7.0	94.7b	409.0c
Feb.6	50.7	11.7	82.7ab	4.4	276.8ab	1136.0a
Feb.16	24.0	58.0	117.3a	3.0	592.0a	854.0ab
SE ±	9.2	24.1	14.4	2.3	111.4	151.8
Wheat variety (V)						
Siete cerros	24.5	56.0	56.5	3.3	114.8	370.0
Florence Aurore 8193	32.5	53.0	65.6	4.2	123.5	371.0
SE ±	3.8	4.4	6.3	0.5	13.3	27.1
Interaction						
S x V	NS	NS	NS	NS	NS	NS

NS= Not significant

Means followed by the same letter(s) within a treatment group are not significantly different at 5% level of significance using DMRT.

The influence of the wheat varieties and the interaction with the sowing dates on the broadleaved weed dry weight were not sigfnificant.

4.1.9 Sedges weed population.

Sowing date had significant effect on the number of sedges per m^2 only in 1994/95 dry season (Table 6). At all the sampling periods, the last sowing date resulted in the highest sedge weed population. At 3 WAS, the first, second, sixth and seventh sowing dates resulted in significantly lower sedge weed population compared with other sowing dates. The first to ninth sowing dates significantly had lower sedge weed population than the appropriate maximum. The last sowing date had significantly similar sedge weed population with the 1st, 4th, 5th and 8th sowing dates and higher than the least with 6th sowing date. The 2nd and 3rd sowing date also were comparable with the least while the 7th and 9th sowing dates were higher at 9 WAS.

Table 6: Population of sedges as affected by sowing date in two wheat varieties at Samaru during 1994/95 and 1995/96 dry seasons..

Treatment	Sedges population/m²					
	1994/95			1995/96		
	Weeks After Sowing			Weeks After Sowing		
	3	6	9	3	6	9
Sowing date (S)						
Nov.18	48.0b	34.7bc	98.7a	43.3	80.0	34.7
Nov.28	31.7b	45.3bc	34.7bc	32.0	48.8	45.3
Dec. 8	80.0a	56.7b	32.0bc	45.3	82.7	24.0
Dec.18	88.7a	50.7b	88.0a	61.3	80.0	117.3
Dec.28	82.7a	40.6bc	66.7ab	50.3	122.7	37.3
Jan.7	18.7b	50.7b	21.3c	88.0	26.7	29.3
Jan.17	21.3b	64.0b	48.0b	53.4	13.3	5.3
Jan.27	88.0a	18.7c	101.3a	96.0	29.3	0.0
Feb.6	88.6a	48.0bc	32.0b	58.7	24.0	5.3
Feb.16	125.3a	90.0a	98.7a	66.7	18.7	2.7
SE ±	18.6	10.6	11.7	29.8	39.9	23.9
Wheat variety (V)						
Siete cerros	44.5	51.2	64.0	63.5	55.5	27.7
Florence Aurore 8193	55.9	47.5	60.3	56.0	49.6	32.5
SE±	6.0	6.1	3.8	8.9	4.6	9.7
Interaction						
S x V	NS	NS	NS	NS	NS	NS

NS= Not significant.

Means followed by the same letter(s) within a treatment group are not significantly different at 5% level of significance using DMRT.

4.1.10 Sedges weed dry weight.

The effect of sowing date on sedge weed dry weight was significant only in 1994/95 dry season (Table 7). The last sowing date resulted in significantly higher sedge weed dry weight at 3 and 6 WAS than those at earlier sowing dates. However, at 9 WAS, sedge weed dry weight with sowing dates 8th to 10th were higher than those at earlier dates. The seventh sowing date also resulted in higher sedge weed dry weight than the least with 3rd and 6th sowing dates.

The effect of wheat varieties on the sedge weed dry weight was not significant in the two dry seasons.

The interaction of sowing date and wheat varieties on sedge weed dry weight was only significant at 9 WAS in 1994/95 dry season (Table 8). The varieties only deffered significantly at the ninth sowing date when Florence Aurore 8193 caused highef sedge weed dry weight than Siete cerros.

Within each variety, the eighth and tenth sowing dates under Siete cerros and the seventh sowing date in addition under Florence Aurore 8193 caused higher sedges weed dry matter production than the least at 9WAS.

4.2 Establishment and Growth of wheat as affected by sowing date, variety and weed infestation.

4.2.1 Days to crop emergence.

The effects of sowing date, wheat varieties and weed infestation and their interactions on number of days to wheat crop emergence were not significant in both dry seasons (Table9).

Table 7: Dry weight of sedges as affected by sowing date in two wheat varieties at Samaru during the 1994/95 and 1995/96 dry seasons..

Treatment	Sedges dry weight (kg/ha) 1994/95 Weeks After Sowing			1995/96 Weeks After Sowing		
	3	6	9	3	6	9
Sowing date (S)						
Nov.18	2.7b	11.4b	6.5bc	46.0	87.4 13.6	
Nov.18	1.1b	10.7b	10.0bc	13.6	20.2	21.5
Dec.8	2.6b	4.3b	2.5c	9.9	54.0	50.1
Dec.18	0.7b	5.6b	5.1bc	52.1	34.8	149.0
Dec.28	1.6b	3.2b	7.0bc	25.0	82.1	47.0
Jan.7	1.9b	9.6b	3.7c	65.5	11.1	24.3
Jan.17	0.8b	4.2b	14.4abe	40.1	28.4	22.0
Jan.27	7.3b	6.7b	20.1a	107.4	28.8	0.0
Feb.6	4.1b	9.5b	20.1a	26.8	78.3	28.0
Feb.16	31.4a	64.1a	18.43a	63.4	22.8	24.0
SE ±	1.9	4.2	3.0	33.7	35.3	28.9
Wheat variety (V)						
Siete cerros	5.4	10.5	9.5	51.4	50.1	31.0
Florence Aurore 8193	5.5	15.4	12.1	50.6	43.7	40.9
SE±	0.6	9.6	1.2	6.8	3.9	12.8
Interaction						
S x V	NS	NS	*	NS	NS	NS

NS= Not significant. * = Significant.

Means followed by the same letter(s) within a treatment group are not significantly different at 5% level of significance using DMRT.

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Table 8: Interaction of sowing date and variety on dry weight (kg/ha) of sedges in two wheat varieties at Samaru during the 1994/95 dry season.

Treatment	Sedges dry weight (kg/ha)	
	V1	V2
Sowing date (S)		
Nov. 18	6.4def	6.5def
Nov. 28	10.9b-f	9.9c-f
Dec. 8	2.6f	2.5f
Dec. 18	3.4ef	6.9def
Dec. 28	4.8ef	9.3cdef
Jan. 7	3.0ef	4.4ef
Jan. 17	12.5b-f	16.4b-e
Jan. 27	2.7c-f	19.3a-d
Feb.6	7.7c-f	32.6a
Feb.16	23.5ab	13.4b-f
SE ±	3.9	

V1 = Siete cerros V2 = Florence Aurore 8193.
Means followedby the same letter(s) within a treatment group are not significantly different at 5% level of significant using DMRT.

Table 9: Effect of sowing date, on the number of days to seedling emergence of two wheat varieties at Samaru during 1994/95 and 1995/96 dry seasons.

Treatment	Number of days	
	1994/95	1995/96
Sowing date (S)		
Nov. 18	5.0	5.0
Nov. 28	7.0	5.0
Dec. 8	7.0	6.0
Dec. 18	8.0	6.0
Dec. 28	6.0	5.0
Jan. 7	7.0	6.0
Jan.17	8.0	5.0
Jan. 27	7.0	5.0
Feb. 6	6.0	5.0
Feb. 16	5.0	5.0
SE ±	0.0	0.0
Wheat variety (V)		
Siete cerros	6.0	5.3
Florence Aurore 8193	6.6	5.3
SE ±	0.0	0.0
Weed infestation (W)		
Weed free	6.6	5.3
Weedy	6.6	5.3
SE ±	0.0	0.0
Interaction		
S x V	NS	NS
S x W	NS	NS
V x W	NS	NS
S x V x W	NS	NS

NS = Not significant

Means followed by the same letter(s) within a treatment group are not significantly different at 5% level of significance using DMRT.

4.2.2 Plant count.

Sowing date had significant effect on the plant count of wheat in both dry seasons (Table 10) when the least plant count were obtained with the last sowing date. In 1994/95, the eight and ninth sowing dates resulted in wheat plant count that was significantly lower than the maximum and comparable to the least. In 1995/96, the fifth to tenth sowing dates resulted in significantly lower wheat plant count compared with the maximum obtained with the second date. However, only the seventh to ninth sowing dates caused comparable plant count to the least in the season.

The effect of wheat varieties and weed infestation on plant count was significant only in 1994/95 dry season. Siete cerros had higher plant count than Florence Aurore. Likewise weed free plot recorded higher plant count than that obtained with weedy plots in 1994/95 dry season.

4.2.3 Leaf Area Index (LAI).

The effect of sowing date on leaf area index (LAI) was significant (Table 11). In all cases, the first two sowing dates produced maximum LAI while the least were produced with the last sowing date. The 4th sowing date was comparable to the maximum at 6 WAS in 1994/95 and at 3 WAS in 1995/96. The 5th sowing date also caused LAI which were lower than the maximum, but significantly higher than the least in 1994/95. The 8th sowing date resulted in lower LAI than the maximum but higher than the later sowing dates.

LAI was significantly lower than the maximum from the 5th sowing date in 1994/95 and 4th in 1995/96 at 6 WAS. However, in both years, LAI was significantly lower than the maximum with the 3rd sowing dates and later. Florence Aurore 8193 had significantly higher LAI than Siete cerros in both seasons and all the sampling periods except at 9 WAS in 1995/96. Similarly, weed free treatment resulted in higher LAI than weedy treatment in the two dry seasons except at 6 WAS in 1994/95.

Table10: Effect of sowing date, variety and weed infestation on plant count of wheat crop at Samaru during the 1994/95 and 1995/96 dry season.

Treatment	Plant count/m^2	
	1994/95	1995/96
Sowing date (S)		
Nov. 18	365.3ab	264.0ab
Nov. 28	390.8a	270.6a
Dec. 8	392.2a	243.8ab
Dec. 18	331.1ab	269.5a
Dec. 28	391.3a	237.7bc
Jan. 7	343.3ab	237.0bc
Jan. 17	356.9ab	213.3cd
Jan. 27	245.9cd	212.3cd
Feb. 6	273.9cd	211.3cd
Feb. 16	190.1d	201.8d
SE ±	29.0	9.1
Wheat variety (V)		
Siete cerros	343.1a	239.1
Florence Aurore 8193	313.3b	233.1
SE ±	4.7	2.6
Weed infestation (W)		
Weed free	337.1a	238.5
Weedy	319.3b	233.8
SE ±	4.7	2.6
Interaction		
S x V	NS	NS
S x W	NS	NS
V x W	NS	NS
S x V x W	NS	NS

NS = Not significant
Means followed by the same letter(s) within a treatment group are not significantly different at 5% level of significance using DMRT.

Table 11: Effect of sowing date, variety and weed infestation on leaf area index (LAI) of wheat crop at Samaru during the 1994/95 and 1995/96 dry seasons.

Treatment	Leaf Area Index					
	1994/95			1995/96		
	(WAS)			(WAS)		
	3	6	9	3	6	9
Sowing date (S)						
Nov. 18	1.4a	4.3a	4.7a	1.4a	3.8a	4.1a
Nov. 28	1.4a	4.0ab	4.6a	1.4a	3.5a	4.0a
Dec. 8	1.4a	3.7abc	3.8b	1.3ab	3.4ab	3.6b
Dec. 18	1.3b	3.7abc	3.3bc	1.3ab	3.0b	3.3b
Dec. 28	1.3b	3.6bc	3.2c	1.3ab	2.9bd	2.8c
Jan. 7	1.3b	3.3cd	3.6bc	1.2b	2.7cd	2.7c
Jan. 17	1.3b	3.2cd	2.6d	1.2b	2.6cd	2.6c
Jan. 27	1.2c	2.8d	2.5d	1.2b	2.4de	2.1d
Feb. 6	1.0d	3.0d	2.3d	1.0c	1.9e	1.7e
Feb. 16	0.9e	2.2e	1.4e	0.9d	1.3f	0.9f
SE ±	0.01	0.2	0.2	0.04	0.23	0.1
Wheat variety (V)						
Siete cerros	1.2b	3.2b	3.1b	1.2b	2.7b	2.7b
Florence Aurore 8193	1.3a	3.5a	3.2a	1.3a	2.8a	2.8a
SE±	0.03	0.05	0.03	0.01	0.03	0.03
Weed infestation (W)						
Weed free	1.3a	3.4	3.4a	1.3a	2.8a	2.9a
Unweeded	1.2b	3.3	3.0b	1.2b	2.7b	2.6b
SE ±	0.01	0.05	0.03	0.01	0.03	0.03
Interaction						
S x V	NS	NS	**	NS	**	**
S x W	NS	NS	NS	NS	NS	NS
V x W	NS	NS	NS	NS	NS	NS
S x V x W	NS	NS	NS	NS	NS	NS

NS= Not significant. * = Significant.
Means followed by the same letter(s) within a treatment group are not significantly different at 5% level of significance using DMRT.

Significant interactions was only obtained between sowing date and variety at 9 WAS in 1994/95 and 6 and 9 WAS in 1995/96. The first two sowing dates in Siete cerros were comparable with the first four sowing dates in Florence aurore 8193. The 7th sowing date with Siete cerros was higher in LAI than the least while both the 7th and 8th sowing dates were higher than the the 9th and 10th sowing dates in Florence Aurore 8193.

In 1994/95 at 9 WAS, the least LAI was produced by the last sowing date of Siete cerros. Other sowing dates were comparable in either varieties. In 1995/96, Siete cerros significantly had lower LAI in the first two sowing dates while other sowing dates were similar in the two varieties (Tables 12 and 13).

4.2.4 Number of tillers

Total number of tillers/m^2 was significantly affected by sowing date only in 1995/96 dry season (Table 14). Tiller production were similar and significantly higher in the first six sowing dates than the least obtained at the 10th sowing date. Production of the 8th sowng date, however, was significantly lower than the maximum but higher than the least.

Siete cerros produced higher tiller than Florence Aurore 8193. Tiller number was higher with weed free situation than weedy.

The interaction of sowing date and variety on the number of tillers of wheat was significant in 1995/96. Florence Aurore significantly produced lower tiller number in the fourth sowing date than Siete cerros although Siete cerros and Florence Aurore 8193 produced tiller

Table 12: Interaction of sowing date and variety on leaf area index (6WAS) of wheat crop at Samaru during the 1995/96 dry season.

Treatment	LAI 6WAS	
	Siete cerros	Florence Aurore 8193
Sowing date (S)		
Nov. 18	3.7ab	3.8a
Nov. 28	3.5abc	3.6abc
Dec. 8	3.1b-e	3.6abc
Dec. 18	2.8def	3.6a-d
Dec. 28	2.8def	3.0cde
Jan. 7	2.7def	2.7def
Jan. 17	2.5efg	2.6efg
Jan. 27	2.3fgh	2.5efg
Feb. 6	2.0ghi	1.9hij
Feb. 16	1.4ij	1.2h
SE ±	0.2	

Table 13 : Interaction of sowing date and variety on LAI (9WAS) of wheat crop at Samaru during the 1994/95 and 1995/96 dry seasons.

Treatment(S)	LAI 9 WAS			
	1994/95		1995/96	
	Siete cerros	Floren Aurore 8193	Siete cerros	Floren Aurore 8193
Sowing date (S)				
Nov.18	4.5a	4.8a	3.8b	4.3a
Nov.8	4.5a	4.7a	3.7bc	4.2a
Dec. 8	3.7bc	3.8b	3.6bc	3.6bc
Dec.18	3.4bcd	3.3bcd	3.4cd	3.2de
Dec. 28	3.4cde	3.1cde	2.9ef	2.8f
Jan. 7	3.4bcd	3.7bc	2.6fg	2.7fg
Jan. 17	2.8def	2.4f	2.7fg	2.4gh
Jan. 27	2.4f	2.5ef	1.9ij	2.2hi
Feb. 6	2.2fg	2.3fg	1.7j	1.6j
Feb. 16	1.0h	1.7g	0.9k	0.8k
SE ±	0.2		0.9	

LAI = Leaf Area Index WAS = Weeks after sowing.
Means followed by same letter(s) within a treatment group are not significantly different at 5% level of significance using DMRT.

Table 14: Effect of sowing date, variety and weed infestation on number of tillers of wheat crop at Samaru during 1994/95 and 1995/96 dry seasons.

Treatment	Tiller number/m^2	
	1994/95	1995/96
Sowing date (S)		
Nov. 18	887.0	594.8abc
Nov. 28	935.0	597.3abc
Dec. 8	837.0	614.73abc
Dec. 18	784.0	624.3ab
Dec. 28	722.0	644.0a
Jan. 7	747.0	626.7ab
Jan. 17	729.0	524.0bcd
Jan. 27	1140.0	556.7bc
Feb. 6	685.0	525.3bcd
Feb.16	385.0	443.7d
SE ±	198.1	35.2
Wheat variety (V)		
Siete cerros	740.0	592.8a
Florence Aurore 8193	728.0	551.5b
SE ±	82.2	8.1
Weed infestation (W)		
Weed free	749	622.0a
Weedy	820	512.3b
SE ±	82.2	8.1
Interaction		
S x V	NS	*
S x W	NS	NS
V x W	NS	NS
S x V x W	NS	NS

NS = Not significant
* = Significant.
Means followed by the same letter(s) within a treatment group are not significantly different at 5% level of significance using DMRT.

number that were comparable to the maximum with 4th sowing date under Siete cerros with the 3rd, 5th and 6th sowing dates in both varieties. The first sowing date also had comparable tiller number with the Siete cerros while in Florence Aurore 8193, the first sowing date produced tiller number comparable to the least but significantly higher in Siete cerros (Table 15).

Table 15 : Interaction of sowing date and variety on total number of tillers of wheat crop at Samaru during 1995/96 dry season.

Treatment	Tiller number/m^2 1995/96	
	Siete cerro	Florance Aurore 8193
Sowing date (S)		
Nov.18	619.0a-e	570.7b-f
Nov. 28	530.0d-g	504.7efg
Dec. 8	646.7a-d	582.7a-e
Dec. 18	700.7a	548.0c-g
Dec. 28	589.3a-e	664.0abc
Jan. 7	589.3a-e	664.0abc
Jan. 17	510.7efg	537.3d-g
Jan. 27	566.7b-f	546.7c-g
Feb. 6	536.0d-g	514.7efg
Feb. 16	458.0fg	429.3fg
SE ±	39.6	

Means followed by same letter(s) within a treatment group are not significantly different at 5% level of significance using DMRT.

4.2.5 Height at harvest.

The effect of sowing date was significant on plant height in both seasons (Table 13). In both cases, plant height tend to be less with delay in sowing. In 1994/95, plant height followed the trend 1st, 2nd, 3rd, > 4th, 5th > 6th, 7th, > 8th, 9th> 10th. In 1995/96, 1st, and 2nd were also comparable to 3rd as well as 4th and 5th in plant height. It followed a trend 3rd = 1st, 2nd = 4th, 5th > 6th= 7th= 8th =9th> 10th sowing date.

Table 16: Effect of sowing date, variety and weed infestation on plant height at harvest of wheat crop at Samaru during 1994/95 and 1995/96 dry seasons.

Treatment	Plant height(cm)	
	1994/95	1995/96
Sowing date(S)		
Nov. 18	88.9a	78.4ab
Nov. 28	87.0a	76.8ab
Dec. 8	85.8a	80.9ac
Dec. 18	76.0b	74.3b
Dec.28	75.1b	75.6b
Jan. 7	69.8c	60.3cab
Jan. 17	67.5c	57.3cdcd
Jan. 27	59.3d	53.2de
Feb. 6	58.4d	50.8e
Feb. 16	53.2e	44.1f
SE ±	1.4	1.7
Wheat variety (V)		
Siete cerros	64.0b	58.4ba
Florence Aurore 8193	80.2a	71.7a
SE ±	0.3	0.3
Weed infestation (W)		
Weed free	72.3	65.8a
Weedy	71.9	64.3b
SE ±	0.3	0.3
Interaction		
S x V	**	* *
S x W	NS	NS
V x W	NS	NS
S x V x W	NS	NS

NS = Not significant
** = Highly Significant.
Means followed by the same letter(s) within a treatment group arek not significantly different at 5% level of significance using DMRT.

In the two seasons, plant of Florence aurore 8193 were taller than those of Siete cerros. The difference between the height of plants of weed free and weedy plots was only significant in 1995/96 dry season when those of the weed free plots were taller than the weedy ones.

In the two dry seasons, there was significant interaction between sowing date and wheat varieties. In all cases, Florence aurore 8193 had taller plants than Siete cerros. Plants with 6th sowing dates were significantly shorter than those with the 5th sowing date in Florence Aurore 8193, but significantly similar with the first sowing date in Siete cerros. Similarly, no significant difference in height of plants of Florence Aurore 8193 with the 10th and 9th sowing dates, but significantly shorter in Siete cerros.

In 1995/96, Siete cerros was only similar at the first sowing date which was comparable to the maximum in the 3rd sowing date. The first, second and fifth sowing dates were comparable to the appropriate maximum with 3rd sowing date in Florence aurore 8193 (Table 17).

4.2.6 Number of days to maturity.

The effect of sowing date, wheat varieties and weed infestation and their interactions on number of days to wheat maturity were not significant in both dry seasons (Table 18).

Table 17 : Interaction of sowing date and variety on plant height at harvest of wheat crop at Samaru during 1994/95 and 1995/96 dry seasons.

Treatment	Plant Height (cm)			
	1994/95		1995/96	
	Siete cerros	Florence Aurore	Siete cerros	Florence Aurore 8193
Sowing date (S)				
Nov. 18	77.3c	100.5a	70.8cd	86.09b
Nov. 28	76.3c	77.8a	67.7d	85.9ab
Dec. 8	74.6c	97.1a	73.2c	88.5a
Dec. 18	67.1dd	84.9bd	67.3d	81.3b
Dec. 28	66.4d	83.8b	67.7d	83.4ab
Jan. 7	63.2def	76.4c	54.7g	65.8de
Jan. 17	60.3ef	74.8c	51.7gh	61.0ef
Jan. 28	54.1g	64.5de	47.9h	58.5fg
Feb. 6	53.9g	62.9def	44.8h	56.7fg
Feb. 16	46.9h	59.4f	38.5hi	49.8gh
SE ±	1.5		1.8	

Means followed by same letter(s) within a treatment group are not significantly different at 5% level of significance using DMRT.

Table 18: Effect of sowing date, variety and weed infestation on days to maturity of wheat crop at Samaru during 1994/95 and 1995/96 dry seasons.

Treatment	Days to maturity	
	1994/95	1995/96
Sowing date (S)		
Nov. 18	109.0	84.0
Nov. 28	105.0	82.0
Dec. 8	99.0	79.0
Dec. 18	95.0	79.0
Dec. 28	88.0	77.5
Jan. 7	83.0	76.0
Jan. 17	78.0	72.0
Jan. 27	73.0	73.0
Feb. 6	69.0	70.0
Feb 16	65.5	65.0
SE ±	0.0	0.0
Wheat variety (V)		
Siete cerros	86.2	75.6
Florence Aurore 8193	86.7	75.9
SE ±	0.0	0.0
Weed infestation (W)		
Weed free	86.4	75.7
Weedy	86.4	75.7
SE ±	0.0	0.0
Interaction		
S x V	NS	NS
S x W	NS	NS
V x W	NS	NS
S x V x W	NS	NS

NS= Not significant

Means followed by the same letter(s) within a treatment group are not significantly different at 5% level of significance using DMRT.

4.3.0 Effect of sowing date, wheat varieties and weed infestation on yield and yield components of wheat.

4.3.1 Number of effective tillers.

The effect of sowing date on effective tiller number per m^2 was significant in the two dry seasons (Table 19). In 1994/95, the 4th sowing date resulted in lower tiller number than the first three sowing dates while the 7th and later sowing dates caused significantly lower tiller production than the maximum with the 3rd sowing date in 1995/96. The least effective tiller number was recorded at the last sowing date in both seasons although the last sowing date was comparable to the 9th sowing date in tiller production in 1995/96

The two wheat varieties significantly differed in effective tiller production in 1995/96 when Siete cerros produced more effective tillers than Florence Aurore 8193. The influence of weeds was significant in both seasons. Weed free plots recorded higher effective tillers than the weedy plots.

The interaction of sowing date and wheat varieties on the number of effective tillers of wheat was significant in 1995/96 dry season. While no difference among the 8th to 10th sowing in Siete cerros, only the 9th sowing date was comparable to the least with the 10th sowing date in Florence Aurore 8193. With Siete cerros, sowing dates 1 -3 and 5 - 6 were comparable to the maximum with the 4th sowing date while sowing dates 3 and 6 were comparable to the maximum in Florence Aurore 8193 (Table 20).

Table 19: Effect of sowing date, variety and weed infestation on number of effective tillers of wheat crop at Samaru during 1994/95 and 1995/96 dry seasons.

Treatment	Effective tiller/m^2	
	1994/95	1995/96
Sowing date (S)		
Nov. 18	784.0a	497.3abc
Nov. 28	779.0a	467.7abc
Dec. 8	793.0a	522.0a
Dec 18	628.0b	504.7ab
Dec. 28	573.0b	497.0abc
Jan. 7	541.0bc	492.3abc
Jan. 17	515.0bcd	409.0bc
Jan. 27	415.0cd	420.0bc
Feb. 6	392.0d	387.0cd
Feb. 16	205.0e	278.1d
SE ±	42.1	37.2
Wheat variety (V)		
Siete cerros	561.0	472.5a
Florence Aurore 8193	564.0	424.5b
SE ±	18.6	10.1
Weed infestation (W)		
Weed free	614.0a	512.3a
Weedy	510.0b	384.8b
SE ±	18.6	10.1
Interaction		
S x V	NS	*
S x W	NS	NS
V x W	NS	NS
S x V x W	NS	NS

NS = Not significant
* = Significant.
Means followed by the same letter(s) within a treatment group arek not significantly different at 5% level of significance using DMRT.

4.3.2 Length of spike.

Sowing date had significant effect on spike length of wheat in the two seasons (Table 21). The first four and three sowing dates significantly had longer spikes than other sowing dates in 1994/95 and 1995/96 respectively. However, in 1995/96 season, the length of spike produced with the first two sowing dates were not significantly different from those of the fourth and fifth sowing dates. In both seasons, the last sowing date produced the shortest spikes. In the two seasons, the 9th sowing date produced shorter spikes, but significantly longer than the least with the 10th sowing date.

Florence Aurore 8193, produced longer spikes than Siete cerros. The weed free plots also produced longer spikes than the weedy plots in both seasons.

Significant interaction between sowing date and wheat varieties was observed in both seasons (Table 22) and between sowing date and weed infestation in 1995/96 dry season(Table23). In both cases, the 1st to 3rd sowing dates Florence Aurore 8193 had longer spike than Siete cerros while with the later sowing dates, no difference was observed between the two varieties.

In 1994/95, within variety, while in Siete cerros the 4th sowing date resulted in production of longer spike than the 2nd and the 5th sowing date and later dates. Spike length in Florence Aurore 8193 with the first sowing date was only significantly longer compared with the six later dates. Similarly, spike produced with the 10th sowing date were similar in length to those with 9th in Siete cerros but not comparable in Florence Aurore 8193. Shorter spikes were produced at 9th sowing date compared with 7th and 8th sowing dates in Florence Aurore 8193 while the spikes were similar for the same sowing date in Siete cerros.

Table 21: Effect of sowing date, variety and weed infestation on spike length of wheat crop at Samaru during 1994/95 and 1995/96 dry seasons.

Treatment	Spike length(cm)	
	1994/95	1995/96
Sowing date (S)		
Nov. 18	8.8 a	8.8ab
Nov. 28	8.6ab	8.8ab
Dec. 8	8.8a	9.1a
Dec. 18	8.8a	8.4b
Dec. 28	8.1cd	8.5b
Jan. 7	7.8de	7.8cd
Jan. 17	7.7de	7.7de
Jan. 27	7.5e	6.9ef
Feb. 6	7.0f	6.4f
Feb.16	6.5g	5.6g
SE ±	0.2	0.2
Wheat variety (V)		
Siete cerros	7.7b	7.6b
Florence Aurore 8193	8.1a	8.0a
SE ±	0.05	0.04
Weed infestation (W)		
Weed free	8.0a	8.1a
Weedy	7.8b	7.5b
SE ±	0.05	0.04
Interaction		
S x V	**	**
S x W	NS	NS
V x W	NS	NS
S x V x W	NS	NS

NS = Not significant
** = Highly significant

Means followed by the same letter(s) within a treatment group are not significantly different at 5% level of significance using DMRT.

Table 22: Interaction of sowing date and variety on spike length of wheat crop at Samaru during 1994/95 and 1995/96 dry seasons.

Treatment	Spike length (cm)			
	1994/95		1995/96	
	Siete cerros	Florence Aurore 8193	Siete cerros	Florence Aurore 8193
Sowing date(S)				
Nov.18	8.3bc	9.3a	8.3cd	9.2ab
Nov. 28	8.1cd	8.8ab	8.4cd	9.2ab
Dec. 8	8.3bc	9.3a	8.6bcd	9.7a
Dec. 18	8.8ab	8.9ab	8.3cd	8.6bcd
Dec. 28	7.8cde	8.4bc	8.3cd	8.7bc
Jan. 7	7.6def	7.9cde	7.5efg	8.1cde
Jan. 17	7.4efg	7.9cde	7.4fgh	8.0def
Jan. 27	7.3efg	7.8cde	7.0ghi	6.8hi
Feb. 6	6.9ghi	7.0fgh	6.2jk	6.4ij
Feb. 16	6.6hi	6.4i	5.7kl	5.5L
SE ±	0.2		0.2	

Table 23: Interaction of sowing date and weed infestation on spike length of wheat crop at Samaru during 1995/96 dry season.

Treatment	Spike length (cm)	
	1995/96	
	Wf	Wi
Sowing date (S)		
Nov. 18	8.9ab	8.7abc
Nov. 28	8.9ab	8.7abc
Dec. 8	9.3a	8.9ab
Dec. 18	8.6bcd	8.2cde
Dec. 28	8.7a	8.4bcd
Jan. 7	8.0def	7.6efg
Jan. 17	8.0def	7.4fg
Jan. 27	7.2gh	6.6hi
Feb. 6	7.1gh	5.8j
Feb. 16	6.4ij	4.9k
SE ±	0.2	

Wf - weed free. Wi - weed infested.
Means followed by same letter(s) within a treatment group are not significantly different at 5% level of significance using DMRT.

In 1995/96, the 6th and later sowing dates produced shorter spikes than the earlier sowing dates in Siete cerros while in Florence Aurore 8193, the 7th and later sowing dates produced shorter spike than the first five sowing dates except the 4th. Similaly the 10th sowing date produced significantly shorter spike than the 9th in Florence Aurore 8193 but comparable in Siete cerros. The interaction between sowing date and weed infestation shows that longer spikes were produced with weedy situation while other sowing dates were similar in length .

4.3.3 Spikelet/spike.

Table 24 shows a significant effect of sowing dates on number of spikelet per spike in the two dry seasons. In 1994/95, the first five sowing dates produced similar spikelet which were significantly higher than the least in the 10th sowing date. Similarly, in 1995/96, the first three sowing dates and the 7th sowing date produced spikelet which were significantly higher than the least in the 10th sowing date. The 6th sowing date in 1994/95 and 4th sowing date in 1995/96, also produced higher number of spikelet per spike than the least but also lower than the maximum.

Siete cerros had significantly higher number of spikelet per spike than Florence Aurore 8193 in both seasons. The effect of weed infestation was only significant on spikelet per spike in 1995/96 dry season when weed free plots had higher number of spikelet/spike than the weedy plots.

Significant interaction was only observed between sowing date and wheat varieties in both seasons.

Table 24: Effect of sowing date, variety and weed infestation on spikelet/spike of wheat crop at Samaru during 1994/95 and 1995/96 dry seasons.

Treatment	Spikelet/spike	
	1994/95	1995/96
Sowing date (S)		
Nov. 18	42.7ab	38.1a
Nov. 28	44.3ab	35.9a
Dec. 8	44.7a	39.1a
Dec. 18	41.4ab	30.1bc
Dec. 28	40.1abc	28.5bcd
Jan. 7	38.4bcd	27.0bcd
Jan. 17	32.4e	34.9ab
Jan. 27	35.3cde	26.4cd
Feb. 6	33.2de	24.9cd
Feb. 16	29.8e	23.7d
SE ±	1.9	1.8
Wheat variety (V)		
Siete cerros	40.4a	34.6a
Florence Aurore 8193	32.1b	27.1b
SE ±	0.6	0.6
Weed infestation (W)		
Weed free	36.8	31.8a
Weedy	35.6	29.9b
SE ±	0.6	0.6
Interaction		
S x V	**	**
S x W	NS	NS
V x W	NS	NS
S x V x W	NS	NS

NS = Not significant
** = Highly Significant.
Means followed by the same letter(s) within a treatment group are not significantly different at 5% level of significance using DMRT.

In all the sowing date except the 3rd and 10th, Siete cerros produced higher spikelet/spike than Florence Aurore 8193 in 1994/95. In 1995/96, Siete cerros produced significantly higher number of spikelets with the 3rd, 6th, 7th and 8th sowing dates than Florence Aurore 8193. While the 7th to 10th sowing dates produced spikelet less than the maximum in Siete cerros, only the 3rd sowing date was comparable with the maximum in Florence aurore 8193 in 1994/95. All the earlier sowing date (1st to 8th) produced significantly higher spikelet number per spike than the least in Siete cerros while the 3rd and 8th sowing dates produced higher spikelet number per spike than the least in Florence Aurore 8193.

Similarly in 1995/96 the 1st and 7th sowing dates produced spikelets comparable to the maximum in Siete cerros while no date was comparable to the maximum in Florence aurore 8193 (Table 25).

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Table 25: Interaction of sowing date and variety on spiketelet/spike of wheat crop at Samaru during 1994/95 and 1995/96 dry seasons.

Treatment	Spikelet/spike			
	1994/95		1995/96	
	Siete cerros	Florence Aurore 8193	Siete cerros	Florence Aurore 8193
Sowing date (S)				
Nov. 18	44.2a-c	31.3efg	41.4ab	34.7bcd
Nov. 28	47.8ab	30.8efg	39.3bc	32.5cde
Dec. 8	44.4abc	44.9abc	47.8a	30.4def
Dec. 18	49.9a	32.9efg	32.5cde	27.7ef
Dec. 28	47.1ab	33.1efg	31.1def	25.8ef
Jan. 7	44.1abc	32.6efg	31.0def	23.0g
Jan. 17	36.6def	28.2g	41.0ab	28.8g
Jan. 27	40.7bcd	29.9f	30.1def	22.5g
Feb. 6	37.7cde	28.6g	27.3efg	22.5g
Feb. 16	31.1efg	28.6g	24.8fg	22.5g
SE ±	2.4		2.3	

Means followed by same letter(s) within a treatment group are not significantly different at 5% level of significance using DMRT.

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4.3.4 Number of grain/spike.

The effect of sowing date on number of grain/spike was significant in the two dry seasons (Table 26). In both cases, the first three sowing dates produced significantly higher grain/spike than the later sowing dates. The least was obtained with the 10th sowing date although this was comparable with the 8th and 9th sowing date in 1995/96. In the two years, the 4th sowing date significantly produced lower grain/spike but significantly higher than the least.

Siete cerros had more grain number per spike than Florence Aurore 8193 in both seasons. The effect of weed infestation was significant in 1995/96 when weed free plots had more grains per spike than the weedy plots.

Significant interaction was only observed between sowing date and wheat varieties in the two dry seasons. Except at the 3rd and 10th sowing dates in 1994/95 dry seasons, Siete cerros had higher grains per spike than Florence Aurore 8193 (Table 27). In Siete cerros, all the first eight sowing dates resulted in higher grain per spike than the 10th sowing date while in Florence Aurore 8193 only the 3rd and 4th sowing date resulted in higher grain per spike than the remaining sowing dates in 1994/95. However, in 1995/96 Siete cerros and Florence 8193 at 8th and 9th sowing dates were comparable to the least with the 10th sowing date and sixth sowing date also comparable in addition in Florence Aurore 8193.

4.3.5 Grain weight per spike.

Sowing date significantly affected the weight of grain per spike in the two dry seasons (Table 28). The first three sowing dates resulted in significantly higher grain weight per spike than the other sowing dates in both seasons while the least weights were recorded at the 9th and 10th dates in 1994/95 and 7th to 10th dates in 1995/96 dry seasons. But the 7th sowing in 1995/96 dry season was not significantly different from those found with the 4th to 6th sowing

Table 26: Effect of sowing date, variety and weed infestation on grain number per spike of wheat at Samaru during 1994/95 and 1995/96 dry seasons.

Treatment	Grain/spike	
	1994/95	1995/96
Sowing date (S)		
Nov. 8	41.7a	36.3a
Nov. 28	43.1a	33.8ab
Dec. 8	43.5a	36.8a
Dec. 18	39.5a	26.4cd
Dec. 28	37.9bc	24.8cd
Jan. 7	35.5cd	23.1def
Jan. 17	29.1f	30.4bc
Jan. 27	31.6ef	21.1efg
Feb. 6	28.4f	18.8fg
Feb. 16	24.7g	16.4g
SE ±	1.2	1.7
Wheat variety (V)		
Siete cerros	37.6a	30.0a
Florence Aurore 8193	29.4b	23.6b
SE ±	0.6	0.6
Weed infestation (W)		
Weed free	34.1	27.7a
Weedy	32.8	25.9b
SE ±	0.6	0.6
Interaction		
S x V	**	**
S x W	NS	NS
V x W	NS	NS
S x V x W	NS	NS

NS = Not significant
** = Highly significant.
Means followed by the same letter(s) within a treatment group are not significantly different at 5% level of significance using DMRT.

Table 27: Interaction of sowing date and variety on grain number per spike of wheat crop at Samaru during 1994/95 and 1995/96 dry seasons.

Treatment	Grain/spike			
	1994/95		1995/96	
	Siete cerros	*Florence Aurore* 8193	*Siete cerros*	*Florence Aurore* 8193
Sowing date (S)				
Nov. 8	43.8ab	29.5fghij	39.25b	33.3bcd
Nov. 28	46.4a	29.7fghij	36.7bc	30.8cde
Dec. 8	43.3abc	43.6ab	46.0a	27.7def
Dec. 18	48.0a	30.9defgh	27.2def	25.5efg
Dec. 28	44.9a	31.0defghi	27.4def	22.2fgh
Jan. 7	44.1abc	29.8fghij	26.8f	19.3ghi
Jan. 17	33.1dfg	25.0ij	33.6bc	25.3ef
Jan. 27	36.9bcd	26.4ghij	23.5fgh	18.7hi
Feb. 6	32.7dfgh	24.1ij	20.0ghi	17.7hi
Feb.16	25.9hij	23.6ij	17.6hi	15.2i
SE ±	2.3		2.1	

Means followed by same letter(s) within a treatment group are not significantly different at 5% level of significance using *DMRT*.

The 4th to 8th sowing dates resulted in grain weight higher than the least in 1994/95 while only the 4th to 6th sowing dates were higher in 1995/96. In addition, in 1994/95, the 4th to 6th sowing dates resulted in significantly higher grain weight per spike than 7th and 8th sowing dates.

The effect of wheat varieties was significant only in 1994/95 dry season when Florence Aurore 8193 produced higher grain weight per spike than Siete cerrros. Similarly, the weed free plots produced higher grain weight per spike than the weedy plots.

Table 28: Effect of sowing date, variety and weed infestation on grain weight/spike of wheat at Samaru during 1994/95 and 1995/96 dry seasons.

Treatment	Grain wt./spike (g)	
	1994/95	1995/96
Sowing date (S)		
Nov. 18	1.6a	1.4a
Nov. 28	1.5a	1.3a
Dec. 8	1.5a	1.4a
Dec. 18	1.3b	0.8b
Dec. 28	1.2bc	0.7b
Jan. 7	1.1c	0.7b
Jan. 17	0.9d	0.6bc
Jan. 27	0.8d	0.4c
Feb. 6	0.7e	0.4c
Feb. 16	0.6e	0.4c
SE +	0.04	0.06
Wheat variet(V)		
Siete cerros	1.1b	0.8
Florence Aurore 8193	1.2a	0.8
SE ±	0.02	0.02
Weed infestation (W)		
Weed free	1.2a	0.8
Weedy	1.1b	0.8
SE ±	0.02	0.02
Interaction		
S x V	**	**
S x W	NS	NS
V x W	NS	NS
S x V x W	NS	NS

NS = Not significant
** = Highly significant.
Means followed by the same letter(s) within a treatment group are not significantly different at 5% level of significance using DMRT.

Significant interaction was only observed between sowing date and wheat varieties in the two dry seasons. The varieties differed at 1st, 2nd, 3rd, 6th and 8th sowing dates in 1994/95 and 2nd sowing date in 1995/96 when Florence Aurore 8193 significantly produced higher grain weight per spike than Siete cerros. However the reverse is the case of 6th sowing date when Siete cerros produced higher grain weight per spike than Florence Aurore 8193 in 1994/95. In 1994/95, the first sowing date had significantly higher grain weight per spike than the 5th and later sowing dates in Siete cerros and the 4th and later sowing dates in Florence Aurore 8193. None of the sowing date in Siete cerros was camparable to the maximum obtained with Florence Aurore 8193 while the 2nd and 3rd sowing dates were comparable in Florence Aurore 8193.

In 1995/96, the first sowing date resulted in higher grain weight per spike in Siete cerros while the first three sowing dates were significantly higher than the later sowing in Florence Aurore 8193. Similarly, the first to the Sixth sowing dates reslted in significantly higher grain weight per spike in Siete cerros than the least and the 4th to 7th sowing dates resulted in significantly higher grain weight per spike than the least in Florence aurore 8193 (Table 29).

4.3.6 1000-grain weight.

Delay in sowing date significantly depressed 1000-grain weight in the two dry seasons (Table 30). The first sowing date in 1994/95 and first three sowing dates in 1995/96 dry seasons significantly produced the highest 1000-grain weight. However, the 2nd to 6th sowing dates in 1994/95 and 4th to 8th sowing dates in 1995/96 also resulted in significantly higher 1000-grain weight than the least obtained in the later sowing dates.

Florence Aurore 8193 had higher 1000-grain weight than Siete cerros in the two dry seasons. Weed infestation had no significant effect on 1000-grain in the two dry seasons.

Table 29: Interaction of sowing date and variety on grain weight per spike of wheat crop at Samaru during 1994/95 and 1995/96 dry seasons.

Treatment	Grain weight/spike (g)			
	1994/95		1995/96	
	Siete cerros	Florence Aurore 8193	Siete cerros	Florence Aurore 8193
Sowing date (S)				
S1	1.4b	1.7a	1.4a	1.3ab
S2	1.3bc	1.6a	1.1b	1.4a
S3	1.3bc	1.6a	1.1b	1.2ab
S4	1.3bc	1.2cd	0.8c	0.8c
S5	1.2cd	1.1de	0.8c	0.7c
S6	1.2cd	0.9f	0.8cd	0.7c
S7	0.9fg	1.0ef	0.6cd	0.7c
S8	0.8gh	0.9f	0.4de	0.4de
S9	0.7h	0.8gh	0.4de	0.4de
S10	0.6i	0.6i	0.4de	0.3e
SE +	0.06		0.08	

Means followed by same letter(s) within a treatment group are not significantly different at 5% level of significance using DMRT.

Significant interaction was observed in the two dry seasons only between sowing dates and wheat varieties. In 1994/95, 1000-grain weight decreased from first to fourth sowing dates in Siete cerros while second and third sowing dates produced significantly similar 1000-grain weight in Florence aurore 8193. The first to fifth sowing dates resulted in significantly higher 1000-grain weight than the least in Siete cerros while the fourth to seventh sowing dates caused significantly higher 1000-grain weight in Florence aurore 8193. The best grain size obtained with first sowing date in Siete cerros was comparable with those of second and third sowing dates in Florence aurore 8193. Similarly, the least grain size obtained with the 10th sowing date in Florence was comparable to that obtained in the 4th sowing date with Siete cerros.

Table 30: Effect of sowing date, variety and weed infestation on 1000-grain weight of wheat crop at Samaru during 1994/95 and 1995/96 dry seasons.

Treatment	1000- grain wt. (g)	
	1994/95	1995/96
Sowing date (S)		
Nov. 18	44.9a	39.6a
Nov. 28	40.0b	39.9a
Dec. 8	36.9b	38.2a
Dec. 18	31.8de	27.9bc
Dec. 28	32.0d	28.5bc
Jan. 7	29.8def	29.6b
Jan. 17	28.8efg	27.4bc
Jan. 27	28.1fg	25.6c
Feb. 6	27.2fg	21.4d
Feb. 16	25.8g	21.0d
SE ±	1.0	1.1
Wheat variety (V)		
Siete cerros	30.0b	27.7b
Florence Aurore 8193	35.0a	32.0a
SE ±	0.2	0.4
Weed infestation (W)		
Weed free	32.8	30.2
Weedy	32.3	29.6
SE ±	0.2	0.4
Interaction		
S x V	**	**
S x W	NS	NS
V x W	NS	NS
S x V x W	NS	NS

NS = Not significant
** = Highly significant.
Means followed by the same letter(s) within a treatment group are not significantly different at 5% level of significance using DMRT.

In 1995/96, none of the sowing dates resulted in 1000-grain weight in Siete cerros that was comparable to the maximum obtained in Florence aurore 8193 (Table 31).

Table 31: Interaction of sowing date and variety on 1000-grain weight of wheat crop at Samaru during 1994/95 and 1995/96 dry seasons.

Treatment	1000-grain wt.(cm).			
	1994/95		1995/96	
	Siete cerros	Florence Aurore 8193	Siete cerros	Florence Aurores 8193
Sowing date (S)				
Nov. 18	40.7b	49.2a	35.1b	44.8ab
Nov. 28	36.5c	43.6b	35.0b	44.8a
Dec. 8	33.1d	40.6b	33.9bc	42.4a
Dec. 18	30.1fg	33.5cde	26.1ef	29.6df
Dec. 28	29.8fg	34.2cd	24.3hi	32.6bcd
Jan. 7	28.2fghi	31.4def	28.9dfg	30.2cde
Jan. 17	26.4hij	31.2def	26.6efg	Jan. 27
Jan. 27	25.9hij	30.4efg	25.9fg	25.3gh
Feb. 6	25.2ij	29.2fgh	21.2hi	21.5hi
Feb. 16	24.5j	27.1ghij	20.5i	21.5hi
SE ±	1.1		1.4	

Means followed by same letter(s) within a treatment group are not significantly different at 5% level of significance using DMRT.

4.3.7 Straw weight.

The effect of sowing date on wheat straw weight at harvest was significant in the dry seasons (Table 32). In 1994/95, the first two sowing dates resulted in significantly higher yields than the fifth to tenth sowing dates, while straw weight with the third to seventh dates were also higher than the later sowing dates. The least straw weight produced with the tenth sowing date was also lower than those of the 8th and ninth dates in the trial.

Table 32: Effect of sowing date, variety and weed infestation on straw weight and grain yield of wheat crop at Samaru during the 1994/95 and 1995/96 dry seasons.

Treatment	Straw weight (Kg/ha)		Grain yield(kg/ha)	
	1994/95	1995/96	1994/95	1995/96
Sowing date (S)				
Nov. 18	5416a	5175a	2792a	2164a
Nov. 28	5447a	4828b	2432ab	2138a
Dec. 8	4948ab	5267a	2510a	1916a
Dec. 18	4898ab	4572ab	1973bc	1445b
Dec. 28	4429b	4228abc	1558cd	1499b
Jan. 7	4497b	3759bcd	1288de	1091c
Jan. 17	4108b	3336cde	980ef	845cd
Jan. 27	3064c	3401cde	749f	578de
Feb. 6	2617c	30006de	757f	327ef
Feb. 16	1701d	2814e	527f	110f
SE ±	297.1	375.1	154.2	98.4
Wheat variety (V)				
Siete cerros	3822b	3771b	1678a	1280a
Florence Auror 8193	4403a	4306a	1437b	1142b
SE ±	99	70.2	41.6	40.2
Weed infestation (W)				
Weed free	4130	4368a	1777a	431a
Weedy	4095	3709b	1338b	991b
SE ±	99	70.2	41.6	40.2
Interaction				
S x V	NS	NS	NS	NS
S x W	NS	NS	NS	NS
V x W	NS	NS	NS	NS
S x V x W	NS	NS	NS	NS

NS = Not significant

Means followed by the same letter(s) within a treatment group are not significantly different at 5% level of significance using DMRT.

In 1995/96, the first and third sowing dates resulted in higher straw weight than the sixth to tenth while the first sowing date only caused higher straw weight than the last two sowing dates. Wheat straw weight with the seventh to tenth sowing dates did not differ significantly while the sixth sowing was also comparable to the ninth in wheat straw weight.

Siete cerros resulted in lower dry matter production than Florence Aurore 8193 in the two dry seasons. However, the weed free plots produced significantly higher straw weight than the weedy plots only in 1995/96 dry season.

The interactions of various factors on wheat straw weight were not significant in the trials.

4.3.8 Grain yield.

The effect of sowing date on grain yield of wheat was significant in the two dry seasons (Table 32). The first three sowing dates resulted in significantly higher wheat grain yields than the fifth to tenth dates in 1994/95 fourth to tenth dates in 1995/96 dry seasons. The first six sowing dates in 1994/95 and the first eight sowing dates in 1995/96 resulted in higher grain yields than the least obtained with the tenth sowing date. The grain yield follow the pattern S1 S2 S3 > S4 S5> S6 S7 > S9 S10 in 1995/96.

Delay in sowing from the first to the last caused 81.4% and 94.9% reduction in wheat grain yield in 1994/95 and 1995/96 respectively compared with the appropriate maxima.

Siete cerros resulted in higher grain yield than Florence Aurore 8193 in the two seasons. Weed free plots also produced higher grain yield than the weedy plots. The interaction of various factors on wheat grain yield were not significant in the trials.

4.3.9 Harvest Index

The effect of treatment on harvest index is significant in both dry seasons (Table 33). In 1994/95 dry season crop sown on Dec. 8 significantly result in higher harvest index than

Table 33: Effect of sowing date, variety and weed infestation on harvest index of wheat crop at Samaru during 1994/95 and 1995/96 dry seasons.

Treatment	Harvest index 1994/95	1995/96
Sowing date (S)		
Nov. 18	0.34ab	0.30a
Nov. 28	0.31ab	0.30a
Dec. 8	0.35a	0.28ab
Dec. 18	0.28bcd	0.23ab
Dec. 28	0.27cd	0.28ab
Jan. 7	0.22de	0.23ab
Jan. 17	0.19e	0.21bc
Jan. 27	0.18e	0.14cd
Feb. 6	0.23de	0.10de
Feb. 16	0.23de	0.04e
SE ±	0.021	0.022
Wheat variety(V)		
Siete cerros	0.29a	0.23a
Florence Aurore		
8193	0.23b	0.19b
SE ±		
Weed infestation(W)		
Weed free	0.29a	0.23a
Weedy	0.23b	0.19b
SE ±	0.007	0.009
Interaction		
S x V	NS	NS
S x W	NS	NS
V x W	NS	NS
S x V x W	NS	NS

NS = Not significant

Means followed by the same letter(s) within a treatment group are not significantly different at 5% level of significance using DMRT.

those crops sown beyond this particular date. Wheat crop sown on Jan. 17 gave the least harvest index, although at par with those of Jan. 7 and all the sowing dates that follow thereafter. But in 1995/96 dry season the first six sowing dates had the highest harvest index, though no significant differences between the 7th and 3rd to 6th sowing dates. The least harvest index was recorded when crops were sown beyond Jan. 27.

Siete cerros recorded significantly higher harvest index than Florence Aurore 8193 in both seasons. Likewise, in both dry seasons weed free treatment significantly had the highest harvest index than the weedy treatment.

Interaction of the various factors had no significant influence on the harvest index.

Correlation of weed variables and grain yield, growth and yield attributes of wheat

Tables 34 and 35 show the relationship between wheat and weed variables for the two dry seasons. In the two dry seasons grain yield was significantly and positively correlated with both growth and yield parameters of wheat measured and negetively correlated with the weed parameters except the sedge population in 1994/95 and sedge dry weight, height and population 1995/96.

Similarly the growth and yield parameters of wheat were negetively correlated with the weed variable except sedge population and broadleaf and grass weed population which was not correlated with 1000-grain weight in 1994/95 season. The relationships among the weed variables were all positive in 1994/95 while in 1995/96 season, relationship between sedge variables and other types of weed variables was negetive.

Table 34: Relationship between weed variables and grain yield, growth and yield attributes of wheat grown at Samaru during the 1994/95 dry season.

	Variables															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Grain yield(kg/ha)	1.00															
2. No. Of effective tillers/m²	0.75**	1.00														
3. Length of spike(cm)	0.83**	0.63**	1.00													
4. Grain wt./spike(gm)	0.87**	0.67**	0.82**	1.00												
5. 1000-grain wt.(gm)	0.70**	0.60**	0.76**	0.81**	1.00											
6. Straw weight (kg/ha)	0.98**	0.74**	0.87**	0.88**	0.74**	1.00										
7. LAI 9WAS	0.85**	0.71**	0.74**	0.85**	0.78**	0.87**	1.00									
8. Plant height (cm)	0.76**	0.65**	0.85**	0.78**	0.90**	0.81**	0.76**	1.00								
9. Total weed dry wt.(kg/ha)	-0.79**	-0.53**	-0.73**	-0.67**	-0.49**	0.84**	-0.74**	-0.59**	1.00							
10. BG dry weight (kg/ha)	-0.77**	-0.55**	-0.72**	-0.65**	-0.48**	-0.82**	-0.71**	-0.58**	0.97**	1.00						
11. Sedge dry weight(kg/ha)	-0.61**	-0.34**	-0.44**	-0.53**	-0.32**	-0.59**	-0.48**	-0.37**	0.44**	0.35**	1.00					
12. Total weed number	-0.62**	-0.36**	-0.47**	-0.49**	-0.25*	-0.61**	-0.40**	-0.44**	0.57**	0.49**	0.39**	0.62**	0.55**	1.00		
13. BG number	-0.49**	0.26*	-0.28*	-0.30*	-0.17	-0.48**	-0.36**	-0.34**	0.49**	0.46**	0.25*	0.53**	0.45**	0.64**	1.00	
14. Sedge number	-0.17	-0.02	-0.08	-0.13	-0.01	-0.20	-0.12	-0.15	0.32**	0.10	0.20	0.26*	0.49**	0.45**	0.26**	1.00

Degree of freedom (df=58)
* = Significant at P=0.05r = 0.25
** = Significant at P = 0.01 r = 0.32

Table 35: Relationship between weed variables and grain yield, growth and yield attributes of wheat grown at Samaru during the 1995/96 dry season.

	Variables															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Grain yield(kg/ha)	1.00															
2. No.of effective tillers/m^2	0.64**	1.00														
3. Length of spike(cm)	0.86**	0.44**	1.00													
4. Grain wt./spike(gm)	0.74**	0.44**	0.75**	1.00												
5. 1000-grain wt.(gm)	0.72*	0.26*	0.75**	0.76**	1.00											
6. Straw weight (kg/ha	0.74**	0.35**	0.79**	0.72**	0.71**	1.00										
7. LAI 9WAS	0.87**	0.49**	0.88**	0.81**	0.79**	0.79**	1.00									
8. Plant height (cm)	0.76**	0.38**	0.86**	0.67**	0.76**	0.94**	0.81**	1.00								
9.Total weed dry wt.(kg/ha)	-0.79**	-0.52**	-0.84**	-0.65**	-0.64**	-0.68**	-0.84**	-0.72**	1.00							
10.Grass weed dw (kg/ha)	-0.88**	-0.49**	-0.83**	-0.63**	-0.64**	-0.62**	-0.80**	-0.70**	0.93**	1.00						
11.Broadleaved dw (kg/ha)	-0.62**	-0.50**	-0.66**	-0.63**	-0.61**	-0.49**	-0.65**	-0.49**	0.75**	0.73**	1.00					
12.Sedges dw (kg/ha)	-0.02	-0.09	-0.50**	-0.03	-0.04	-0.25**	-0.15	-0.23**	0.16	0.16*	0.01	1.00				
13.Total weed number	-0.43	-0.32**	-0.44**	-0.34**	-0.32*	-0.30**	-0.41**	-0.42**	0.53**	0.54**	0.38	0.04**	0.39*	-0.29**	0.12	1.00
14.Grass weed no.	-0.43**	-0.30**	-0.45**	-0.36**	0.31*	-0.35**	-0.43**	-0.47**	0.50**	0.53**	0.36**	-0.23	0.39**	0.33**	-0.20	0.96**
15.Broadleaved weed no.	-0.30*	-0.28*	-0.34*	-0.19	-0.33**	-0.26*	-0.35**	-0.22	0.51**	0.49*	0.48**	-0.05	0.41**	0.37**	-0.17	-0.48**
16.Sedge weed no.	-0.18	-0.13	-0.29*	-0.17	-0.12	-0.34**	-0.33**	-0.31**	-0.21	-0.31*	-0.21	0.90**	-0.31*	-0.40**	0.49	-0.06

Degree of freedom (df=58)
* = Significant at P=0.05r = 0.25
** = Significant at P = 0.01 r = 0.32

CHAPTER FIVE.

5.0 DISCUSSION

5.1.1 Effect of sowing date on weeds and wheat.

The ability of the weed seeds to germinate and grow depends among other conditions on conducive environmental factors such as temperature and moisture in the soil. In this trial, sowing date caused a significant variation in weed population. Higher weed population was generally recorded at the last three sowing dates in both seasons. Although both soil and ambient temperatures had increased, weed seeds produced during the wet season would need to undergo after-ripening dormancy, the period between the wet season and dry season was adequate for the weed seed produced by the ephemeral weeds. However, the population and growth of the weeds increased with time for the dormancy cycle to be completed and increased in temperature (Appendixes 1 and 2). This result is similar to those obtained by Singh (1980), Dadari (1988), Nekendawira (1989) and Falaki (1994), who observed that weed population in wheat increases as seasonal temperature increase from February to March. The population of grasses was generally higher than those of broadleaved and sedges weeds.

Even at some early sowing dates when weed population was similar to those of later sowing dates, their dry weight was lower than those of the later sowing dates. However, the low temperature at the early sowing dates which caused initial slow growth of weeds facilitated rapid growth of wheat. The combination of rapid growth with close spacing and profuse tillering of wheat crop caused rapid canopy development hence weed growth supression as reflected on the weed dry weight. Choudhary and Ndahi (1980) had similarly reported that the highest weed dry weight obtained in a trial at Kadawa was 500kg/ha which was low.

The warm condition which prevailed in the later sowing dates was not conducive for wheat growth and tillering but appropriate for rapid weed growth with consequent high weed dry matter production. Cyperus spp. produced the highest dry weight even though the population of grass weeds was higher at 3 and 6 WAS in the early sown crop in 1994/95 dry season.

Cyperus spp. was seen to grow vigorously even at the early stages of wheat growth when the temperature was low. This confirms the result of Bell and Nalewaja (1968) that Cyperus spp cause serious problem in wheat crop. However, grass weeds gave the highest dry weight at 6 and 9 WAS in the late sown wheat crop. In contrast, Dadari (1988) observed more broadleaved weeds than grasses in a trial at Kadawa. The high grass infestation observed in this study, could be due to the presence of Cynodon spp, on the location. In addition, the trial was conducted in the Northern Guinea savanna unlike the trial conducted by Dadari (1988) in the Sudan savanna zone where there is higher broadleaved weeds infestation (Choudhary and Lagoke 1981).

The decrease in number of plant per plot at the later sowing dates could be due to increase in temperature which has deterimental effect on wheat seed germination as similarly reported by Ibrahim et al. (1976).

The subsequent reduction in LAI and plant height observed with delay in sowing could also be attributed to unfavourable high temperature for wheat plant growth as indicated by Ibrahim et al. (1976). Abd-El-Bar (1968) had earlier reported the determinental effect of higher temperature on the plant height of wheat.

The obvious detrimental effect of delayed sowing on tiller production by wheat in the 1995/96 season could be due to the higher temperature compared with the other season. The reduction in tillering at the later sowing dates due to early rise in temperature agrees with the

results of Singh and Alam (1944) and Abd-El- Bar (1968). Although the influence of sowing date on days to maturity was not significant, the number of days tended to decrease with delay in sowing date due to the fact that the increased temperature at later sowing tends to hasten the developmental processes of wheat and facilitate early maturity. This conforms with the result of Rawson (1986) that the speed of the phenological development of the wheat plant caused by heat is so fast that the environment cannot supply the necessary inputs fast enough.

The reduction in straw weight observed in the two dry seasons could also be attributed to increase in temperature which has a detrimental effect on growth and development of wheat crop. Ford et al. , (1976) has found that high temperature reduced crop growth and therefore lowered dry matter accumulation.

The decrease in effective tillers, length of spike, spikelet/spike number and weight of grain per spike and 1000-grain weight as the sowing date was delayed could be due to increased temperature at the later sowing dates which adversely affected crop growth and development. The decrease in these yield attributes with delay in sowing date could also be responsible for the decrease in crop yield. Many workers including Abd-El-Bar (1968), Ansari et al ., (1989), Ibrahim et al., (1976), Sain et al (1992) and Falaki (1994) have similarly attributed the reduction in these yield components and attributes caused by delayed sowing to rise in temperature at the critical growth stage. Winter and Musick (1993) attributed the reduction in grain yield as sowing of wheat was delayed to insufficient rooting resulting in not fully extracting soil water from below the root zone.

5.1.2 The differential performance of wheat varieties

It was observed that under similar environmental conditions, the two varieties (Siete

cerros and Florence Aurore 8193) did not show any significant difference with regards to period taken to seedling emergence. This result confirmed an earlier germination test conducted prior to the commencement of the experiment and also indicated that both varieties have about 95% germination.

Although Siete cerros tended to have higher plant count than Florence Aurore 8193, the difference was not significant in 1995/96 dry season. The apparent difference could be attributed to the fact that, seeds of Siete cerros are smaller in size and would contain greater number of seeds in the same weight as Florence Aurore 8193. Therefore, with good germination of the both varieties, Siete cerros is expected to be more in population. The bigger seeds of Florence Aurore 8193 have more food reserve to support early seedling growth through emergence as earlier observed by Olugbemi et al. (1991), but this was not the case in this study.

In all cases, Florence Aurore 8193 had higher LAI than Siete cerros except at 9 WAS in 1995/96. The difference observed could be due to the fact that genotypically, Florence Aurore 8193 plants are taller and more robust than Siete cerros. The number of days taken to maturity of the two varieties did not differ significantly. This confirms the earlier result of Olugbemi et al., (1991) who gave the range of the maturity period of the two varieties to be the same (110 - 120 days).

Siete cerros had higher number of effective tillers than Florence Aurore 8193 in 1995/96 dry season due to the higher number of total tillers of Siete cerros than Florence Aurore 8193.

The higher number of spikelets and grains per spike of Siete cerros than those of Florence Aurore 8193 which had longer spike could be attributed to the shorter internodes of the spike of Siete cerros compared to that of Florence Aurore 8193. The higher grain weight

per spike and 1000-grain weight of Florence Aurore 8193 are however, due to the fact that genotypically, the grains of Florence Aurore 8193 are bigger in size than those of Siete cerros as has earlier been reported by Olugbemi et al., (1991).

The straw weight of Florence Aurore 8193 was also expectedly higher than that of Siete cerros due to the taller and more robust nature of the Florence Aurore 8193 as similarly reported by Olugbemi et al., (1991).

The higher grain number per spike and more effective tillers of Siete cerros contributed to its higher grain yield and harvest index than Florence Aurore 8193 even though Florence Aurore 8193 had higher 1000-grain weight. The bigger seeds of Florence Aurore 8193 was a product of fewer grains to big photosynthetic organ hence more assimilate production for grain filling.

5.1.3. Effect of weed control on the performance of wheat

Weed infestation did not have significant effect on days to seedling emergence because weeds had not emerged during the period of crop sowing. Weed infestation generally depressed the establishment and growth of wheat. In 1994/95 dry season, the weeded plots had better plant establishment than the weedy plots as a result of the smoothering effect of the early emerged weeds in the weedy plots. Similarly, in all cases, higher LAI was observed in the weeded plots. This difference could be attributed to the adverse effect of weeds on the growth of the crop due to competition for various factors of growth which affected the leaf size hence the LAI. Zindahl (1980) had given similar result of competition of weeds with wheat which reduces its growth and grain quality.

Weed infestation significantly reduced tillering in the wheat crop only in 1995/96 dry season, but not in 1994/95 probably because the higher seasonal temperature early in 1995/96 season, (appendix 2) encouraged early weed emergence and rapid growth which suppressed tillering. The non-significant effect of weed on tiller number in 1994/95 dry season could be attributed to the low temperature at early stage of crop growth despite the increase at later stages of growth. The low temperature might have encouraged tillering at the early period before weeds became serious at later period. The shorter plants observed in the weedy plots in 1995/96 dry season could be attributed to the competition of the weeds with the crop for nutrients, water, space which was accentuated by the higher temperature. The lower temperature which was not conducive for vigorous growth of weeds hence competition of weeds with the crop in 1994/95 was probably responsible for the non-significant effect of weeds on wheat plant height as earlier observed by Kataria et al., (1981). Weed infestation, however, had no significant effect on days to maturity of the crop in both dry seasons. The reduction in straw weight in 1995/96 due to weed infestation is supported by the result of Hume (1962).

Except 1000-grain weight, weed infestation had significant effect on all the yield and components of the yield. The weeded plots produced higher yield and its attributes than weedy plots because of the competition between the wheat crop and the weeds for growth factors such as water, space, minerals, air etc. This led to the reduction in these yield attributes hence the yield. Similar results have been reported by Pande (1956) and Verma (1962), who observed 60 - 70% yield loss due to weeds. The non significant effect on seed size was probably due to the fact that the vegetative part of the crop could produce adequate assimilate for the filling of few grains produced under weed infestation.

5.2 Interaction of sowing date, wheat varieties and weed infestation on weed and wheat performance .

The significantly higher sedge dry weight observed at 9 WAS where Florence Aurore 8193 was sown on February 6 in 1994/95 dry season could be due to higher temperature which was favourable to the growth of sedges and unfavorable to wheat crop. The higher sedges weed dry weights observed under Florence Aurore 8193 compared with Siete cerros may be attributed to the higher plant count of Siete cerros which in turn gave more suppression of the growth of sedges. The non-significant difference observed with regards to sedges weed dry weight in 1995/96 dry season, could be due to the fewer sedges weed recorded on the site used in the season.

The significant interaction of sowing date and wheat varieties on LAI in both seasons shows, that at 6 WAS in 1995/96, only the first two sowing dates (November 18 and 28) in Siete cerros were comparable to maximum in Florence Aurore 8193 with the first sowing date while the second to the fourth sowing dates (November 28 to December 18) were comparable in Florence Aurore 8193. Similarly at 9 WAS no sowing date in Siete cerros was comparable to the maximum in Florence Aurore 8193 planted on the first sowing date. The result indicates that the LAI is more sensitive to delay in sowing in Siete cerros than Florence Aurore 8193.

The higher tiller production obtained with Siete cerros could be because of the higher plant count recorded by it which invariably gave it higher tiller in a given area than Florence Aurore 8193.

The result shows that although the plants sown on January 7 were significantly shorter than those sown on December 28 date in Florence Aurore 8193, they were statistically similar to plants sown on November 18 in Siete cerros. No sowing date

produced a plant in Siete cerros that was comparable in height with the tallest plant in Flourence Aurore. This is due to the genotypes of the two varieties and even at higher temperatures, Florence Aurore 8193 still maintained the superiority in height.

There was also significant interaction of sowing date and wheat varieties on effective tillers per m^2 in 1995/96 dry season. The result indicates that maximum effective tillers was recorded where Siete cerros was planted on December 18and only the December 8 and January 7 plantings in Florence Aurore 8193 were comparable to it while the November 18 to Dec. 8 and Dec. 28 and Jan. 7 plantings in Siette cerros were comparable to the maximum. This confirms the result of Olugbemi et al., (1981) that Siete cerros is superior in effective tiller production than Florence Aurore 8193 which is one of those desirable characters that contribute to its higher yield than Florence Aurore 8193.

The observed significant interaction of sowing date and wheat varieties on spike length in both seasons shows that longer spikes were produced by Florence Aurore 8193 at Nov. 18 and Dec. 8 planting and only Dec.18 planting in Siete cerros was comparable to the maximum while the second and fourth sowing dates were comparable to the maximum in Florence Aurore 8193 in 1994/95. Similarly, in 1995/96, longer spikes were produced in the Florence Aurore 8193 with the third sowing date and the first and second sowing dates in Florence Aurore 8193 were comparable to the maximum while no sowing date in Siete cerros was comparable to the maximum. The reason for the superiority of Florence Aurore 8193 over Siette cerros on spike length is genetical. However, the declining and comparable spike length of the two varieties at later sowing dates in the two seasons could be due to high temperature which might have affected the development of the spike. Spike formation in Florence Aurore 8193 is therefore more sensitive to delay in sowing than in Siete cerros.

However, the significant interaction of sowing date and wheat varieties on spikelets per spike in both seasons shows that in 1994/95 except the Dec. 8 and Feb. 16 plantings, Siete cerros produced higher spikelet per spike than Florence Aurore 8193 and only the Dec. 8 planting in Florence Aurore 8193 was comparable to the maximum in Siete cerros, the Nov. 18 to Dec. 8 planting and Dec. 28 to Jan. 7 plantings were comparable to the maximum.

In 1995/96 season, no sowing date in Florence Aurore 8193 was comparable to the maximum spikelet per spike obtained with the Dec. 8 planting in Siete cerros. The higher spikelets observed in Siette cerros is probably because of the shorter internodes of Siette cerros compared with Florence Aurore 8193.

Similarly, the significant interaction of sowing date and wheat varieties on number of grains per spike observed in the two dry seasons shows that in 1994/95 only the Dec.8 and Feb. 16 plantings in Florence Aurora 8193 were comparable to the maximum obtained in Siete cerros with the Nov. 28 planting. In 1995/96 also no sowing date in Florence Aurora 8193 was comparable to the maximum obtained in Siete cerros with the Dec. 8 planting. The superiority of grain per spike of Siete cerros over Florence Aurora 8193 was partly due to higher number of spikelet per spike produced by Siete cerros. Another possible reason is the compensatory mechanism of assimilate utilization. The produced assimilate in Siete cerros was probably used for the formation of more seeds as against Florence Aurora whose assimilate might have been used for bigger grain filling.

The observed significant interaction of sowing date and wheat varieties in the two dry seasons on grain weight per spike shows that in 1994/95 dry season, no sowing date in Siete cerros was comparable to the maximum with the Nov. 18 planting in Florence Aurore 8193. However, at later sowing dates, the two varieties were comparable except at the Jan. 7 and

Jan.27 plantings. In 1995/96 season, however, the Nov.28 planting in Siete cerros was comparable to the maximum obtained with the Nov. 28 planting in Florence Aurore 8193. The Dec. 8 and later plantings of the two varieties were comparable despite the bigger size of the grains of the Florence Aurore 8193. This is probably due to higher temperature regime at the later sowing dates which usually hinders growth and development of wheat. This shows that grain filling in Florence Aurora 8193 is more sensitive to delay in sowing than Siete cerros .

The significant interaction of sowing date and wheat varieties on 1000-grain weight in the two dry seasons indicates that no sowing date in Siete cerros was comparable to the maximum weight obtained in Florence Aurore 8193 with the Nov. 18 planting. In 1994/95, the least 1000-grain weight obtained in Florence Aurore 8193 with the last sowing date (Feb. 16) was even comparable to that obtained with the Dec. 18 planting in Siete cerros. This proved the earlier result of Olugbemi et al.(1991) that the grains of Florence Aurora 8193 are bigger in size than those of Siete cerros hence given the same number, the higher weight of Florence Aurore 8193 is expected. However, the comparable 1000-grain weight in 1995/96 with the Jan. 7 to Feb. 16 plantings could be due to the generally high temperature experienced in the season which adversely affected assimilate production and grain filling and hence the weight. This shows also that Florence Aurore 8193 is more sensitive to late sowing than Siete cerros which results in poor filling of grain.

There was also significant interaction of sowing date and weed infestation on spike length in 1995/95 dry season. The results shows that all the sowing dates were comparable except the Dec. 28, Feb.6 and 16 plantings, when the weed free plots produced longer spikes

than the weedy ones. Since the difference manifested at later sowing dates, it shows that competition for growth factors between the weeds and the crop was more serious at these periods which might have reduced the spike length.

5.3 Correlation coefficient.

The positive correlation of wheat grain yield with growth parameters such as LAI, plant height could be due to the fact that these attributes directly determine the extent of photosynthesis and the amount of assimilates that were available for plant growth and finally grain yield.

The positive correlation between yield attributes such as number of effective tiller per m^2 , length of spike, grain number per spikes, grain weight per spike and 1000-grain weight with grain yield, revealed these as important yield components as well as critical determinats of wheat grain yield. The result obtained indicates that an increase in any of the variables would contribute to increase in grain yield.

The negative relationship observed between the wheat grain yield, growth and yield attributes with the weed variables indicates that weeds have detrimental effect on the growth and yield of wheat. Hence if weeds are left to compete with wheat crop, they can lower the yield obtained.

The positive correlation between total weed dry weight with weed variables indicates the combined effect of these weed variables on the total weed dry weight.

However, the negative correlation between sedge variables with total weed dry weight and other types of weed variables in 1995/96, could be due to the fewer number of sedges recorded in the plot used in 1995/96 dry season.

CHAPTER SIX.

6.0 SUMMARY AND CONCLUSION.

Field trials were conducted to study the effects of sowing date and weed infestation on the performance of two varieties of irrigated wheat (Triticum aestivum L.) on the farm of the Institute for Agricultural Research, Ahmadu Bello University, Samaru (11° 11' and 07° 08'E) Zaria during 1994/95 and 1995/96 dry seasons. Ten sowing dates of wheat from 18th November to 16th February at ten days interval constituted the main plot treatment and the sub-plot treatments of combinations of two wheat varieties (Siete cerros and Florence Aurore 8193) and weed infestation (weeded and weedy conditions) were replicated three times.

Weed population, and dry weight generally increased with delay in sowing date in the two dry seasons. Sowing date also significantly affected all the growth and yield parameters except maturity period. As the sowing date was delayed, both the growth and yield parameters decreased. However, in most cases, the first three sowing dates (Nov. 18, Nov.28 and Dec. 8) had similar effect on various growth and yield parameters. Grain yield significantly declined after the third sowing date i.e from 8th December in both dry seasons. Delay in the sowing to the third sowing date caused a yield reduction of only 9.8% and 11.5% for 1994/95 and 1995/96 dry seasons, respectively, while delaying further to the last date, caused a yield reduction of 81.4% and 94.9% for 1994/95 and 1995/96 dry seasons, respectively. However, sowing date did not significantly affect days to seedling emergence of the crop.

The wheat varieties used in the trial had no significant effect on the weed parameters except at 9 WAS when Florence Aurora 8193 had higher sedge dry weight than Siette cerros. Significant variation was, however, observed in some wheat parameters between the two varieties in the two dry seasons. Siete cerros was superior in effective tillers, number of spikelets per spike, grains per spike and grain yield per hectare even though Florence Aurore 8193 had longer spike, bigger grains, higher straw weight, and taller plants with large LAI.

Weed infestation was found to have affected both growth and yield components of wheat. The effect was pronounced with the later sown crop.

Significant interaction of sowing date and variety, between sowing date and weed infestation and between variety and sedges dry weight was observed and discused.

Total weed dry weight was significantly and positively correlated with broadleaved weeds, grasses and sedges except dry weight of sedges in 1995/96 dry season which was negatively correlated with total weed dry weight. It was also observed that all the growth characters as well as yield attributes were positively correlated with grain yield of wheat. The weed variables also showed negative correlation with wheat grain yield components in both dry seasons. Based on the result obtained in the study, it is concluded that, grain yield during the first three sowing dates did not differ significantly in the two dry seasons. Delay in sowing date significantly lowered grain yield. Siete cerros was a better yielder than Florence Aurora 8193. Weed infestation and consequently dry weight were higher at later than early sowing dates. Weed infestation significantly reduced wheat grain yield.

It is therefore recommended that sowing of wheat should not be beyond 8th December to avoid weed problems and adverse effect of high temperature on growth of wheat plant which lead to reduction in grain yield.

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Appendix I: Mean maximum and minimum temperatures and Relative Humidity at 10- days interval between 1st November 1994 to end of April 1995.

Month	Min. Temp. (°C)	Max. Temp. (°C)	RH (%)
November 1994			
1 - 10	14.40	31.10	51.75
11 - 20	12.40	30.50	31.50
21 - 30	13.30	28.80	27.80
December 1994			
1 - 10	12.10	26.30	27.50
11 - 20	10.50	26.00	35.00
21 - 31	10.82	28.55	30.86
January 1995			
1 - 10	10.90	30.70	20.45
11 - 20	10.30	28.20	24.10
21 - 31	10.27	25.91	33.63
February 1995			
1 - 10	11.40	28.10	31.20
11 - 20	12.60	29.90	24.10
21 - 29	13.32	32.87	24.05
March 1995			
1 - 10	17.10	36.20	28.15
11 - 20	17.10	36.15	30.75
21 - 31	18.35	35.77	27.61
April 1995			
1 - 10	19.20	37.40	27.50
11 - 20	19.85	37.15	27.60
21- 30	19.37	36.23	36.24

Appendix III: The physical and chemical properties of the soil of the experimental site at Samaru during the 1994/95 dry season.

Soil Characteristics		Soil Depth (cm) 0 - 15	15 - 30
Physicl Particle size of distribution			
Sand	(%)	40	30
Silt	(%)	36	30
Clay	(%)	24	40
Textural class		Loam	Clay-loam
Chemical properties			
pH in water (1:2:5)		6.8	6.8
PH in $Cacl_2$ (1:2:5)		6.4	6.4
Organic carbon (%)		0.62	0.96
Total nitrogen (%)		0.084	0.012
Available phosphorus (ppm)		13.44	4.03
Ca	Meq/100g soil	1.40	1.60
Mg	" "	1.02	1.38
K	" "	0.37	0.42
Na	" "	0.11	0.35
CEC	" "	5.10	6.10

Appendix IV: The physical properties of the soil of the experimental site at Samaru during the 1995/96 dry season.

Soil properties	Soil depth (cm)	
Physical Particle size of distribution	0 - 15cm	15 - 30cm
Sand (%)	44	34
Silt (%)	42	42
Clay (%)	14	24
Textural class	Loam	Clay-loam
Chemical properties		
pH in $H_2 0$	6.60	6.50
pH in 0.01m $Cacl_2$	5.80	5.60
Organic carbon (%)	0.64	0.56
Available phosphorus (ppm	5.38	3.58
Total nitrogen (%)	0.140	0.133
Ca Meq/100g soil	1.40	1.60
Mg " "	1.02	1.38
K " "	0.37	0.42
Na " "	0.11	0.35
CEC " "	5.10	6.10

Appendix V: Weed species present in the experimental site and their levels of infestation at Samaru during the 1994/95 and 1995/96 dry seasons.

Type of weed spp.	Levels of infestation 1994/95	1995/96
Grass weeds		
Chloris pilosa Schunuach	++	++
Cynodon dactylon (L) Pers	+++	+++
Dactyloctenum aegyptium (L) Richt	+++	+++
Eleusine indica L	++	++
Eragrostis tremula Hochst ex steud	+	+
Pennisetum pedicellatum Trin.	++	++
Rottboellia cochinchinensis (L) Roxb	+	+
Broadleaved weeds		
Acanthospermum hispidum (DC)	++	++
Ageratum conyzoides (L)	+++	+++
Amaranthus spinosus (L)	+	+
Crotalaria retusa(L).	+	+
Euphorbia heterophylla (L)	++	++
Euphorbia hirta (L)	+	+
Physalis angularis (L) B	+	+
Solanum nigrum (L)	+	+
Vernonia galamensis (Cass)	+	+
Sedges		
Cyperus rotundus (L)	+++	++
Cyperus esculentus	+++	++

Key:

+	=	Low infestation
++	=	Moderate infestation
+++	=	Heavy infestation

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