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Effect of Different Sowing Dates on the Performance of Maize

Md. Jewel Alam[1*], Kazi Shahanara Ahmed[2], Most. Khairun Nahar[3], Sabera Akter[4] and Md. Azam Uddin[5]

Entomology Field Laboratory, Department of Entomology
Bangladesh Agricultural University (BAU), Mymensigh, Dhaka (Bangladesh)

ABSTRACT

The research experiment was conducted on maize in order to find out the effect of different sowing dates on the performance of maize at Entomology Field Laboratory, Department of Entomology, Bangladesh Agricultural University (BAU), Mymensigh during *Rabi* season of 2016-17. The experiment was laid out in randomized complete block design (RCBD) with three replications. BARI Hybrid Butta-09 variety of Maize and nine sowing dates *viz.* 3rd(S_1) & 4th(S_2) week of October; 1st(S_3), 2nd(S_4), 3rd(S_5) & 4th(S_6) week of November; 1st(S_7), 2nd(S_8) & 3rd(S_9) week of December were used as experimental crop and sowing dates, respectively.All sowing dates showed significantly different effect on yield. The results of present investigation revealed that maximum morpho-physiological characters, yield components and yield was obtained with better quality sown on 1st week of November as sowing dates than others due to ensuring the highest plant height (223.66cm), number of cob/ plant (1.73), cob length without husk (23.23cm), number of grain/ cob (641.21), grain weight/cob(235.16) and maximum grain yield (10.56 t/ha), which was followed the increasing order of yield were S_4<S_5<S_6< S_7< S_8< S_9< S_2< S_1.In case of correlation between different sowing dates and yield, the present study showed that very strongly significant negative correlation between sowing dates and grain yield of maize. Therefore, considering all facts, 1st week of November as sowing date could be recommended to the maize grower for the most effective for producing of maize. Henceforth, in addition, 2nd week of November could also be suggested for second best effective sowing date where second crop of cropping pattern is not available or not apply in the field.

Key Words: Maize, Performance, Morpho-physiological characters, Sowing dates, Yield attributes, Yield

INTRODUCTION

In Bangladesh, maize (*Zea mays* L.) is the second most important cereal crops after rice both in terms of area and production (Alam *et al,* 2020). Its production in Bangladesh is about 3.3 MT annually in 2018-2019 (BBS, 2020). Maize is often referred as 'king of grain crop' due to its highpotential of productivity. The productivity of maize is very low compared to neighboring countries but, more than about 90per cent of the home grown maize is feeding a bourgeoning poultry and fish feed and rests are used as human food (Alam *et al,* 2019a,b&c, 2018, 2014). In addition, it is a rich source of food and fodder now a day for rearing of poultry and fish. Maize is also used in many industries for manufacture of corn sugar, oil, protein, corn-flacks, soup, salad, starch, glucose, dextrose and corn syrup etc. This demand should be meet up by increasing yield of maize. For obtaining optimum production, seed must be sown on proper time so that insect pest

*Correspondent Author's Email:agjewel32251@bau.ed.bd

[1]PhD Researcher, Department of Entomology, Bangladesh Agricultural University, Mymensingh, Bangladesh

[2]Professor, Department of Entomology, Bangladesh Agricultural University, Mymensingh, Bangladesh

[3]Department of Agronomy, Bangladesh Agricultural University, Mymensingh, Bangladesh

[4]Metropolitan Agriculture Officer, Gulshan, Dhaka, Bangladesh

[5]Additional Deputy Director, Department of Agricultural Extension (DAE), Khamarbari, Farmgate, Dhaka-1215, Bangladesh

infestation may be minimumor not. Yield loss due to insect pest infestation occur if the crop sown to early or late (Sanp and Singh, 2018). It is the matter of worried that maize production is hindered by sowing dates (Alam *et al,*2019a,b, 2020).

Farmers who plant maize early are concerned about frost, poor emergence and poor growth of plant. On the other hand, farmers who late plant maize are concerned about that how late planting might affect the final grain yield and grain moisturelike mustard crop (Ahmed *et al,*2011 and Alam *et al,* 2015a,b,c). Drought occurring at flowering can lead to greater losses than when it occurs at other developmental stages (Ahmed *et al,* 2011). High temperature at very early sowing which has detrimental effects like inhibits pollination, increase respiration and transpiration rates, and in this way, limit dry matter accumulation, which can cause loss the grain yield (Ahmed *et al,* 2011). If sowing is delayed as a result the plant doesn't get the proper conditions for its growth and results in low productivity or complete failure of the germination. Maize yield is note worthy reduced by hot, dry conditions at inflorescence stage. It is the most important that this inflorescence stage be reached when there would normally be maximum chance of cloud cover and reasonable moisture (Khan *et al,* 2002). Low yield rate in the late sown crop is mainly due to unfavorable environmental effects encountered during the reproductive phase and due to the low net assimilation rate (Sharma and Saxena, 2002).

Sowing date is probably the most important reason to variation due to the great differences in weather at sowing time between seasons and within the range of climates (Alam *et al,* 2020).Therefore, to skip the yield loss and safe eco-system through proper sowing of maize in field, scientists are endeavoring to find out the suitable sowing dates for achieving higher yield, which don't have such negative impacts on the production of maize and the environments. Keeping in view above scenario, the present experiment was conducted with the objective to effect of different sowing dates on the performance of maize with respect to crop morpho-physiological characters, yield attributes and yield.

MATERIALS AND METHODS

The research experiment was conducted at Entomology Field Laboratory under Department of Entomology, Bangladesh Agricultural University (BAU), Mymensingh during *Rabi* season of 2016-17 in order to know the best sowing date of maize production so that maximum yield will be produced. The site was situated at 24.75 N latitude and 0.50 E longitudes at an average altitude of 18m above the mean sea level. The site of experiment belongs to the Sonatola series of the dark grey floodplain soil type under Old Brahmaputra Floodplain Agro-Ecological Zone (AEZ-9) (Alam *et al,* 2019b, c). The details of weather information regarding temperature, relative humidity, rainfall and sunshine hours prevailed at the experimental site during the study period is presented in Table 1. The field was a medium high land with well drained silty-loam texture having pH value 6.5 and moderate fertility level with 1.67per cent organic matter content and other nutrient components well (Table 2). The land is a well-drained silty-loam texture and the condition of climate was moderately cold and high humid with frequent wind during the vegetative stage.

Before final ploughing, all fertilizers were applied during land preparation except urea and Muriate of Potash (MOP). One-fourth of urea and MOP were applied at the time of final land preparation. The nitrogen, phosphorus, potassium, sulphur, mangnishium, zinc and boron fertilizers were applied in form of urea, triple super phosphate, MOP, gypsum, magnesium sulphate, zinc sulphate and boric acid at the rate of 250, 80, 120, 45, 8, 3 and 2.4 kg/ ha, respectively (FRG, 2012, Alam *et al,* 2019b, c, 2020). Maize *var.* BARI Hybrid Butta-09 variety was used as experimental crop. The experiment consisted of nine (09) dates of sowing (Table 3).

The seed rate of maize was 20kg/ha. Remaining urea and MOP were applied three equal installments

Table 1. Meteorological data recorded at the experimental site during the study period.

Month	During 2016-17							
	Average Temperature (^{0}C)			Relative Humidity (%)			Average Rainfall (mm)	Total sunshine (hr)
	Max.	Min.	Av.	Max.	Min.	Av.		
January	23.5	12.0	18.0	97.0	56.0	84.0	18.2	84.70
Feb	27.8	16.8	22.3	96.0	52.0	80.0	4.0	137.8
March	31.0	20.1	25.5	94.0	52.0	75.0	104.8	190.2
April	32.4	24.3	28.4	92.0	65.0	81.0	25.6	171.2
May	32.0	23.7	27.9	93.0	65.0	81.0	331.1	165.3
June	32.7	26.2	29.5	94.0	70.0	84.0	388.8	149.5
July	31.6	26.5	29.1	95.0	74.0	87.0	522.7	101.8
Aug	33.2	26.8	30.0	92.0	66.0	81.0	97.6	179.6
Sept	32.0	26.1	29.1	95.0	73.0	87.0	408.6	125.6
Oct	32.4	24.2	28.3	96.0	64.0	84.0	31.70	200.9
Nov	29.5	18.1	23.4	97.0	52.0	81.0	1.0	204.8
Dec	27.5	14.6	21.1	97.0	48.9	81.4	0.0	180.3

Source: Weather Record (2018), Department of Irrigation and Water Management, BAU, Mymensingh

at pre-vegetative stage, full vegetative stage and early corn formation stage. Weeding, irrigation and other intercultural operation were done properly as and when necessary for better growth and development of maize.

The investigated field experiment was laid out in randomized complete block design (RCBD) with BARI Hybrid Butta-09 variety, replicated thrice with nine (09) sowing dates as treatments. The crop was sown in line according to mentioned treatments wise in the experimental fields with a plot size of 10m^2 (4m×2.5m), spacing of 60×30cm between row to row and plant to plant, respectively, and the distance was 70cm between the two plots. Total number of plots was 27. To assess the impact of different sowing dates on the performance of maize, the whole grain was harvested when 95per cent of the cobs became matured. The harvested cobs were then threshed, cleaned and dried to moisture content of 12-14per cent. The grain yield was received from each replication of each treatment, were weighed and recorded, and data were converted into yield per hectare basis according to each replication of treatment. Plant height was measured using measuring tape based on centimeter scale just after harvest of cob and averaged. Cob length (cm) without husk and diameter of cob without husk were measured from five randomly selected plants in each plot (replication) from the middle portion by measuring tape stretching. They were measured in centimeters and averaged. Number of cobs and grain in the five (05) randomly selected plants and cobs was counted from each replication of treatment after harvest, respectively. After shelling the grain from cobs and were divided by the number of cobs. Then all grains received from each replication were weighed and on the basis of grain yield per plot, grain yield per hectare was calculated in kilogram by using digital weight machine. During observation, different data were collected on two main parameters such as morpho-physiological characters (Plant height, cm) and yield attributes & yield (number of cob/ plant, cob length without husk (cm), diameter of cob without husk (cm), number of grain/ cob, grain weight/cob(g) and grain yield, t /ha).

Table 2. Status of Soil at the research conducted area, Entomology Field Laboratory under Department of Entomology, BAU, Mymensingh during the Rabi season, 2016-17.

Sites	pH	OM (%)	Total N (%)	(meq/100g soil)	(ug/g soil)			
				K	P	S	Zn	B
BAU Campus	6.5	1.67	0.082	0.044	8.92	26.73	1.33	0.31

Source: Alam *et al,* 2020

Table 3. Detail of sowing dates as treatments tested on the maize yield.

Sr. No.	Treatment	Sowing time	Seasonal status
1.	S_1	3rd week, Oct	Early
2.	S_2	4th week, Oct	
3.	S_3	1st week, Nov	Timely
4.	S_4	2nd week, Nov	
5.	S_5	3rd week, Nov	
6.	S_6	4th week, Nov	Late
7.	S_7	1st week, Dec	
8.	S_8	2nd week, Dec	Very late
9.	S_9	3rd week, Dec	

All the recorded data were evaluated for analysis of variance (ANOVA) following randomized complete block design was performed by using R statistics software version 3.5.3 to find out the treatment effect, and the mean differences were adjudged by Duncan's Multiple Range (DMRT) Test (Gomez and Gomez, 1984). Relation of variables with different sowing dates and yield of maize was calculated by using Pearson's Correlation Coefficient and Multiple Regression analysis with the help of R statistics software version 3.5.3.

RESULTS AND DISCUSSION

Plant height (cm)

The results of analysis of variance showed that plant height of maize varied significantly ($P \leq 0.05$) due to the effect of different sowing dates (Table 4), where maximum (221.62cm) plant height was noted sown on 1st week of November (S_3), whereas the minimum (196.76cm) plant height was observed from the date of sowing on 3rd week of October (S_1) which confirms the finding of Buriro *et al* (2015). The early and late sowing had significant effect on plant stature where plants with decreased height were obtained by sowing of maize earlier as compared to 1st and 2nd week of November planting.

Number of cob/ plant

There were significant differences among the different dates of sowing at 1% level of probability (Table 4). The highest (1.75) no. of cob/ plant was obtained from S_3(1stweek of November), which was found at par with S_4 (1.71). They were followed by 1.44, 1.42, 1.23, 1.17, 1.11 and 1.06 in S_5, S_6, S_7, S_8, S_9 and S_2, respectively. The lowest (1.00) no. of cob/ plant was recorded in S_1. The findings were supported by Sharma and Saxena(2002) and Sanp and Singh(2018)who revealed that maize sown on mid-November had maximum number of cob per plant.

Cob length (cm)

The sowing dates significantly ($P \leq 0.05$) affected on length of cob without husk (Table 4). The length of cob without husk was recorded in the range of 13.68 to 22.72cm. Among the different sowing, the maximum (22.72cm) length of cob without husk was found sown on 1st week of November (S_3) followed by S_4 (22.00cm), S_5 (19.06cm), S_6 (17.33cm), S_7 (17.02cm), S_8 (16.29cm), S_9 (15.59cm) and S_2 (14.15cm), respectively, whereas, the minimum (13.68cm) cob length was obtained sown on 3rd week of October (S_1). The results were in line with the findings of Gurung *et al* (2017). In this study, 1st week of November had the highest cob length whereas from sown on mid-December minimum cob length was obtained.

Table 4. Morpho-physiological characters, yield attributes and yield of maize.

Treatment	Plant height (cm)	No. of cob/ plant	Cob length without husk (cm)	No. of grain/ cob	Grain wt. /cob (g)	Grain Yield (t/ ha)
S_1	196.76gh	1.00f	13.68g	364.75f	128.30h	5.60g
S_2	199.25g	1.06f	14.15fg	369.90f	133.90g	5.82f
S_3	221.62a	1.75a	22.72a	639.23a	233.18a	10.53a
S_4	218.14b	1.71a	22.00ab	603.69b	208.32b	10.21b
S_5	215.33cd	1.44ab	19.06c	528.14c	178.04c	9.92c
S_6	211.17d	1.42bc	17.33d	498.89c	170.52cd	9.83c
S_7	208.80de	1.23cd	17.02de	448.36d	158.19e	7.91d
S_8	206.22e	1.17d	16.29e	418.53e	150.49f	7.00e
S_9	203.42f	1.11e	15.59ef	398.45e	140.70g	5.97f
Level of significance	*	**	*	**	*	*
CV (%)	6.75	8.22	6.17	7.52	5.85	6.76
LSD	2.24	0.08	0.22	21.55	8.01	0.17
SE (±)	1.24	1.16	0.98	1.02	1.45	1.03

In column, means followed by different letters are significantly different, *means at 5% level of probability, **means at 1% level of probability, CV= Coefficient of variation, LSD= Least significant difference, SE (±) = Standard error, SD= Symbol of sowing dates.

Number of grain/ cob

There were significant different at 1% level of probability among the different dates of sowing. Henceforth, number of grain/ cob was significantly influenced by various sowing dates. Highest (639.23) number of grain $cob^{-1}$was obtained sown on 1st week of November (S_3), which was followed by S_4 (603.69), S_5(528.14), S_6(498.89), S_7(448.36), S_8(418.53), S_9(398.45) and S_2 (369.90), respectively whereas the smallest (364.75) number of grain/ cob was observed sown on 3rdweek of October (S_1). Similar type of result was found by Amjadian *et al* (2013).

Grain weight/ cob

The results showed that there were significant differences among the different dates of sowing at 5% level of probability (Table 4). The maximum (233.18g) grain weight/ cob was got in S_3(1stweek of November) followed by 208.32g, 178.04g, 170.52g, 158.19g, 150.49g, 140.70g and133.90g in S_4, S_5, S_6, S_7, S_8, S_9 and S_2, respectively. The minimum (128.30g) grain weight /cob was recorded in S_1. This result agree with the finding by Dahmardesh (2010) that optimum planting dates resulted in higher grain weight per cob than early and late planting dates because of higher cob numbers and greater grain number per plant.

Grain yield

A significant variation in grain yield of maize was found under various sowing dates at 5% level of probability. Maximum (10.53 t/ha) grain yield was observed sown on 1stweek of November (S_3) followed by S_4(10.21t/ ha), S_5(9.92t/ ha), S_6(9.83t/ ha), S_7(7.91t /ha), S_8(7.00t /ha), S_9(5.97 t/ ha) and S_2(5.82t/ ha), respectively. However, minimum (5.60t/ ha) grain yield was noted sown on 3rdweek of October (S_1). The results were in agreement with the finding of Gurung *et al* (2018).

Table 5. Regression equation between sowing dates and infestation & yield of aphid.

Parameter	Correlation Coefficient (r)	Regression equation Y=a + bX	Coefficient of determination (R^2)
Sowing dates v/s Grain yield	-0.983	Y_1=7.37-0.663×X_1	0.972***

**means at 1% level of probability, ***means at 0.1% level of probability, X_1=Sowing dates, Y_1= Grain yield

Correlation between different sowing dates and grain yield of maize

The correlation co-efficient (r) of sowing dates with pooled data of yield revealed similar trend *viz.* -0.983. Thus, there was a strong significant (P≤0.001) negative correlation between sowing dates and grain yield of maize during the experimental season in Bangladesh (Table 5). In case of the different dates of sowing with grain yield, the regression equation (Y_1=7.37–0.663×X_1) of sowing dates on grain yield (t/ ha) showed the relationship between the dates of sowing as X_1 and grain yield as Y_1, respectively, where the equation gave a good fit to the data and the co-efficient of determination (R^2=0.972***) fitted regression line had a significant regression co-efficient. It may be concluded that if sowing dates early, late or very late by one (01) week, the grain yield of maize decrease due to delay in sowing of maize by 0.663 t/ ha. That means sowing dates (early, late or very late) was strongly negatively correlated decrease with the grain yield of maize. The equation showed the decreasing trend of the yield as sowing was delayed or early.

CONCLUSION

It may be concluded that significant variations existed among the different sowing dates. The sowing dates adversely affected on yield components which ultimately caused a significant decline in grain yield/ ha. Among the different dates of sowing, maximum morpho-physiological characters, yield components and yield was obtained with better quality sown on 1st week of November as sowing date than others. In case of correlation between different sowing dates and yield, the present study showed a very strong significant negative correlation between sowing date and grain yield of maize. It is therefore, suggested that in order to produce maximum yield, maize may be sown best on 1st week of November as sowing date in Bangladesh, and 2nd week of November is the second best, where second crop of cropping pattern is not available or not apply in the field.

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