Research Article

Sowing Dates Effect on Production of High Yielding Maize Varieties

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Abstract | Maize, an important staple food crop, is grown on largest cropped area every year for food and fodder in Pakistan. Nonetheless, its yield is low with almost half of the national average in the Khyber-Pakhtunkhwa province. The study aims to find outoptimum sowing time for a suitable variety (OPV or hybrid) in Peshawar. Field experiment was conducted at Agronomy Research Farm, the University of Agriculture Peshawar during summer 2016. Experiment was a randomized complete block with split plots in three replications. Factor one was sowing dates (June 18, 30, July 15, 29 and August 5) as main plot treatment. The second factor was maize selected varieties (i.e. Azam, Jalal, Babar, CS-200, CS-220, SB-92K97, SB-909, SB-989, and SB-292) as subplot treatment. Experimental unit was 3.5 m x 3.6 m accommodating 5 rows at 0.7 m distance. Fertilizer was applied 200, 120, 80 kg ha^{-1} (N, P and K) to Hybrids and 120, 90, 60 kg ha^{-1} (N, P, K) to open pollinated varieties (OPV) during seed bed preparation. Data analysis showed that emergence m^{-2} affected by varieties only. Both crop phenology (i.e. days to tasseling, silking & maturity) as well as morphology (i.e. plant height, ear height, including ear length) was affected ($p<0.05$)by sowing dates. Likewise, yield traits (i.e. rows per ear, grains per ear, thousand grain weight) were also adversely affected by sowing dates, which decreases both biomass and grain yield. Varieties did differ in phenology (i.e. emergence, silking, tasseling, maturity) and morphology (i.e. height, leaf area, ear height, cobs per plant and its weight) that showed differences in biomass and grain yields. The study suggested that a delay in sowing of maize crop from June in the region after Wheat or Berseem harvesting has a significant decrease ($p<0.05$) in production. Nonetheless, sowing made in August is unable to mature grains properly. The yield losses rate relatively expands from July 15 onwards for maize in Peshawar valley. Sowing maize later from June month in season is superior to opt for hybrid maize variety SB-909 and SB-92K97 in the Peshawar region.

Received | June 25, 2017; **Accepted** | January 09, 2018; **Published** | February 10, 2018
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Citation | Liaqat, W., M. Akmal and J. Ali. 2018. Sowing date effect on production of high yielding maize varieties. *Sarhad Journal of Agriculture,* 34(1): 102-113.
DOI | http://dx.doi.org/10.17582/journal.sja/2018/34.1.102.113
Keywords | Maize varieties, Hybrids and OPV, Sowing timings, GRAIN yield

Introduction

Maize (*Zea mays* L.), important members of family Poaceae, is grown on alarge area in Pakistan (Ref.). Maize be grown in spring and in summer as richincome source in developing countries (Tagne et al., 2008). Changing rainfall pattern with increasing temperature in summers is expected in future (Hanif and Ali, 2014).They observed increases in monsoon rainfall (July-August) every year, which affects summer crops (e.g. Maize). Predictions for future are that rainfall seems to increase in summer. Genotype and environment interaction (GEI) is the primary factor determining productivity of an area. Appropriate variety selection for a sowing time is worthwhile besides soil health, favorable tempera-

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ture regimes and irrigation (Ramankutty et al., 2002; Khan et al., 2009). Planting at right time is very important to expect optimum yield. Significant decrease in yield is reported with delayed sowing (Anapalli et al., 2005). Optimum yield is attributed to appropriate sowing time and variety along with recommended management practices (Qureshi et al.,2007). Sowing time is a critical factor for harvesting higher radiant energy if soil moisture and nutrients are not deficient (Ogobomo and Remison, 2009). According to Hanif and Ali (2014), changes in climate of Pakistan and Khyber Pakhtunkhuwa (KP) are expected with a relatively wet and cool summer season for maize production. In the recent past, hybrid maize cultivation has increased. It is obvious to know by comparing that OPV or hybrids for the area be profitable for the suitability and adjustment in the cropping system to yield for a planting time available for maize sowing after the previous crop harvesting. The challenge for growers is to decide which maize OPV or hybrid to plant in scenario of changing climate with a suitable variety (Nielson et al., 2002). Identification of suitable high yielding variety to plant is a key factor for future farming. Maize is a summer crop and delay in sowing limits its productivity due to limited time to complete life cycle (Akmal et al., 2014; Hanif and Ali, 2014). Despite increasing use of fertilizers in Pakistan and KP, the maize yield is very low in KP of the country average (MNFSR, 2016). Climate of KP indeed is most favorable for maize growth (Binder et al., 2008; Meza et al., 2008) but suitable time for an appropriate variety is the main concern.

Keeping in view the possibility of choices for an OPV and/or hybrid for the possible sowing time available to plant maize in KP, it is most important to know the optimum planting time for an OPV or hybrid maize best suited in the cropping system, the present research was designed to compare productivity and performance of different maize varieties (i.e. OPV and Hybrids) with sowing from mid-June to early-August in Peshawar when land is free after wheat harvesting.

Materials and Methods

Site and layout

Field study was conducted at Agronomy Research Farm, the University of Agriculture Peshawar during summer 2016. The research field was irrigated by Warsak canal water from river Kabul. Soil was clay-loam, low in organic matter (0.88%), alkaline (pH 8.3) and calcareous ($CaCO_3$>3%) in nature. The experiment was laid out in a randomized complete block design, split plot arrangement in four replications. Experiment was a two factors study (a) sowing dates (SD) and (b) varieties. Five sowing dates i.e. June 18, June 30, July 15, July 29 and August 5 as main plot and varieties i.e. Azam, Jalal, (OPV) Babar, CS-200, CS-220, SB-92K97,SB-909, SB-989, and SB-292 (Hybrids) as sub plot treatments. Each experimental unit was 3.5m wide and 3.6m long planted with five rows at equal spacing i.e. 0.70m from each other. Seedbed was prepared with tractor as recommended for maize by ploughing twice at proper field capacity for a sowing date with cultivator followed by a rotavator. Irrigations were applied according to crop water requirement and weather conditions. In addition to seasonal natural precipitations, four irrigations were applied to all sowing dates on August 22, September 6, 21 and October 5,respectively when crop has turned to reproductive stage. A flood irrigation was measured about 56 mm rainfalls by water flow rates and timings applied. Due to monsoon rainy season all sowing dates had enough moisture in soil. Recommended fertilizer i.e. 200, 120, 80 and 120, 90, 60 kg ha^{-1} were applied as N,P, K, respectively to hybrids and OPV varieties, respectively. Nitrogen was applied from Urea in two equal splits i.e. half at sowing and other half a month after each sowing the day when rain was forecasted. Phosphorous from DAP was applied during seedbed preparation. Weeding was done manually with the help of hoe two times: one after 20 days of emergence and second after 40 days of emergence for weeds eradication. Other cultural practices (thinning, insecticide, herbicides, etc.) were kept uniform for all experimental units and sowing times. Weather data of the site for the season is shown in Figure 1.

Observations and measurements

Number of plants emerged per unit area were recorded by counting seedlings in a meter-long row at three different positions. Data was converted to plants m^{-2} by dividing on row length and width. Days to tasseling and silking were noted visually by counting number of days taken from sowing to tassel and/or silk. Days to maturity were also determined by counting days from sowing to maturity date. Plant height (cm) was recorded at physiological maturity stage on five randomly selected representative plants. Leaf area index (LAI) was derived by measuring leaf area of all leaves available at measurement day in five sampled plants in a plot. The leaf length x width was multiplied with 0.75 (constant) and mean leaf area per plant was multiplied

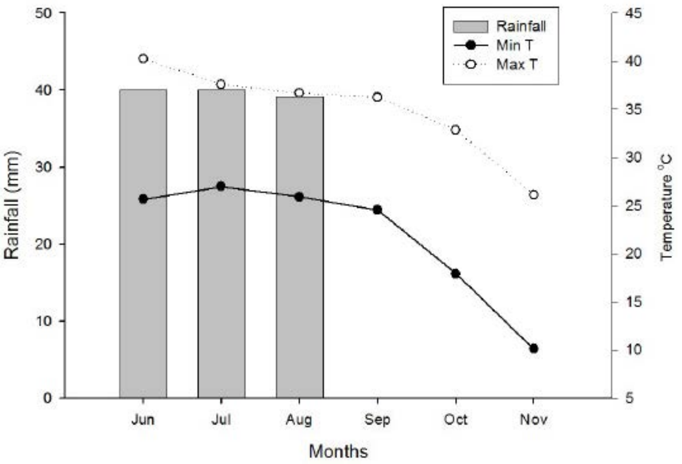

Figure 1: *Total rainfall (mm) is shown in vertical bars while mean maximum and minimum temperature (°C) are shown with dotted and continuous lines, respectively forcrop growth period in Peshawar (PakistanMeteorological Department).*

with plants in two central rows and divided by the area occupied by two rows. Ear height (cm) was recorded by measuring height from grounds of ear's bearing node on five representative plants. Ear number plant^{-1} was recorded by randomly selecting 10 plants in an experimental unit. Ears were counted manually and averaged for a single reading. Data regarding ear length (cm) was measured with a ruler, measuring five ears randomly selected from an experimental unit at harvest. Data on grain number ear^{-1} were calculated by manually counting grains on five ears randomly selected in a plot. At harvest, five ears were randomly selected from an experimental unit. Number of grain's row ear^{-1} was manually counted on selected ears and averaged for a single reading. Shelling percentage as ratio of grains and total ear weight with grain was derived independently and expressed in percent. After threshing, clean grains were taken, counted and weighed (g). Data on plant number was taken manually by counting plant in four rows close to harvesting. Data were converted to plants m^{-2} by dividing on harvested area. At maturity, three central rows in an experimental unit were harvested manually, bundled and dried in sun for ten days. Each bundle was weighed to record biological yield. Ears were removed, de-husked, shelled and weighed for grain yield. Data for biomass and grain yield were used for harvest indices as ratio of grain and total biomass yield.All collected data were entered in computer, double-checked before processing. Data were statistically examined using ANOVA techniques approach recommended for a randomized complete block design with split plot arrangement. Upon significant F-test results, means were compared using Least Significant Difference test (Steel and Torrie, 1980).

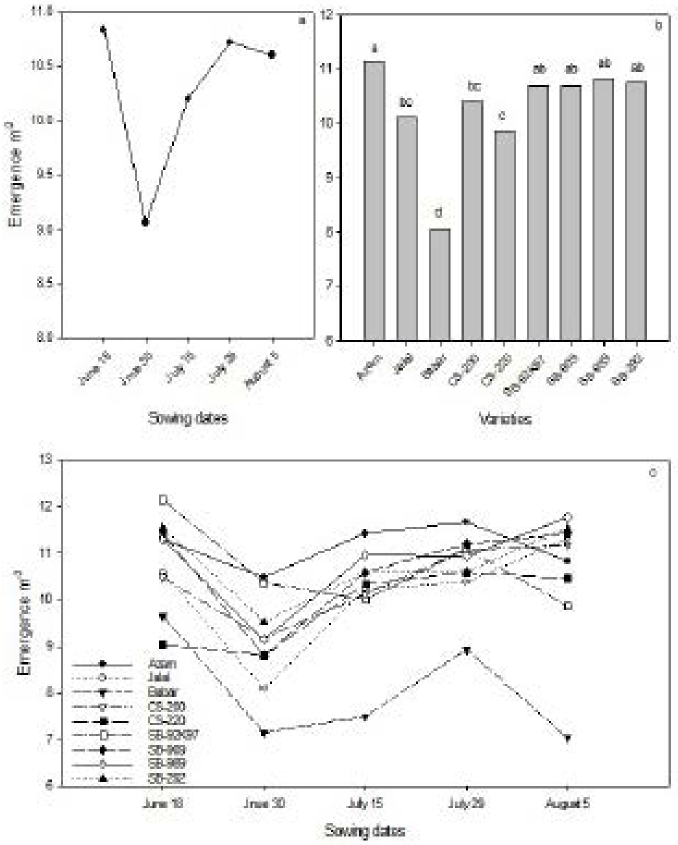

Figure 2: *Emergence m^{-2}for (a) sowing dates = SD, (b) varieties = Vand (c) interaction of SD x V in separate windows. Same letters in a window indicate non-significant effect. LSD (P ≤ 0.05) forV = 0.70.*

Results and Discussion

Crop phenology

Data on emergence (m^{-2}) revealed that sowing date had a non-significant effect on emergence (Figure 2). However, varieties differed ($p<0.05$) in emergence. Maximum emergence was observed for Azam with non-significant differences with SB-989, SB-292, SB-92K97 and SB-909, followed by SB-989, SB-292, SB-92K97,SB-909, CS-200 and Jalal with non-significant differences to each other. Minimum emergence was recorded for Babar. Interaction of treatment was found non-significant for emergence. Data on days to tasseling showed both sowing dates and varieties were significant (Figure 3) with non-significant effect of interaction. Mean across varieties, more days to tasseling were associated to early sowing (June 18), followed June 30. As sowing delayed, days to tasseling decreased for July 15 and July 29 with minimum for August 5. While averaged across sowing dates, varieties are ranked in six groups (i) Babar and CS-220, (ii) CS 220, CS-200 and SB-292, (iii)CS-200, SB-292, Azam and Jalal, (iv) SB-292, Azam, Jalal and SB-909, (v) SB-909and SB-989 and

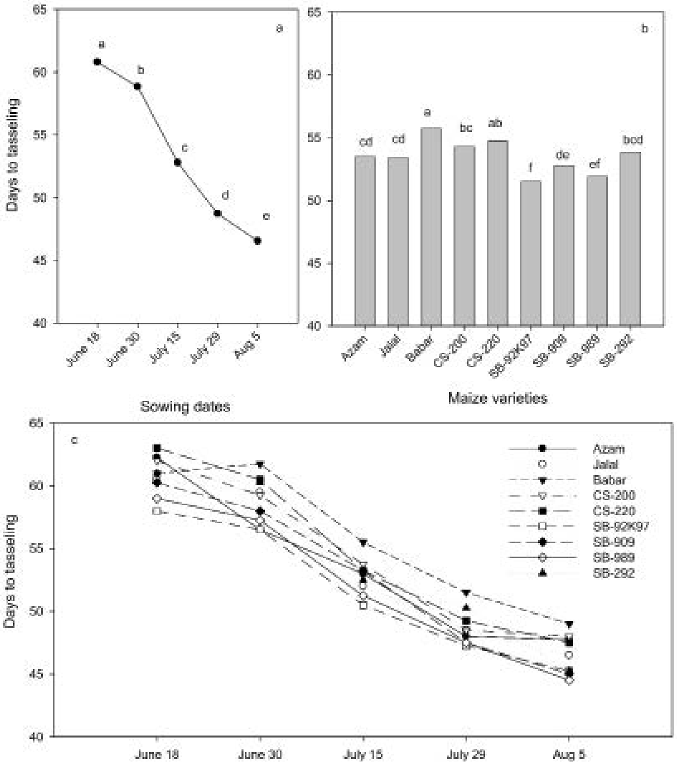

Figure 3: *Days to tasseling for (a) sowing dates = SD, (b) varieties = Vand (c) interaction of SDx V in separate window. Same letters in a window indicate non-significant effects. LSD (P≤0.05) for SD = 1.78 and V = 1.15.*

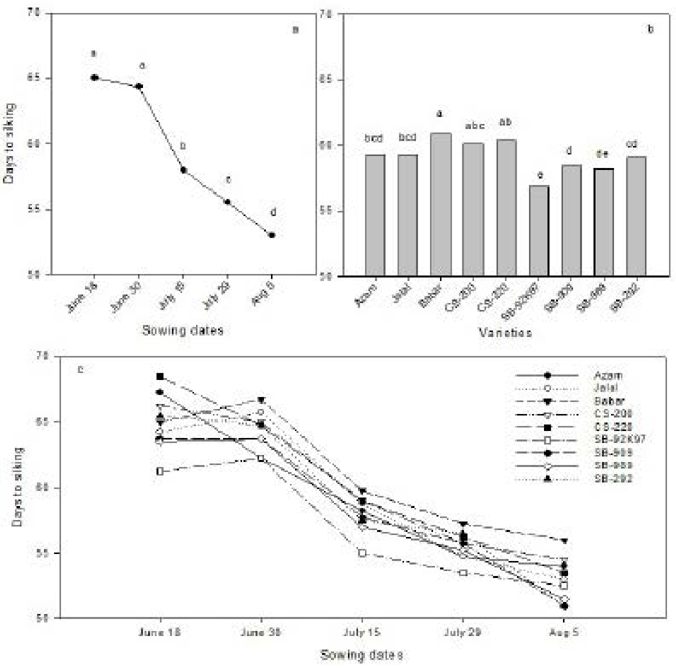

Figure 4: *Days to silkingfor (a) sowing dates = SD, (b) varieties = Vand (c) interaction of SD x V in separate windows. Same letters in a window indicate non-significant effect.LSD (P≤0.05) for SD = 2.02 and V = 1.31.*

(vi) SB-92K97 and each group was non-significant from one another for days to tasseling data. Days to silking indicated significant changes for sowing dates and varieties with non-significant for interaction (Figure 4). Mean across varieties showed that early sowing made on June 18 took maximum days to silking with anon-significant difference from June 30. Delay in sowing, however, decreased daysto silking for July 15 and 29 with minimum for sowing date August 5. While averaged across sowing dates, maximum days to silking were observed for Babar,CS-220, and CS-200, followed by CS-200, CS-220, Azam, and Jalal with non-significant differences. Varieties CS-220, Azam,Jalal, and SB-292 were significantly lower than the earlier mentioned varieties with the minimum days to silking for SB-92K97. Days to physiological maturity were influenced by sowing dates and varieties (Figure 5). Mean across varieties showed highest days to maturity for June 18, followed by June 30 and July 15. A delay in sowing increased days to maturity by 95 days for sowing made on August 5 in season. While averaged across sowing dates, varieties differed with maximum days for CS-220 and CS-220, followed by SB-909 and SB-292. The next set included SB-292, Babar, and Jalal, followed by Babar, Jalal, and SB-92K97. Minimum days to maturity were reported for SB-92K97, SB-989 and Azam.

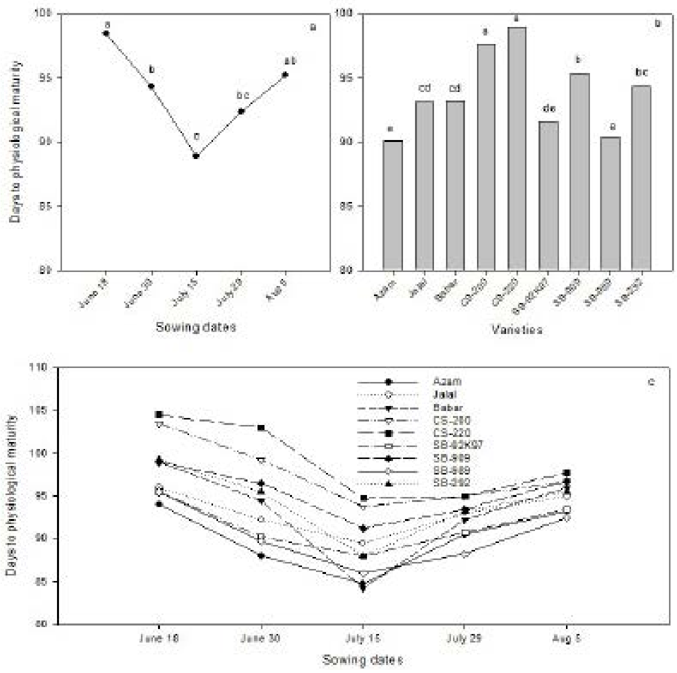

Figure 5: *Days to physiological maturity for (a) sowing dates = SD, (b) varieties = V and (c) interaction ofSD x V in separate window. Same letters in a window indicate non-significant effect.LSD (P≤0.05) for SD = 4.05 and V = 2.05.*

Plant morphology

Plant height (cm) differed (p<0.05) with sowing dates and varieties, but interaction of sowing dates and varieties was not significant (Figure 6). Early sown (June 18) plants were taller with statistically same height for June 30, followed by July 15, which also found non-significant with sowing made on July 29. Shorter plants were for sowing made on August 5. Averaged across sowing dates, varieties stand in four groups, the tallest plant included SB-92K97, CS-200, SB-989, and Azam, followed by SB-989, Azam, SB-909, SB-292, and CS-220. There after includes Azam, SB-909, SB-292, CS-220 and Jalal while lowest plant height for SB-909, SB-292, CS-220 and Jalal. Leaf area index varied for sowing dates only (Figure 7).

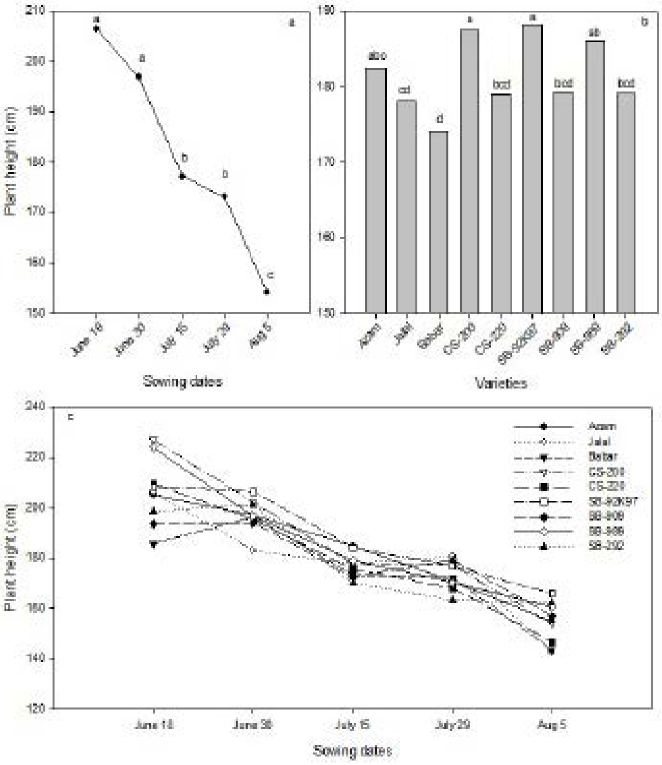

Figure 6: *Plant height for (a) sowing dates = SD, (b) varieties = V and (c) interaction of SD x V in separate window. Same letters in a window indicate non-significant effect.LSD (P≤0.05) for SD = 16.06 and for V = 7.85.*

Highest leaf area index was recorded for June 18, followed by June 30, which was same (p<0.05) with July 15. Lowest leaf area index was associated to August 5 sowing date. Ear height differed (p<0.05) for sowing dates, varieties and their interaction (Figure 8). The maximum ear height was noted for sowing made on June 30, followed by June 18, which was statistically similar to July 15 sowing date. The minimum ear height was recorded for August 5 sowing in the season. On averaged across sowing dates, variety CS-200 gave the highest ear height with no change(p<0.05) from SB-92K97, followed by SB-989, Azam, SB-292, SB-909, Jalal, and the lowest ear height observed for Babar which did not differ from CS-220.Treatment interaction revealed the maximum ear height from early sowing (June 18) for CS-200 and minimum ear height for August 5 for Babar variety. Ear per plants differed for sowing dates only (Figure 9). Mean values across sowing dates showed more ears per plant in early sowing made on June 18, which did not vary (p<0.05) from June 30 and July 15, followed by sowing made on July 29 with minimum for August 5.

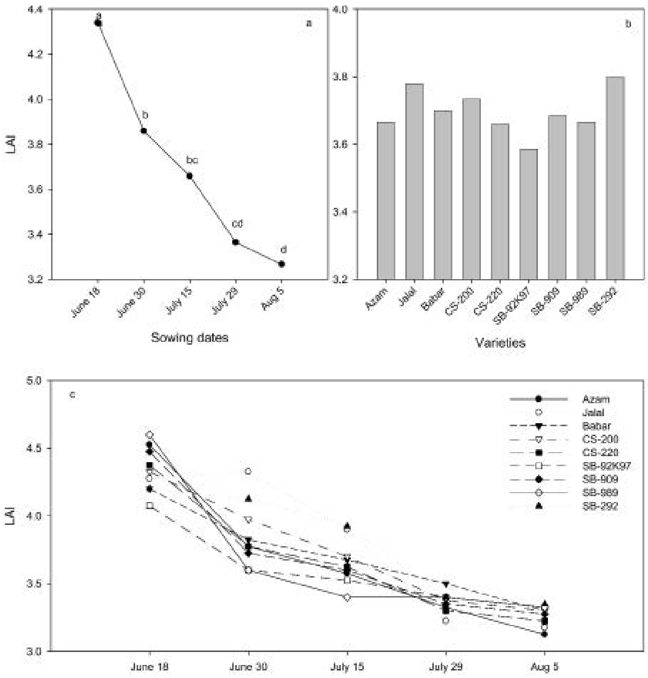

Figure 7: *Leaf area index for (a) sowing dates = SD, (b) varieties = V and (c) interaction of SD x V in separate window. Same letters in a window indicate non-significant effect.LSD (P≤0.05) for SD = 0.38.*

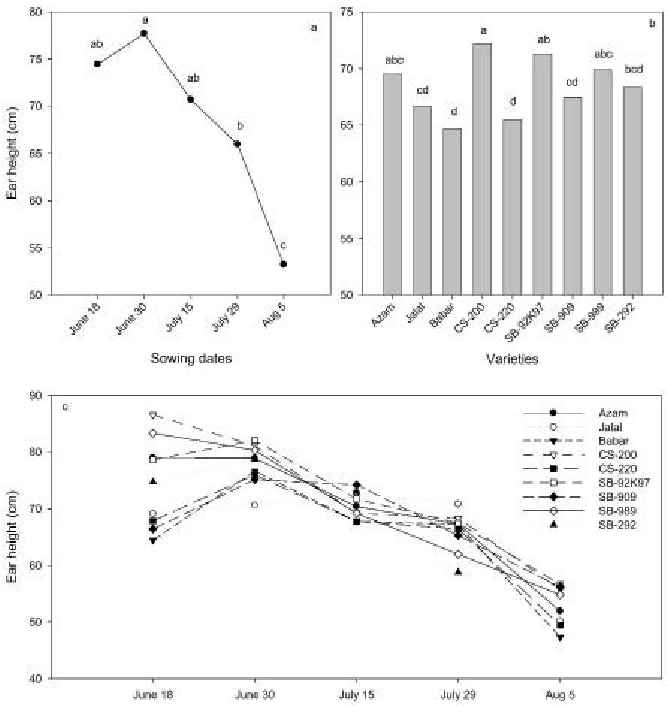

Figure 8: *Ear height for (a) sowing dates = SD, (b) varieties = V and (c) interaction of SD x V in separate window. Same letters in a window indicate non-significant effect.LSD (P≤0.05) for SD = 10.31, V =3.68 and SD x V = 8.23.*

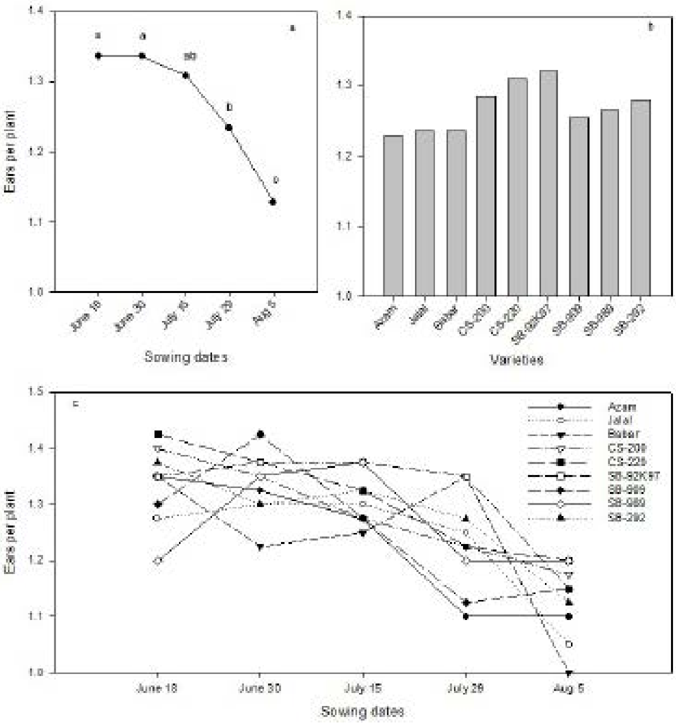

Figure 9: *Ears per plant for (a) sowing dates = SD, (b) varieties = V and (c) interaction of SD x V in separate window. Same letters in a window indicate non-significant effect.LSD (P≤0.05) for SD = 0.09.*

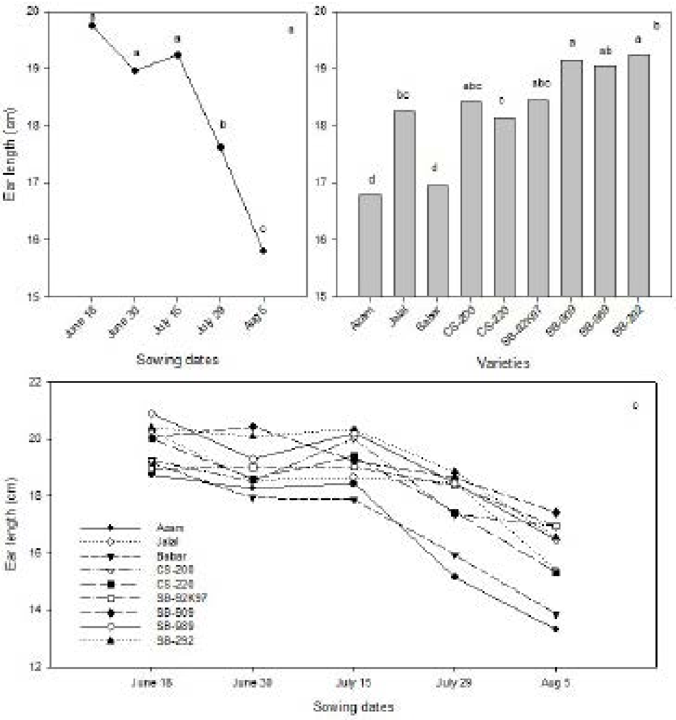

Figure 10: *Ear length for (a) sowing dates = SD, (b) varieties = V and (c) interaction of SD x V in separate window. Same letters in a window indicate non-significant effect.LSD (P≤0.05) for SD = 0.85 and V = 0.83.*

Yield contributing traits

Data on ear length was significant for sowing dates and varieties (Figure 10). Maximum ear length was recorded for sowing made on June 18, which did not differ from June 30 and July 15, followed by sowing made on July 29 with lowest ear length for sowing made in August 5. While averaged across sowing dates, longest ears were seen in varieties SB-292, SB-909, SB-989, SB-92K97 and CS-200 with a non-significant difference, followed by SB-989, SB-92K97, CS-200, and Jalal. Thereafter included SB-92K97, CS-200, CS-220, and Jalal, with the smallest ear for Azam and Babar with non-significant difference to each other. Treatment interaction for ear length data was non-significant. Analysis of grains per ear data showed variation ($p<0.05$) for sowing dates and varieties (Figure 11).

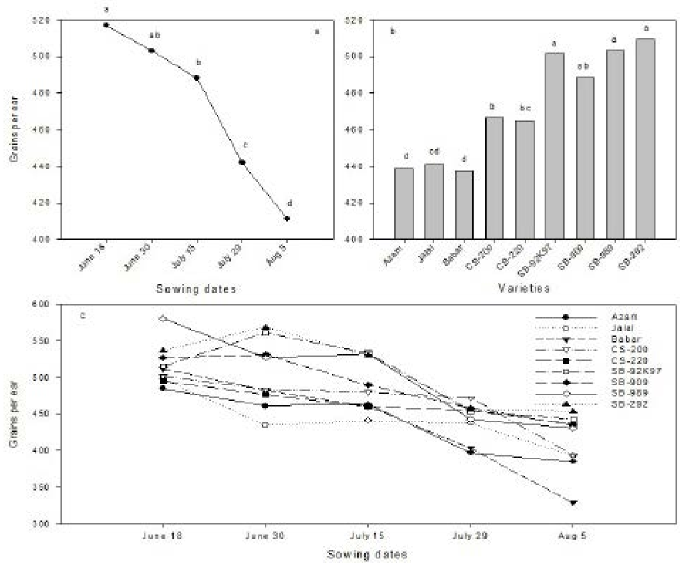

Figure 11: *Grains per earfor (a) sowing dates = SD, (b) varieties = V and (c) interaction of SD x V in separate window. Same letters in a window indicate non-significant effect.LSD (P≤0.05) for SD = 25.47 and V = 25.42.*

Mean of early sowing made on June 18 resulted more grains per ear, which did not differ ($p<0.05$) from June 30 sowing, followed by July 15 and 29 sowing dates, with lowest grains per ear recorded for August 5 sowing date. Varieties having more grains per ear included SB-292, SB-989, SB-92K97 and SB-909 with non-significant differences, followed by SB-909, CS-200, and CS-220 with non-significant differences and CS-220 and Jalal with minimum grains per cob in Babar, Azam and Jalal. Rows per ear differed ($p<0.05$) with sowing dates, varieties and their interaction (Figure 12). Maximum rows per ear was recorded when sowing was made on July 15, which was statistically similar with sowing made on June 18. However, the minimum rows per ear were recorded when sowing made on August 5 in season, which was non-significant to July 29 sowing. While averaged across sowing dates, variety SB-292 produced ear with the highest rows, which was statistically same with

SB-989 and SB-92K97, followed by varieties Azam, Babar, SB-909, and Jalal. The minimum rows per ear were recorded in CS-220, which was same with CS-200. Treatment interaction showed that more rows per ear were recorded in SB-989 for sowing made in July 15 and minimum rows per ear in Babar sown on August 5. Thousand grains weight (TGW) was affected by sowing dates and varieties (Figure 13). Means across varieties revealed the highest TGW (g) for June 18 sowing date, followed by June 30 sowing and the lowest TGW for August 5 sowing. While averaged across sowing dates, the maximum TGW was observed for CS-220, SB-92K97, SB-909, and SB-989 with non-significant difference, followed by varieties SB-909, SB-989 CS-200, SB-292 and Jalal with non-significant difference. Thereafter varieties were CS-200, SB-292, Jalal, and Babar with lowest TGW for Azam, Babar, and Jalal, which were statistically non-significant to each other. Plants at harvest differed ($p<0.05$) forvarieties only (Figure 14). Mean comparison for density showed the highest for Azam, SB-292, SB-989, and SB-909, followed by SB-292, SB-989, SB-909, SB-92K97, CS-200 and Jalal and the lowest number of plants at harvest in Babar and CS -220 with non-significant differences to each other.

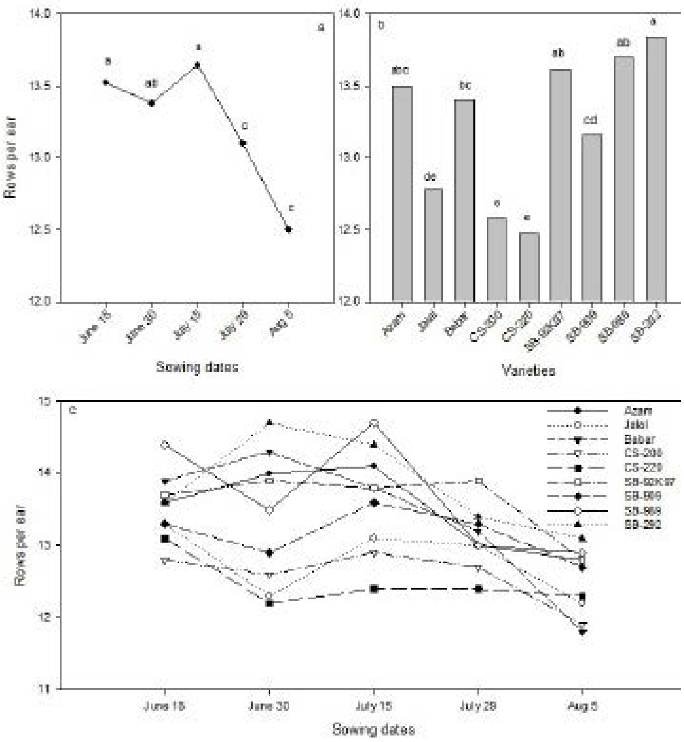

Figure 12: *Rows per ear for (a) sowing dates = SD, (b) varieties = V and (c) interaction of SD x V in separate window. Same letters in a window indicate non-significant effect.LSD (P≤0.05) for SD = 0.29, V = 0.39 and SD x V = 0.87.*

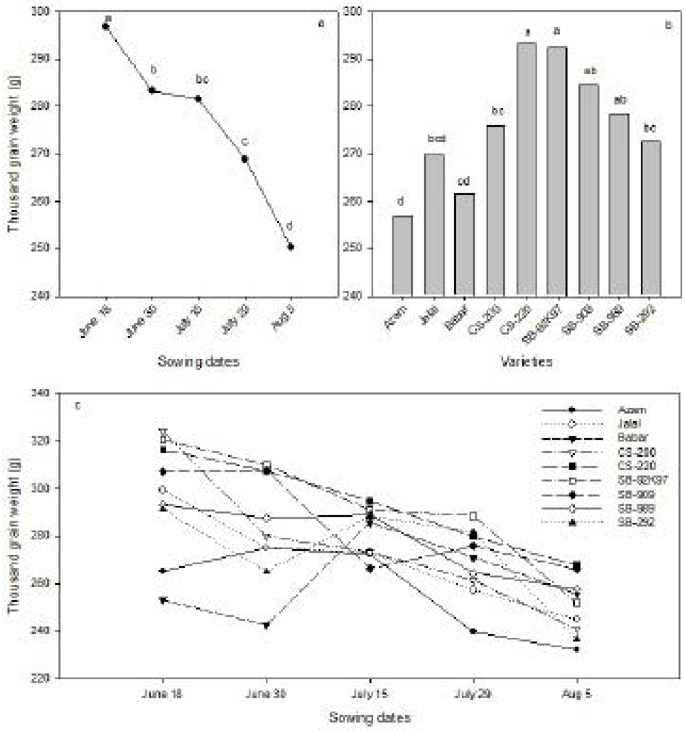

Figure 13: *Thousand grains weight for (a) sowing dates = SD, (b) varieties = V and (c) interaction of SD x V in separate window. Same letters in a window indicate non-significant effect.LSD (P≤0.05) for SD = 13.25 and V = 15.41.*

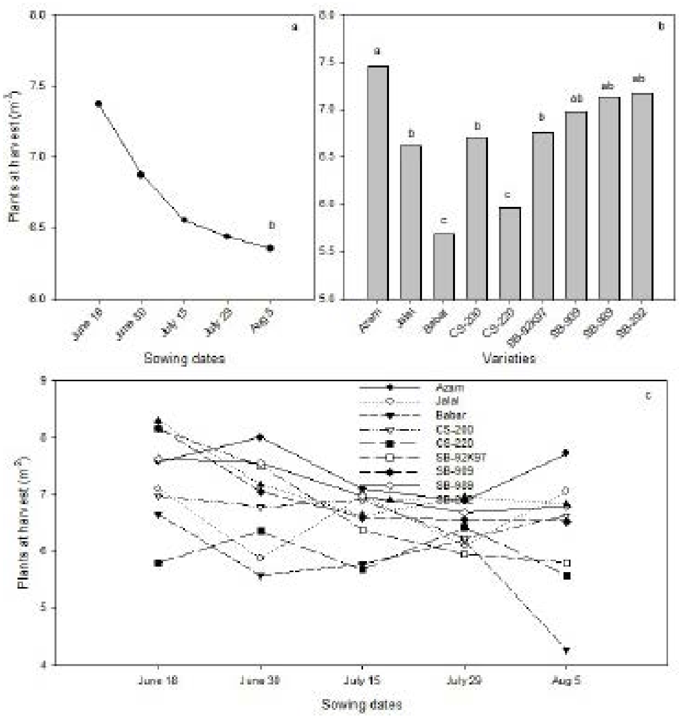

Figure 14: *Plants at harvest (m^{-2}) for (a) sowing dates = SD, (b) varieties = V and (c) interactionof SD x V in separate window. Same letters in a window indicate non-significant effect. LSD (P≤0.05) for V = 0.62.*

Biomass and yield

Sowing dates and varieties had significant ($P<0.05$) effect on above ground total biomass in maize with highest for sowing made on June 18 and 30, followed by July 15 and July 29 sowing with lowest for sowing made on August 5 in season (Figure 15). While averaged across sowing dates, varieties SB-909 and SB-92K97 gave the highest biomass with non-significant differences, followed by SB-92K97, CS-220,and SB-292. Thereafter, varieties CS-220, SB-292, SB-989 and CS-200 were ranked with a non-significant difference. The lowest biomass was recorded for Babar, Azam and Jalal with non-significant differences to each other. Grain yield differed for sowing dates and varieties only. Sowing made on June 18 gave the highest grain yield (Figure 16), followed by June 30 and July 15. The lowest grain yield associated to sowing date August 5. While averaged across sowing dates, highest grain yield recorded for SB-909 and SB-92K97, followed by varieties SB-989, CS-200 and SB-292 with non-significant differences. The lowest grain yield was recorded for Babar, Azam and Jalal with a non-significant difference.

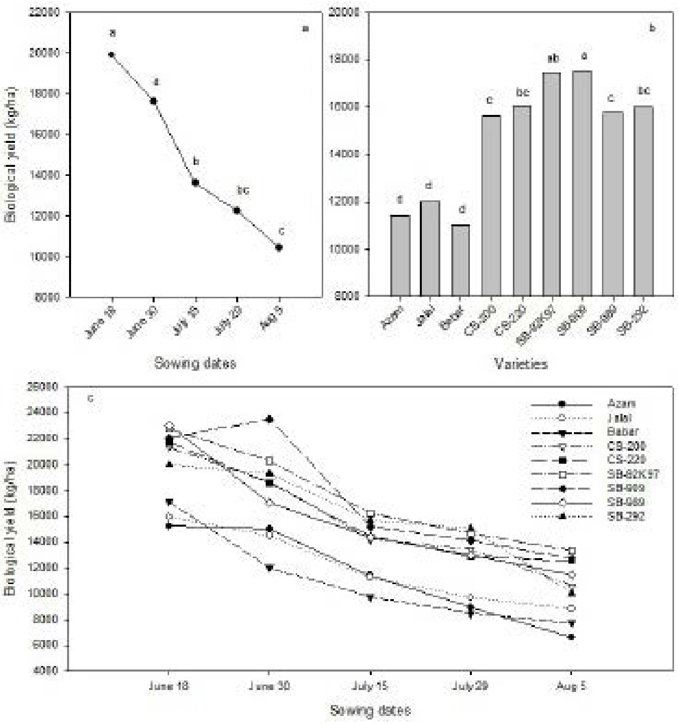

Figure 15: *Biomass for (a) sowing dates = SD, (b) varieties = V and (c) interaction of SD x V in separate window. Same letters in a window indicate non-significant effect.LSD (P≤0.05) for SD = 2527.08 and V = 1486.72.*

Only varieties had a significant effect on emergence, which can attribute to seed sizes, rate of water diffusion in seeds, activation of enzymes within seeds and seed vigor of varieties have different genetic makeup (Azam et al., 2007). The differences in seed size had difference in germination process from imbibition to blasting, which creates variation in emergence duration of different varieties. It is quite obvious that early sown took more days to tasseling and silking because the days from August onwards decreased in length, which enhanced crop towards maturity with initiating reproductive phase of development. Both temperature and photoperiod have great influence on maize crop development (Cirilo and Andrade,1994). Khan et al. (2002) observed that a decrease in days to silking by late sowingis very common for a crop, which is due to changes in climate of the following days in season. Differences in different maize varieties for days to tasseling and silking are quite obvious. Different varieties on the basis of their reproductive performance in a climate are classified into different maturity groups i.e. early, medium and late,which related to its vegetative and reproductive performance within a climate (Azam et al., 2007). Variation also exists within plant height of varieties. A variety has toper roam optimum when planted in time in season. Taller plants of a variety in early sowing are therefore reported, which decreased plant height when sowing was delayed in season. It is because the vegetative duration limited with decreasing temperature and crop has to change from vegetative to reproductive stage. Early sown crop availed more days of life cycle for vegetative development than late sown crop (Kharazamshahi et al., 2015). Differences in height among varieties were due togenetic constitution of varieties (Hussain et al., 2010). Leaf area index was significant for sowing dates. Early sowing resulted in higher leaf area index, which may be due to more favorable weather for vegetative growth of the plants (Shah and Akmal et al., 2012). Ear height in early sowing of June 30 could be due to optimum inter node length attaind by plants with favorable vegetative growth (Kharazmshahi et al., 2015). However, varieties differed in genetics, which expressed their morphological features. Number of ears per plant was similar for June sowing but decreased for July sowing. Ears number on plants correlates to most appropriate climate. A suitable temperature, photoperiod and prevailing other environmental factors when crop vegetative development is completed supports its reproductive parts development and if that is met conducive for a variety, it can produce the maximum ears in the canopy density. This better coincides with an optimum sowing timings and plants growth in the area (Mega et al., 2015). Ear length remained statistically the same for June 18 to July 15 sowing dates but decreased thereafter. Crop sown late in the season from July 15 has allowed plants late to develop ears, which growth was associated with humid wet and hot climate of a lower photoperiod, limited and diffused sunshine durations, and hot humid durations by spread of moonsoon rains in the area. In addition to moisture content of air with higher temperature have changes the prevailing climate when crop was at an thesis stage of growth and/or has started reproductive development (Shah et al., 2012). Maryam et al. (2011) also observed reduction in cob length by late sowing maize in their study. Differences in cob length of varieties were obvious due to their nature OPV and hybrids and leaf area and growth potential (Buriro et al., 2015). Number of grains per ear was more in early sowing, which decreased as sowing was delayed.

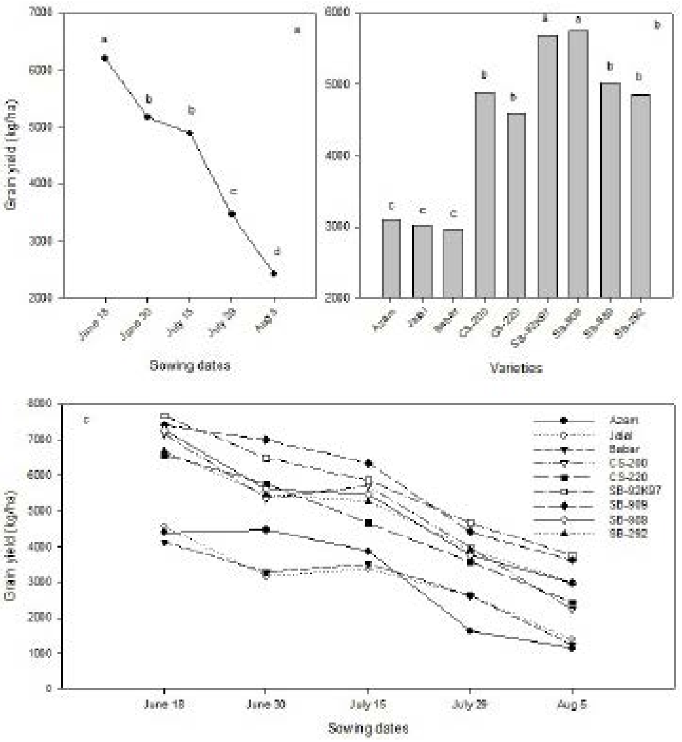

Figure 16: *Grain yield for (a) sowing dates = SD, (b) varieties = V and (c) interaction of SD x V in separate window. Same letters in a window indicate non-significant effect.LSD (P≤0.05) for SD = 865.12 and V = 668.40.*

Early sown crop availed optimum conditions for maximum duration, and completed process of fertilization and grain formation (Ali et al., 2015). Differences in varieties for grains per ear were due to difference in the ear length, rows per ear and grainsper row as well as grain size (Ali et al., 2015). Similarly, rows per ear were more in early sowing, which could be due the better plant growth and healthy reproductive parts. This result is in conflicts with those reported by Khan et al. (2002). Difference in rows per ear of varieties could be due to their OPV and hybrids status as well as the variety performance in environment (Lashkari et al., 2011). Healthy grains were produced by early sowings, which may be due to maximum days to complete grain size and weight in early sowing. Seed filling duration was also greater in early sown for assimilates storage (Giunta et al., 2009; Shah et al., 2012). Thousand grains weight also relates to genetic makeup of variety, therefore, varieties did differ in TGW. Environment effect on TGW was also significant but could be compensated with selection of suitable variety (Jing et al., 2003). Maize in the area is usually faced monsoon rains and winds, which hits plants with heavy cobs to lodge. Sowing dates did not change the density at harvest, but varieties did significantly. Difference in varieties for plants at harvest was that variety was susceptible to heavy winds faced in the area. Biomass and yield are the most important segments of production for growers use as feed and food. Biomass was significantly affected by sowing dates and varieties. Higher biomass in early sowing was natural that plant has sufficient time to develop and perform. Early sown crop had opportunity to avail maximum solar light for thermal hours required for production of biomass (Ali et al., 2015). Grain yield was higher for early sowing in season with decreasing trends for delayed sowing. It was quite obvious that longer growth period resulted in healthy plants with better traits and hence produced the maximum yield (Ali et al., 2015). Varieties did differ in grain yield due to their genetic superiority over one another. SB-92K97and SB-909 produced higher grain yield, which was due to the maximum grains with almost uniform sizes. Early sowing resulted healthy plant status, which showed higher grain per plant. Late sown resulted in a decrease in biomass but higher reduction in grains weight. This affects varieties harvest index i.e. the ability of varieties to convert dry matter in grains (Dahmardeh, 2012).

Conclusions

Maize in Peshawar region is planted after wheat and berseem. The duration is very limited and hence the maize sowing is delayed. Moreover, moon-soon outbreak also hindered maize sowing in many regions of Pakistan. The study suggested that maize sowing either OPV or Hybrids if planted late from June has decrease both biomass and grain yield. By unavoidable circumstances, sowing made in July with variety SB-909 and SB-92K97 is recommended for higher production. Sowing made in extreme late July or early August is preferably for fodder or edible ear, because the crop hardly able to reach proper maturity.

Author's Contribution

Waqas Liaqat: Conducted experiment, recorded data and drafted the paper.
Mohammad Akmal: Supervise the research
Jawad Ali: Designed the experiments and funded the experiment

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