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SCREENING OF THE SUITABLE MAIZE HYBRIDS ON THE BASIS OF VEGETATIVE CHARACTERISTICS

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Abstract

The experiment was conducted to screen the suitable maize hybrids available in Bangladesh on the basis of their vegetative characteristics. The mean and range were calculated by using MSTATC software program. Highly significant variations among 50 maize genotypes understudied. The range of cob height was recorded from 53 to 90 cm with a mean value of 74.29 cm. The highest cob height (90 cm) was recorded in genotype BM-5, and the lowest cob height (53 cm) was observed in the genotype PAC-999. Plant height varied significantly in different maize genotypes. It ranged from 156.67 cm to 298.90 cm, with a mean value of 210.34 cm. The lowest (156.67 cm) plant height was recorded in genotype Badsha, and the highest (238.90 cm) plant height was observed in genotype NZ-510. The average number of leaves per plant was recorded at 12.82, and it ranged from 10.53 to 14.63. The maximum (14.63) number of leaves per plant was recorded in the genotype BHM-6, and the minimum (10.53) number of leaves per plant was observed in maize genotype PAC-999. The average leaf length was recorded at 87.04, and it ranged from 65.33 to 102.10. The longest (102.10) leaf length was found in genotype BM-5, and the shortest (65.33) leaf length was observed in genotype Badsha. The average leaf breadth was recorded at around 8.81, and it ranged from 5.80 cm to 10.37 cm. The broadest (10.37 cm) leaf was recorded in genotype NZ-003, and the narrowest (5.80 cm) leaf was observed in the genotype of Badsha, which was followed by Kbd-222 (7.56 cm). The lowest plant height (156.67 cm) was recorded in genotype Badsha, and the maximum number of the leaf (14.63) per plant was recorded in the genotype BHM-6; these two hybrids can be cultivated as a commercial variety.

Keywords: Maize, Genotype, Vegetative characteristics, Variation.

Introduction

Maize (*Zea mays* L.) belongs to the family Gramineae one of the most important families in the order poales. It is a multipurpose crop and one of the main cereal crops in Bangladesh. It has been accepted by the farmers of Bangladesh as an important cereal crop. It plays a significant role in human and livestock nutrition worldwide (Bantte and Prasanna, 2004). It is also a key component of poultry ration (Dhakal B. *et al.*, 2017) and fish feed. The rapid expansion of the poultry and culture fisheries industries during the 1990s significantly drove up demands for maize grain as poultry and fish feed. According to the Food and Agriculture Organization (FAO), maize is grown over 954,158 ha and with an annual production of 2,473,283 tons (FAOSTAT, 2018). Maize is ranked first among the cereals in terms of yield rate (6.59 t ha^{-1}) as compared to Boro (dry winter), rice (3.90 t ha^{-1}), and wheat (2.78 t ha^{-1}) (BBS, 2012). Now maize is one of the most profitable crops in the world. Maize production is not only profitable but also the technical and economic efficiency of the maize farmers is much higher than those of rice and wheat farmers (Rahman and Rahman, 2014). The Bangladesh Government started efforts to boost maize production in the 1980's and the results are visible (Roy, 2012). Now there are a lot of hybrid maize varieties cultivated in Bangladesh. Among the varieties maximum are hybrids, and some are open-pollinated varieties. The yield of hybrid maize is about 20-30% higher than that of open pollination composite ones, which encourages the farmers to prefer hybrid maize (Islam *et al.*, 2021). A new hybrid must be superior to the standard hybrids in grain yield and other economic traits. For high profitability and productivity

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in maize, different hybrids are grown commercially. This is because the Bangladesh Agricultural Research Institute (BARI) has developed some open-pollinated and hybrid varieties (BARI, 2008; Begum and Khatun, 2006) whose yield potentials are 5.5–7.0 t ha^{-1} and 7.4–12.0 t ha^{-1}, respectively, which are well above the world average of 3.19 t ha^{-1} (FAO and FAOSTAT, 2011). The seeds of hybrid maize are costlier than synthetics, composites, and open-pollinated varieties. Farmers have to purchase fresh hybrid seeds every year. So cultivation of hybrids required more money and inputs. On the other hand, the research support and supply of seeds and other inputs are also lacking (Karim, 1992). As a result, farmers grow traditional maize varieties of their own save seeds. But significant yield loss is evident when the seed is derived from hybrids and segregating generations of certified hybrid varieties. The yield loss is attributed to genetic breakdown and the low quality of such seeds (Zambesiet et al, 1997; Hallauer and Miranda, 1988). By using hybrid maize varieties instead of segregating generations, this yield loss can be reduced. Considering the above-mentioned aspects, this experiment is undertaken to find out the superior maize varieties on the basis of vegetative characteristics for commercial cultivation.

Materials and Methods

The experiment was laid out in a Randomized Complete Block design (RCBD) with three replications. Each plot was 3.5 m in length and 2 m in breadth containing three rows. The plant spacing provided was 75 cm between rows and 25 cm between plants of the same row. The materials and methods are discussed on different heads are as follows:

Land preparation

The experimental plot was opened with a power tiller and was exposed to the sun for a weak. After a week, the land was prepared by several ploughing and cross ploughing followed by laddering and harrowing with power tiller and country plough to bring about good tilth.

Manure and fertilizer application

Generally, cow dung, Urea, TSP, and MP fertilizers are required for maize cultivation. The field was fertilized with 10-ton cow dung per ha. The field was also fertilized with 185-276-276-185-17-12 kg N, P, K, S, Zn, and B ha^{-1} ,respectively. The entire amount of cow dung was applied seven days before sowing. TSP,MP, Gypsum, and Boron were applied during final land preparation and incorporated into the soil. The total amount of urea will be divided into two phases. Half of the urea will be applied after 40 - 45 days of seed germination, and the rest of the urea will be applied after 70 - 75 days of seed germination (before flowering) of the plants.

Experimental materials

There are 50 maize varieties used in this study. The experiment was replicated thrice. A list of the maize varieties used in the study is shown in Table 1.

Table-1. List of different hybrid varieties of maize used in the experiment

Sl.	Varieties	Sources	Sl.	Varieties	Sources
01	BHM-3	BARI	26	AS-999	ACI
02	BHM-5	BARI	27	Kaberi-369	ACI
03	BHM-6	BARI	28	NZ-001	ACI
04	BHM-7	BARI	29	NZ-003	ACI
05	BHM-9	BARI	30	NZ-510	ACI
06	Shuvra	BARI	31	25KSS	ACI
07	BM-5	BARI	32	Pioneer-3056	Petrocem Co.
08	BM-6	BARI	33	AgroG-8255	Energypac Ltd.
09	Khaibhutta	BARI	34	GP-50	Getco
10	BHM-8	BARI	35	Auto-987	Auto Crop Care Ltd.
11	NK-40	Syngenta	36	GP-901	Getco
12	Pacific-11	BRAC	37	Krishibid -550	Krisibid Group
13	PAC-399	BRAC	38	PAC-984	BRAC

14	BARI Mistri-1	BARI	39	PAC-555	BRAC
15	PAC-984	BRAC	40	Elite	
16	Dekalb S. Gold	Monsanto	41	Krishibid -102	Krisibid Group
17	Dekalb-962	Monsanto	42	GP-838	Getco
18	Khaibhutta	BRAC	43	Pioneer-07	Petrocem Co.
19	Barnali	BRAC	44	ACI-3110	ACI
20	VB-100		45	Krishibid -222	Krisibid Group
21	Pacific-98	BRAC	46	Progreen-1000	AR Malik
22	PAC-740	BRAC	47	GP-100	Getco
23	Dekalb-9120	Monsanto	48	PAC-999	BRAC
24	VA-786		49	Bioseed-707	Getco
25	Profit	ACI	50	Badsha	Getco

Bed preparation

Accordingly, 3.5 m × 2.0 m sized plots were prepared for seed sowing. Seeds of different hybrids of maize varieties were accommodated in this plot.

Seed sowing

Two seeds per hill for each set of varieties were sown at a spacing of 75 cm × 25 cm with a seed rate of 20 kg ha^{-1}.

Intercultural operations

Intercultural operations like irrigation, weeding, mulching, thinning, gap filling, earthing up, and stacking were done. The experimental plots were irrigated when necessary during the crop period. Flood irrigation was given five times at 15 days intervals starting from 15 DAE. Further irrigation was made at 15, 30, 45, 60, 75, and 90 DAS. Weeding was done in the soil whenever it was necessary to keep the soil free from weeds. Generally the 1st and 2nd weeding were applied after 30 and 60 days of sowing, respectively. The soil was mulched frequently after irrigation by breaking the crust for better aeration and conservation of soil. Mulching was done properly. The field was thinned to one plant per hill two weeks after the emergence of the plant. Necessary gap filling was made by re-sowing within eight days of sowing. Earthing up was done twice during the growing period. The first earthing up was done at 45 days after sowing (DAS) and the second earthing up was done after 65 DAS. Stacking was done during the silking stage of plants. For staking bamboo stick was placed, and a spike was tied with the stick. Each plant was supported by 100 cm long bamboo sticks to facilitate the plant to keep erect. The plant was fastened loosely with the bamboo stick by jute string to prevent the plant from lodging.

Plant protection

For plant protection, pesticide and insecticide are applied when it is necessary. Adult and larva of many insects were found in the crop during the vegetative and flowering stage of the plant. To control such insects, Malathion-57 EC @ 2ml/litre and Diazinon 60 EC @ 2 ml/litre of water were sprayed at 70 and 90 DAS, respectively. The insecticide was applied in the afternoon. Ridomil 2g per litre of water was sprayed thrice as protective measures against fungal disease.

Harvesting

The crops were harvested after maturation. Minor variation in the maturity among the hybrid maize varieties was observed.

Data collection

Data on yield and yield components were taken properly. Data were collected from the selected plants at random from each unit plot. Data were collected in respect of the following parameters.

Cob height (cm)

The heights of ten randomly selected plants were measured from each unit plot in centimeters with a graduated measuring stick. Ear height was taken from the soil surface (ground level) to the node bearing the uppermost ear node. Ear heights were measured from the same plant from which plant heights were recorded.

Plant height (cm)

Plant height refers to the length of the plant from ground level up to the last node (base of the tassel/flag leaf node) of the plant. Height of 10 randomly selected plants of each unit plot was measured at an interval of seven days, starting from 30 days after sowing (DAS) till 90 DAS, and the mean was calculated. It was measured in cm with a graduated measuring stick.

Leaves per plant

All the leaves of selected plants were counted at an interval of 7 days, starting from 30 DAS to 90 DAS. The number of leaves per plant was recorded by counting all the leaves from the selected plants of each unit plot and the mean was calculated.

Leaf length (cm)

The length of leaves of randomly selected plants was recorded at an interval of seven days, starting from 30 DAS to 90 DAS. The length of leaves from randomly selected plants was measured by a measuring scale from the leaf base (ligules) to the tip and was expressed in cm.

Leaf breadth (cm)

The width of leaves of randomly selected plants was recorded at an interval of seven days, starting from 30 DAS to 90 DAS. The width of leaves of randomly selected plants was measured by a measuring scale from one side of the middle and was expressed in cm.

Statistical analysis

Mean data of the characters were used for statistical analysis like analysis of variance (ANOVA), mean and range were calculated by using MSTATC software programme and Microsoft Excel 2007 software.

Results & Discussion

This experiment was conducted to select the suitable maize varieties yield and yield contributing characteristics of maize. Fifty maize varieties were used in this study (Table-1). Analysis of variance, and mean performance on different yield contributing characters was estimated. Analysis of variance and mean performance was presented in Appendix VI and VII. Highly significant variations among 50 maize genotypes in terms of all the yield contributing characters and yield of maize were studied (Table-2). The findings of the experiment have been presented under the following sub-headings:

Cob height (cm)

Cob height varied significantly in different maize genotypes. The range of cob height was recorded from 53.00 to 90.00 with a mean value of 74.29 (Table-2). The highest (90.00) cob height was recorded in the genotype of BM-5, which was followed by Progreen-1000 (87.50), Uttaran-2 (87.00), 25KSS (84.50), PAC-399 (84.50), BHM-7 (83.50), PAC-555 (82.50) and Kbd-550 (82.00) respectively. The lowest (53.00) cob height was observed in the genotype PAC-999 and which was followed by NK-40 (60.00), Dekalb Super Gold (61.50), and ACI-3110 (62.50), respectively.

Plant height (cm)

Plant height is a genetically as well as environmentally controlled trait and different cultivars represent different plant height. Plant height varied significantly in different maize genotypes. It ranged from 156.67 to 298.90, with a mean value of 210.34 (Table-2). The lowest (156.67) plant height was recorded in genotype Badsha, which was closely followed by AgroG-8255 (163.20). In the contrary the highest (238.90) plant height was observed in genotype NZ-510, which was followed by BM-6 (238.30), NZ-003 (237.70), Pioneer-3056 (235.50), and BHM-8 (232.20) respectively. Tahir *et al.* (2008) reported that maximum (206.00) plant height was found in Pioneer-32B33, which was followed by FSH-421 (200.00), HG-3740 (196.75), and pioneer-3062 (195.00); and the minimum (173.75) plant height was observed in Rafhan-2303. These results are also in accordance with the results of Ali (1994), who also reported differences in plant height in different hybrids.

Leaf per plant

Significant variation was observed in respect of leaf per plant among different maize genotypes under study. The average number of leaves per plant was recorded at 12.82, and it ranged from 10.53 to 14.63 (Table-2). The maximum (14.63) number of leaves per plant was recorded in the genotype BHM-6, which was followed by BHM-5 (14.10) and Dekalb Super Gold (14.00), respectively. On the other hand, the minimum (10.53) number of leaves per plant was observed in maize genotype PAC-999, which was followed by genotypes Krishibid-102 (11.10) and AgroG-8255 (11.23), respectively.

Table-2: Mean performance of vegetative characteristics of different hybrid maize varieties

Sl.	Varieties	Cob height (cm)	Plant Height (cm)	Leaf per plant	Leaf length (cm)	Leaf breadth (cm)
01	Barnali	77.00e-j	208.1a-h	13.33a-i	85.33e-m	8.73e-m
02	Shuvra	81.50b-h	223.3a-f	13.67a-g	88.13d-l	8.96b-m
03	Khaibhutta	73.00i-m	222.2a-f	13.33a-i	88.43d-l	8.80d-m
04	BARI S.Corn-1	80.50c-h	231.1a-d	13.43a-h	78.57m	9.33b-j
05	BM-5	90.00a	227.8a-e	13.70a-f	102.1a	9.10b-l
06	BM-6	72.50i-n	238.3a	13.33a-i	89.20d-j	9.63a-e
07	BHM -3	78.00f-k	213.9a-h	13.77a-e	93.53b-e	9.23b-k
08	BHM-5	74.50h-m	202.5b-i	14.10ab	80.77j-m	9.23b-k
09	BHM-6	73.00i-m	222.2a-f	14.63a	91.47b-g	8.33h-n
10	BHM-7	83.50b-e	228.8a-d	13.87a-d	92.23bf	8.40g-n
11	BHM-8	78.00d-i	232.2a-c	13.00b-j	86.10e-m	9.10b-l
12	BHM-9	76.00f-k	228.9a-d	13.67a-g	91.43b-g	9.33a-j
13	NK-40	76.00f-k	217.7a-g	12.67b-k	91.90b-g	9.47a-g
14	Pacific-11	78.00d-i	214.5a-h	12.57c-k	82.87g-m	9.83a-d
15	PAC-399	84.50a-d	211.7a-h	13.00b-j	92.47b-f	9.90a-c
16	PAC-984	70.50j-q	201.1c-i	12.77b-j	100.2ab	9.43a-g
17	Dekalb S. Gold	61.50st	202.2b-i	14.00a-c	82.73g-m	9.10b-l
18	Dekalb-962	75.50f-k	202.3b-i	13.43a-h	84.90e-m	8.40g-n
19	Uttaran-2	87.00a-c	192.8f-j	13.33a-i	85.33e-m	8.73e-m
20	VB-100	69.50k-q	198.3c-i	12.43d-l	92.43b-f	10.0ab
21	Paciffic-98	76.50f-k	208.1a-h	13.10b-j	84.33e-m	9.23b-k
22	PAC-740	65.00p-t	222.2a-f	13.10b-j	87.00d-m	9.17b-k
23	Dekalb -9120	68.00m-s	199.4c-i	13.33a-i	89.10d-k	9.16b-k
24	VA-786	77.00e-j	222.2a-f	13.90a-c	90.20c-i	9.20b-k
25	Profit	69.50k-q	228.9a-d	12.43d-l	84.00f-m	8.67e-m

26	AS-999	77.50e-j	219.4a-f	13.90a-c	93.10b-f	9.40a-h
27	Kaberi-369	74.50h-m	225.0a-f	13.23a-i	90.10c-i	9.20b-k
28	NZ-001	75.00g-l	226.1a-f	12.43d-l	98.33a-c	9.67a-e

Sl.	**Varieties**	**Cob height (cm)**	**Plant Height (cm)**	**Leaf per plant**	**Leaf length (cm)**	**Leaf breadth (cm)**
29	NZ-003	64.50q-t	237.7a	12.57c-k	92.57b-f	10.37a
30	NZ-510	73.00i-m	238.9a	11.97i-l	90.00c-j	9.36a-i
31	25KSS	84.50a-d	226.7a-f	11.77j-m	95.33a-d	9.50a-f
32	Pioneer-3056	76.50f-k	235.5ab	12.00h-l	91.43b-g	9.33a-j
33	AgroG-8255	66.00n-t	163.2jk	11.23k-m	81.07i-m	8.30i-n
34	GP-50	72.50i-n	206.2a-i	12.33e-l	79.90k-m	7.60n
35	Auto-987	72.00i-o	200.6c-i	12.67b-k	79.67lm	8.06l-n
36	GP-901	68.50l-r	182.6h-k	13.23a-i	81.10i-m	7.90mn
37	Kbd-550	82.00b-g	172.8i-k	11.67j-m	85.20e-m	8.46f-n
38	NK-6607	60.00t	209.7a-h	12.23g-l	91.30b-h	8.20k-n
39	PAC-555	82.50b-f	226.7a-f	12.43d-l	88.33de-l	7.93mn
40	Elite	77.00e-j	216.9a-g	12.23g-l	85.77e-m	7.93mn
41	Kbd-102	66.00n-t	201.6b-i	11.10lm	84.33e-m	8.07l-n
42	GP-838	76.00f-k	210.8a-h	12.00h-l	84.90e-m	8.33h-n
43	Pioneer-07	78.50d-i	207.2a-h	13.67a-g	84.87e-m	8.43f-n
44	ACI-3110	62.50r-t	193.5e-j	12.30f-l	85.13e-m	8.26j-n
45	Kbd -222	76.00f-k	197.4d-i	13.70a-f	81.43i-m	7.56n
46	ProGreen-1000	87.50ab	193.3f-j	11.30k-m	87.67d-m	8.53f-n
47	GP-100	65.50o-t	183.9g-k	12.13h-l	78.53m	8.93c-m
48	PAC-999	53.00u	180.7h-k	10.53m	82.03h-m	8.30i-n
49	Bioseed-707	76.00f-k	202.2b-i	12.80b-j	79.83k-m	8.46f-n
50	Badsha	71.50i-p	156.67k	11.90i-l	65.33n	5.80o
Min		**53.00**	**156.67**	**10.53**	**65.33**	**5.80**
Max		**90.00**	**238.90**	**14.63**	**102.10**	**10.37**
Mean		**74.29**	**210.34**	**12.82**	**87.04**	**8.81**

Leaf length (cm)

Leaf length varied significantly in different maize genotypes under the present trial. The average leaf length was recorded at 87.04, and it ranged from 65.33 to 102.10 (Table-2). The longest (102.10) leaf length was found in genotype BM-5, which was closely followed by the genotypes PAC-984 (100.20), NZ-001 (98.33), 25KSS (95.33), BHM-3 (93.53) and AS-999 (93.10) respectively. On the other hand, the shortest (65.33) leaf length was observed in genotype Badsha which was followed by the varieties GP-100 (78.53) and BARI Sweet Corn-1 (78.57), respectively.

Leaf breadth (cm)

Leaf breadth varied significantly in different maize genotypes. The average leaf breadth was recorded at around 8.81, and it ranged from 5.80 to 10.37(Table-2). The broadest (10.37) leaf was recorded in genotype NZ-003, which was followed by the genotypes VB-100 (10.00), PAC-399 (9.90), Pacific-11(9.83), and BM-6 (9.63), respectively. The narrowest (5.80) leaf was observed in the genotype of Badsha, which was followed by Kbd-222 (7.56).

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