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Organic mulches improves morphophysiological and yield attributes of white maize variety

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Key words: Growth, Development, Rice straw, Water hyacinth, Ash.

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Abstract

The objectives of the research work were to evaluate the morphophysiological behaviour and yield contributing attributes of white maize under different organic mulches. The experiment was laid out in a randomized complete block design (RCBD) with three replications at the central research field of Sher-e-Bangla Agricultural University, Dhaka-1207, from October 2019 to May 2020. This experiment used 4 types of organic mulches these are T_1 = Control (without mulch); T_2 = Water hyacinth; T_3 = Rice straw; T_4 = Rice husk; T_5 = Ash and white maize variety Shuvra. Due to this (T_3) mulch material, tasselling, silking, cob appearance was hastened by (10-12) days than T_1. The highest plant height (cm), number of leaves plant^{-1}, leaf area (cm^2), leaf area index were obtained from T_3 (Rice straw). The highest days to harvesting 148.83a were observed in T_3. The highest total dry matter after harvest (506.44gm per plant) was recorded from T_3. In case of yield attributes, highest cob length, cob diameter, cob wt. plant^{-1}, no. of cob plant^{-1}, no. of row cob^{-1}, no. of seed row^{-1}, no. of seed cob^{-1}, no. of seed plant^{-1}, seed wt. cob^{-1}, seed wt. plant^{-1} and 1000 seed wt., was recorded at (22.13cm, 5.07cm, 910.68gm, 3.03, 15.57, 37.87, 589.68, 1791, 167gm, 506.46gm and 335.5gm) from mulch treatment T_3 (Rice straw). The results showed that rice straw mulch had outstanding superiority for morphophysiological and yield attributes in white maize over the other organic mulches.

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Introduction

Maize (*Zea mays* L.) belongs to the family Poaceae is one of the most important cereal crops that contribute to the world agricultural economy both as food for humans and feed for animals. Maize ranks 1st in respect of yield per unit area, 2nd in respect to total production and 3rd after wheat and rice in respect of acreage in cereal crops. It is a high yielder in comparison to rice and wheat, occupying the first position among the cereals in terms of yield (maize 6.98 t ha^{-1}; wheat 3.085 t ha^{-1}; and rice 3.038 t ha^{-1}) (BBS, 2016). Maize has been called the "Queen of cereals" for its high yield potential. It has attracted the attention in the world due to its importance in being used as fodder and human food (Guruprasad *et al.*, 2016; Dogan *et al.*, 2015). In many countries, it has been contributing to human food security (Katinila *et al.*, 1998). Due to the global climate-change scenario, it may be forecasted that the currently cultivated varieties of different crops may not perform well under the adverse situation and from this point of view, Bangladesh's food demand might not be met from growing only rice and wheat. So, to meet this challenge, maize (*Zea mays* L.) can be chosen to supplement cereal food deficiency because of its higher yield potential as compared to rice and wheat (Mian *et al.*, 2002). Compared to other crops, the acreage of maize has expanded rapidly. A major shift in global cereal demand is underway and, by 2020, demand for maize in developing countries is expected to exceed demand for both wheat and rice (Pingali and Pandey, 2001). Over the past 40 years, the total global area under maize has increased by 40%, while production has doubled (Huang *et al.*, 2006). So, it can be inferred that maize is on the way to its increased popularity. In Bangladesh, due to the expansion of the poultry industry since 2004, the popularity of growing maize got momentum and farmers have been raising the acreage of yellow maize from 50 thousand hectares to 307 thousand hectares in 2012-13 growing season with the total production of 2.12 million M tons (BBS, 2016) being which is mostly used as poultry feed. The maize is also consumed as human food throughout the world, which is mostly from white-grained type. Although Bangladesh produces enough food grains of nearly 38.332 Million tons annually for its 160 million people (BBS, 2016), most of which comes from rice and wheat. However, such an amount cannot be guaranteed in all the years, especially in the year(s) when natural calamities such as floods, cyclones and drought happen. Moreover, after 2050 when the population has been projected to be 202 million (UN, 2015; Timsina *et al.*, 2016), posing an increased demand for foods for Bangladesh, leaving uncertainty in sustaining food security. So, under this assumption, third crop maize, being a C4 crop and having two to three-fold productivity as compared to that of rice and wheat, which has higher productivity, might be considered. The growing global population and rising consumption are exerting increasing pressure on food supply, while the continued increase in food production is facing challenges, such as water and energy shortages (Godfray *et al.* 2010; Tilman *et al.* 2011; Makowski *et al.* 2014). Maize is generally cultivated in winter in our country. During winter, rainfall is erratic and evapotranspiration is high and only 40% of the cultivable land can be brought under irrigation (Islam and Kaul, 1986). The rain is not evenly distributed throughout the year in Bangladesh. Due to scarce rainfall in the winter season, the crop yield is reduced to a considerable amount irrigation facilities are not always available. At the same time, the cost of irrigation is sometimes very high. The maize crop is a C4 plant that can tolerate different adverse conditions. Still, if irrigation facilities are not available, the yield is reduced seriously. Mulching is a very effective practice to retain soil moisture in the crop field. Mulching has been widely used in many grain-producing areas of the world (Maurya and Lal 1981; Fisher 1995; Kwabiah 2004; Ramakrishna Tam *et al.* 2006; Anisuzzaman *et al.* 2009). Organic mulches like straw, water hyacinth etc., can help to retain soil moisture as well as can improve the nutrient status of the soil by supplying organic matter and other minerals. Mulching is a desirable management practice that regulates farm environment and thereby enhances crop production through regulating soil temperature (Khan, 2001), by reducing leaching and evapotranspiration (Liu *et al.*,

2000), by increasing the soil organic matter content (Roldan *et al.,* 2003) and by reducing nutrient loss due to runoff (Smart and Bradford, 1999). Considering the above facts, this study has been undertaken to investigate the response of morphophysiological and yield attributes of white maize variety using different organic mulches.

Materials and Methods

The experiment was carried out at the Research Field of Sher-e-Bangla Agricultural University, Dhaka-1207, from October 2019 to May 2020.

Description of the experimental site

Experimental sites: The experiment was carried out at the principle Research Field of Sher-e-Bangla Agricultural University (SAU), Dhaka-1207, during *Rabi* season from (October-May) of 2019-2020.

Climate: Experimental area is under the sub-tropical zone.

Soil: Experimental site top soil are characterized by olive-grey with common fine to medium especially dark yellowish-brown mottle with silty clay in texture. Soil pH and organic carbon was sufficient for maize production.

Experimental materials

Plant material: White maize variety Shuvra which is discovered by BARI and These varieties are recommended for *Rabi* season.

Indigenous mulch materials: I. Water hyacinth II. Rice straw III. Rice husk IV. Ash

Treatments of the experiment

Organic Mulch materials are as follows.

T_1= Control (without mulch)

T_2= Water hyacinth

T_3= Rice straw

T_4= Rice husk

T_5= Ash

Design and layout of the experimental field

The experiment was set up in the field according to the experimental design (RCBD). The field was divided into 4 blocks to represent 4 replications. There were 20 unit plots altogether in the experiment. The size of each unit plot was 12 m^2 (4m × 3m). Distance maintained between replication to replication 1m and plots to plots were 0.6m. Plant to plant distance is 0.25m and row to row distance 0.75m.

Crop management

Seed collection: Healthy seeds of hybrid white maize variety were collected from BARI.

Land preparation: The plot selected for the experiment was opened in the first week of November, 2019 with a power tiller and was exposed to the sun for a week, after one week the land was harrowed, ploughed and cross- ploughed several times followed by laddering to obtain a good tilth. Weeds and stubbles were removed.

Application of manure and fertilizers: Methods and doses was followed and respectively as recommended by BARI. Cowdung was used @ 100 ton per ha before final land preparation. Urea, TSP, MOP, Gypsum, Zinc Sulphate and Boric acid was used at the rate of 600-250-250-220-12 and 10 kg per ha and also used vermi-compost and organic manure for betterment of field.

Seed treatment: For each treatment, dry clean and homogenous air-dried seeds with about 12% moisture content were used. Seeds were treated with Vitavex at the rate of 0.2% to 0.3% of seed weight.

Seed sowing: 15th November 2019 in row maintaining a row to row distance as per treatments having 2 seeds $hole^{-1}$.

Mulch materials apply: Mulch material apply on the field after seed sowing.

There were four types of mulch material these are water hyacinth, rice straw, rice husk and ash. Mulches were applied at maintaining proper thickness in each plot.

Intercultural operations

Thinning, Gap filling and Weeding: Thinning and gap-filling were done after 15 DAS of seed sowing. Weeding was done after 40 DAS of seed sowing and dry weight was taken for comparison with different mulching.

Spraying of insecticides and fungicides: In the time of seed sowing Diazinon 10G and Furadon 5G were applied in the rows. Seed is also treated with Bavistin. Diazinon 10G and Furadon 5G are also applied for the destruction of cutworm and maize stem borer. Darsban 20EC was applied for fungus destruction. Ripcord 25EC was applied for the aphid destruction.

Protection of crops from other pests: Parrots are the main pest of the maize fields. The net was used to protecting maize crops.

Harvesting

Harvesting was started when the husk cover completely dried and black coloration was found on the grain base. Harvesting was started after 140DAS from the control plot and it was over 148.83DAS in the rice straw mulch treated plot. Data were taken from 10 samples of each plot according to the requirement.

Drying

Harvested products were taken on the threshing floor. Then the seed was dried in the sun and yield per plot was recorded on 14% moisture basis and then converted to kg per ha.

Data collection

Different morphophysiological data were recorded at different Days After Sowing (DAS) from 30 to 120 DAS and yield contributing data were recorded after harvesting of cob.

Data on the following parameters were recorded during the course of the experiment, such as plant height (cm), number of leaves plant-^{1}, leaf area (cm^{2}), leaf area index, reproductive attributes, dry matter, highest cob length, cob diameter, cob wt. plant^{-1}, no. of cob plant^{-1}, no. of row cob^{-1}, no. of seed row^{-1}, no. of seed cob^{-1}, no. of seed plant^{-1}, seed wt. cob^{-1}, seed wt. plant^{-1} and 1000 seed
wt and harvest index(%).

Statistical analysis

The experiments followed an RCBD design and three replicates were run. All data measured were subjected to analysis of variance (ANOVA).

The mean differences were compared by Duncan's multiple range test (DMRT) and correlation analysis was done using Statistix 10 software. Differences with $P \leq 0.05$ were considered significant (Gomez and Gomez, 1984).

Results and discussion

Plant height (cm)

Significant variation was observed of plant height influenced for different mulch materials in the growth period over control (Table 1).

Table 1. Effect of mulch materials on plant height at different DAS of white maize.

Mulch material	Plant height(cm)							
	30DAS	40DAS	50DAS	60DAS	70DAS	80DAS	90DAS	120DAS
T_1	52.09c	101.39c	122.51d	130.52d	136.03c	148.05d	151.87d	153.98d
T_2	80.07a	136.48a	161.83ab	182.67ab	204.71a	225.75a	234.68ab	236.78ab
T_3	81.54a	136.23a	167.61a	192.82a	207.12a	235.5a	247.47a	249.55a
T_4	69.7b	119.55b	153.6b	169.14b	192.82a	207.45b	214.05bc	216.15bc
T_5	56.23c	106.54c	135.53c	146.11c	169.98b	185.46c	192.62c	194.07c
LSD(0.05)	6.805	10.88	9.81	13.99	16.52	18.15	22.2	22.1
CV%	8.39	7.57	5.54	7.13	7.59	7.58	8.93	8.81

T_1 = Control, T_2 = Water hyacinth, T_3 = Rice straw, T_4 = Rice husk, T_5 = Ash.

Application of mulch in soil and preserve the soil moisture and influence plant height. Among the mulches materials treatment T_3 (Rice straw) mulch produced the tallest plant (81.54, 136.23, 167.61, 192.82, 207.12, 235.5, 247.47 and 249.55 cm) at 30, 40, 50, 60, 70, 80, 90 and 120 DAS, respectively and

it was statistically similar with the treatment T_2 (Water hyacinth) mulch for all the different days after sowing. The shortest plant was observed for the treatment T_1 (control) and they were 52.09, 101.39, 122.51, 130.52, 136.03, 148.05, 151.87 and 153.98 cm at 30, 40, 50, 60, 70, 80, 90 and 120 DAS, respectively. It was statistically similar with the plant height of treatment T_5 (ash) at 30, and 40 DAS.

Table 2. Effect of mulch materials on No. of leaves plant^{-1} at different DAS of white maize.

Mulch material	No. of leaves plant^{-1}							
	30DAS	40DAS	50DAS	60DAS	70DAS	80DAS	90DAS	120DAS
T_1	5.27c	6.22c	9.39c	10.41c	11.66c	12.18c	12.98c	12.38b
T_2	6.73a	7.54a	11.15a	11.84a	13.07a	13.69a	15.49ab	13.35ab
T_3	6.82a	7.74a	11.19a	12.1a	12.79ab	13.5ab	15.68a	14.45a
T_4	6.18b	7.47a	10.78ab	11.14b	12.5ab	12.87bc	13.75bc	12.93b
T_5	5.6c	6.93b	10.17b	10.91bc	12.18bc	12.5c	13.1c	12.38b
LSD(0.05)	0.51	0.46	0.73	0.63	0.68	0.78	1.79	1.47
CV%	7.03	5.38	5.78	4.64	4.58	5.05	10.55	9.39

T_1 = Control, T_2 = Water hyacinth, T_3 = Rice straw, T_4 = Rice husk, T_5 = Ash.

It was practically shown that the rice straw was the best mulch for more plant height, followed by water hyacinth, rice husk, ash and control because rice straw work as an insulation system on soil and don't permit soil water evaporation eventually, soil microbial activity increased and improved the soil condition, and maize plant can uptake more available nutrients from the soil for its growth and development.

Number of leaves plant^{-1}

Huge variety was recorded because of various mulch materials as far as number of leaves per plant of maize at 30, 40, 50, 60, 70, 80, 90 and 120 DAS (Table 2). At 30, 40, 50, 60, 90 and 120 DAS, the most extreme number of leaves per plant (6.82, 7.74, 11.19, 12.1, 15.68 and 14.45) was accomplished from T_3 (rice straw), which was measurably comparable (6.73, 7.54, 11.15, 11.84, 15.49 and 13.35) with T_2 (water hyacinth). The most extreme number of leaves per plant (13.07 and 13.69) at 70 and 80 DAS was appeared by mulch treatment T_2 (water hyacinth). While the lowest number of leaves per plant (5.27, 6.22, 9.39, 10.41, 11.66, 12.18, 12.98 and 12.38) at 30, 40, 50, 60, 70, 80, 90 and 120 DAS was found from T_1 (control).

Table 3. Effect of mulch materials on leaf area (cm^2) at different DAS of white maize.

Mulch material	Leaf area (cm^2)							
	30DAS	40DAS	50DAS	60DAS	70DAS	80DAS	90DAS	120DAS
T_1	889.7c	1355.1d	2651.8c	3540c	6510.3c	7417.1c	7927.8d	7260.2c
T_2	1315.5ab	1868ab	3608.2a	5120.1a	8831.2a	9449.2a	9730.3a	9067.4a
T_3	1374.7a	1963.6a	3672.7a	5155.5a	9133a	9618.5a	9719.3a	9162.2a
T_4	1213.9b	1643.6bc	3131.7b	4726.6ab	8415.8a	9194.6a	9190.7b	8824.7a
T_5	1014c	1492cd	2990.4b	4205.3b	7455.7b	8292.1b	8635.3c	7979.4b
LSD(0.05)	159.07	272.88	279.6	561.34	781.7	625.44	525.08	550.65
CV%	11.47	13.73	7.29	10.33	8.11	5.95	4.86	5.45

T_1 = Control, T_2 = Water hyacinth, T_3 = Rice straw, T_4 = Rice husk, T_5 = Ash.

Leaf area (cm^2)

Significant variation was observed for leaf area due to the different mulches materials (Table 3). The highest leaf area was recorded at 30, 40, 50, 60, 70, 80, 90 and 120 DAS was 1374.7, 1963.6, 3672.7, 5155.5, 9133, 9618.5, 9719.3 and 9162.2 cm^2 from treatment T_3, which was statistically similar to T_2. The lowest leaf area was recorded at 30, 40, 50, 60, 70, 80, 90 and 120 DAS was 889.7, 1355.1, 2651.8, 3540, 6510.3, 7417.1, 7927.8 and 7260.2 cm^2 from treatment T_1.The lowest leaf area was observed from mulch treatment T_1 for all the days after sowing.

Table 4. Effect of mulch materials on Leaf area index at different DAS of white maize.

Mulch material	Leaf area index							
	30DAS	40DAS	50DAS	60DAS	70DAS	80DAS	90DAS	120DAS
T_1	0.52c	0.79c	1.54c	2.1c	3.78b	4.38c	4.62c	4.26c
T_2	0.76ab	1.11ab	2.16a	3.05a	5.28a	5.63a	5.82a	5.37a
T_3	0.81a	1.16a	2.19a	3.07a	5.46a	5.73a	5.78a	5.43a
T_4	0.7b	0.97bc	1.86b	2.82a	5.04a	5.47a	5.3b	5.18a
T_5	0.59c	0.85c	1.74bc	2.48b	4.25b	4.78b	4.95bc	4.78b
LSD(0.05)	0.099	0.18	0.2	0.32	0.53	0.36	0.38	0.38
CV%	12.38	15.2	9.01	9.94	9.38	5.75	5.98	6.3

T_1 = Control, T_2 = Water hyacinth, T_3 = Rice straw, T_4 = Rice husk, T_5 = Ash.

Table 5. Effect of mulch materials on reproductive attributes of white maize.

Mulch material	Reproductive attributes					
	Days to tasseling		Days to cob appearance		Days to silk appearance	
	1st	100%	1st	100%	1st	100%
T_1	64a	97a	65.33a	96a	79.67ab	108.17a
T_2	61b	81.17c	62.67b	83.67bc	78.67bc	99.67cd
T_3	57.83c	79.5c	59.67c	80.33c	76.33d	98.83d
T_4	61.83ab	87.5b	62.33b	87.67b	77.33cd	101.33c
T_5	61.83ab	96.67a	62b	92.17a	80.5a	105b
LSD (0.05)	2.48	3.21	1.51	4.1	1.69	2.25
CV (%)	3.39	3.04	2.02	3.90	1.80	1.84

T_1 = Control, T_2 = Water hyacinth, T_3 = Rice straw, T_4 = Rice husk, T_5 = Ash.

Leaf area index

The significant difference was observed for leaf area index for different mulches materials (Table 4). The highest leaf area index was recorded at 30, 40, 50, 60, 70, 80, 90 and 120 DAS was 0.81, 1.16, 2.19, 3.07, 5.46, 5.73, 5.78 and 5.43 from mulch treatment T_3, which was statistically similar to treatment T_2 . The lowest leaf area index was recorded at 30, 40, 50, 60, 70, 80, 90 and 120 DAS was 0.52, 0.79, 1.54, 2.1, 3.78, 4.38, 4.62 and 4.26 from mulch treatment T_1, which was statistically similar to treatment T_5 except 60, 80 and 120 DAS.

Table 6. Effect of mulch materials on the dry weight of different parts at the mature stage of white maize.

Mulch material	Dry weight (g/plant) of different parts at the mature stage									
	Leaf	Stem	Tassel	Cob sheath	Cob rachis	Root	Seed	Shoot	Total dry matter	Leaf Weight Ratio
T_1	40.33e	24.34d	2.69d	15.09d	14.98e	6.23d	94.5d	191.93d	198.16d	0.2a
T_2	63.05a	53.29a	5.95b	25.15b	29.43b	20.29a	266.45a	443.33a	463.62a	0.14cd
T_3	59.92b	50.09b	6.84a	30.08a	34.01a	21.76a	303.75a	484.68a	506.44a	0.12d
T_4	51.27c	33.81c	3.55c	20.06c	20.56c	15.48b	207.94b	337.2b	352.68b	0.15c
T_5	47.64d	32.05c	3.08cd	19.34c	18.23d	11.25c	141.47c	261.8c	273.05c	0.18b
LSD (0.05)	2.77	2.28	0.75	1.87	2.13	2.17	41.710	45.65	46.08	0.02
CV (%)	4.42	4.92	14.27	7.15	7.58	12.13	17.22	11.12	10.75	9.75

T_1 = Control, T_2 = Water hyacinth, T_3 = Rice straw, T_4 = Rice husk, T_5 = Ash.

Reproductive attributes

Significant variation was recorded for reproductive attributes due to different mulches materials (Table 5). The maximum days to tasselling (64 and 97 days) were recorded from T_1 treatment, whereas the minimum (57.83 and 79.5 days) was recorded T_3. The maximum days to cob appearance (65.33 and 96 days) were recorded from T_1 treatment, whereas the minimum (59.67 and 80.33 days) was recorded from T_3.

Table 7. Effect of mulch materials on total dry matter of white maize.

Mulch material	Total dry matter m^{-2} (g)	Total dry matter (ton ha^{-1})
T_1	743.1d	7.43d
T_2	1738.6a	17.39a
T_3	1899.2a	18.99a
T_4	1322.6b	13.23b
T_5	1023.9c	10.24c
LSD $_{(0.05)}$	172.79	1.73
CV (%)	10.75	10.75

T_1 = Control, T_2 = Water hyacinth, T_3 = Rice straw, T_4 = Rice husk, T_5 = Ash.

The maximum days to silk appearance (80.5 and 108.17 days) was recorded from T_5 and T_1treatment in 1st and 100% appearance, whereas the minimum (76.33 and 80.33 and 98.83 days) was recorded from T_3.

Days to harvesting

Significant variation was recorded for days to harvest due to different mulches materials (Fig. 1). The maximum days to harvest (148.83 days) was recorded from T_3 treatment, whereas the minimum (140 days) was recorded T_1, which is statistically similar to T_5. Because in the control plot lower the content of moisture, so plant becomes straw color quickly as well cob. But in rice straw, mulch treated plot plants get water from soil moisture and they get more time to develop, so harvesting time is lengthy in rice straw treated plots.

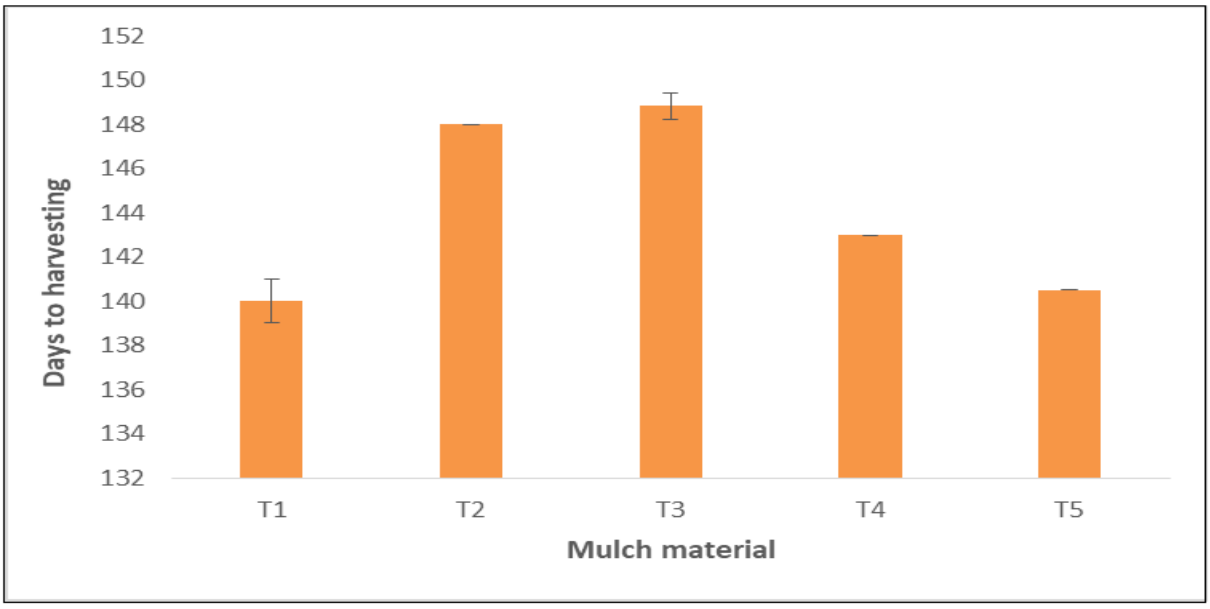

Fig. 1. Effect of mulch materials on days to the harvesting of white maize.

T_1 = Control, T_2 = Water hyacinth, T_3 = Rice straw, T_4 = Rice husk, T_5 = Ash; Mean (±SD) was calculated based on three replications of each treatment. Values of the bar are significantly different at $p \leq 0.05$ applying the LSD test.

Dry weight (gm/plant) at different parts at the mature stage

Significant variation was recorded for Dry weight (gm./plant) at different parts at the mature stage due to different mulches materials (Table 6). The highest leaf dry wt. (63.05gm) and stem dry wt.(53.29gm) was observed in the T_2 and the lowest (40.33 and 24.34gm) in T_1, respectively. Highest tassel dry wt. cob sheath dry wt., cob rachis dry wt., root dry wt., seed dry wt., shoot dry wt. and the total dry matter is (6.84, 30.08, 34.01, 21.76, 303.75, 484.68 and 506.44 gm) respectively in T_3, which is statistically similar with T_2 in case of root, seed, shoot, and total dry matter.

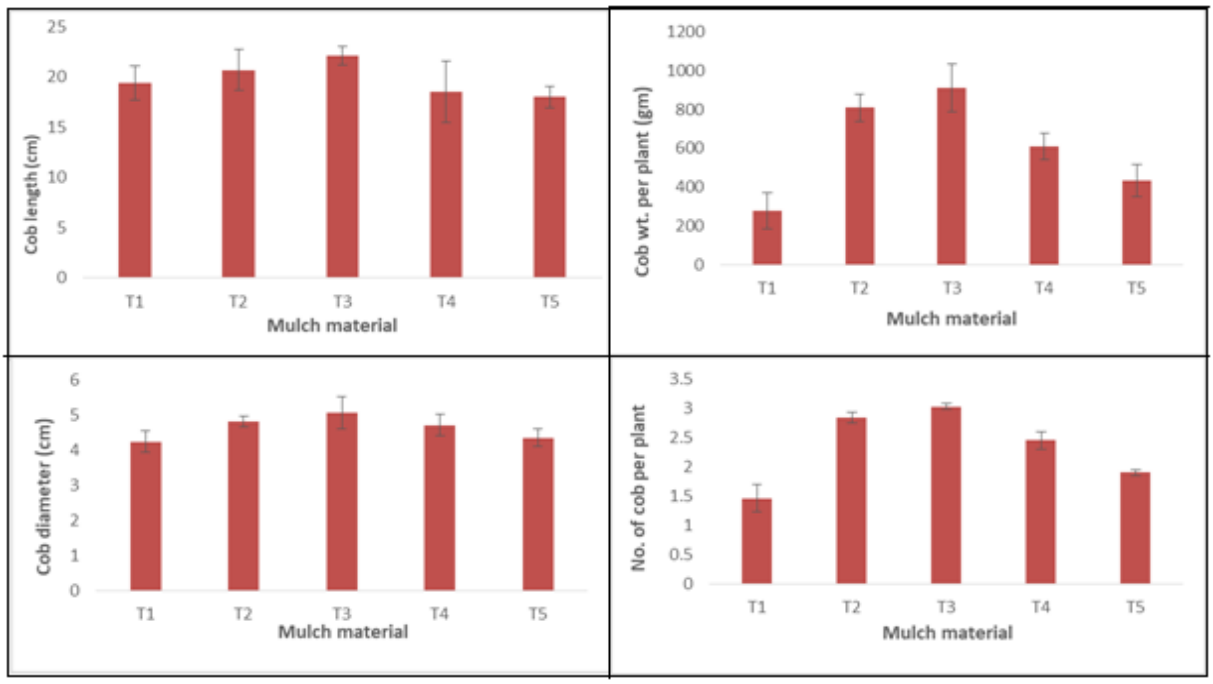

Fig. 2. Effect of mulch materials on cob length, cob wt. per plant, cob diameter and no. of cob per plant of white maize.

T_1 = Control, T_2 = Water hyacinth, T_3 = Rice straw, T_4 = Rice husk, T_5 = Ash; Mean (±SD) was calculated based on three replications of each treatment. Values of the bar are significantly different at $p \leq 0.05$ applying the LSD test.

The lowest leaf dry wt., stem dry wt., tassel dry wt. cob sheath dry wt., cob rachis dry wt., root dry wt., seed dry wt., shoot dry wt. and the total dry matter is (40.33, 24.34, 2.69, 15.09, 14.98, 6.23, 94.5, 191.93 and 198.16) respectively. In case of leaf wt. ratio highest (0.2) in T_1 and lowest (0.12) in T_3, which is statistically similar with T_2.

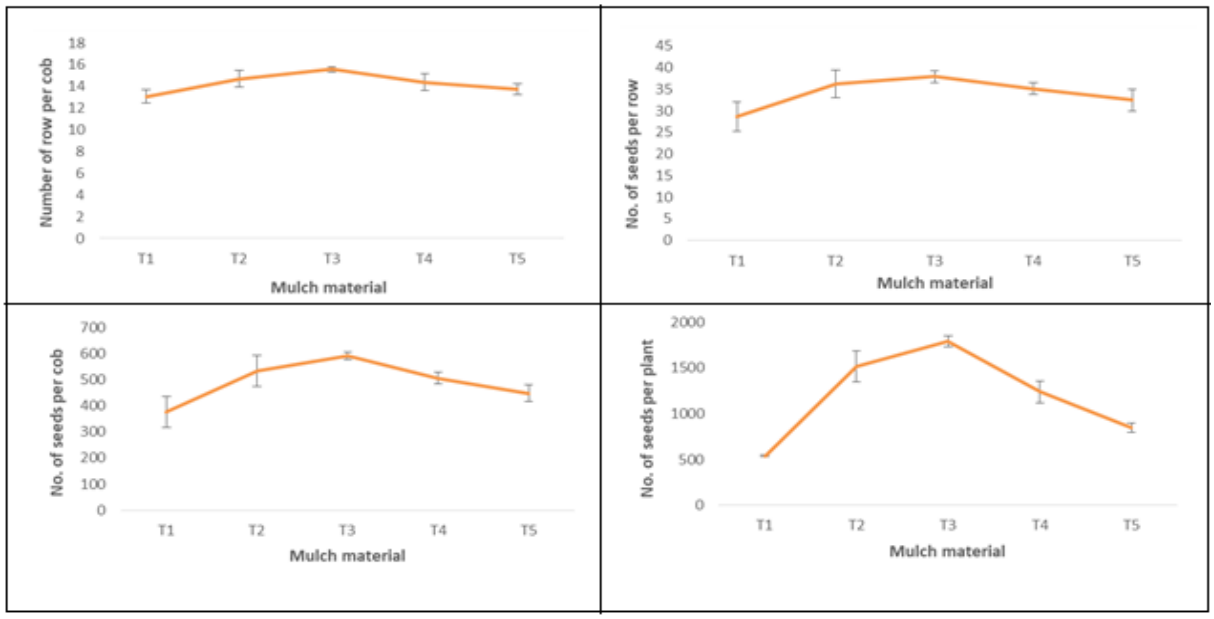

Fig. 3. Effect of mulch materials on no. of row per cob, no. of seed per row, no. of seeds per cob and no. of seeds per plant of white maize.

T_1 = Control, T_2 = Water hyacinth, T_3 = Rice straw, T_4 = Rice husk, T_5 = Ash; Mean (±SD) was calculated based on three replications of each treatment. Values of the bar are significantly different at $p \leq 0.05$ applying the LSD test.

Total dry matter in per m² (gm) and (ton/ha)

Different mulches materials showed significant variation for total dry matter/m² (Table 7).

The highest total dry matter/m² (1899.2 g) was found from T_3, which was followed by T_2 (1738.6 g), whereas the lowest total dry matter/m² (743.1 g) was recorded from T_1. Different mulches materials showed significant variation for total dry matter ton/per ha. The highest (18.99 ton/ha) was found from T_3, which was followed by T_2 (17.39 ton/ha), whereas the lowest (7.43 ton/ha) was found from T_1.

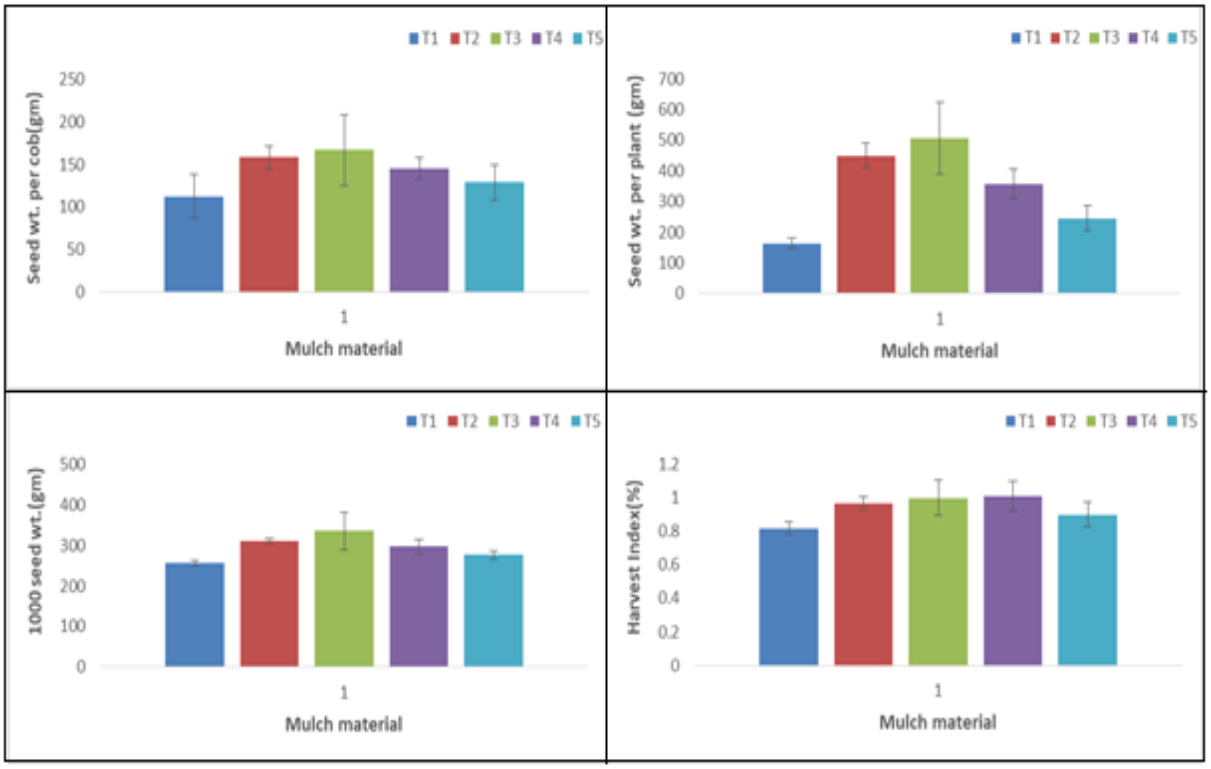

Fig. 4. Effect of mulch materials on seed wt. per cob, seed wt. per plant, 1000 seed wt. and harvest index(%) of white maize.

T_1 = Control, T_2 = Water hyacinth, T_3 = Rice straw, T_4 = Rice husk, T_5 = Ash; Mean (±SD) was calculated based on three replications of each treatment. Values of the bar are significantly different at $p \leq 0.05$ applying the LSD test.

Yield components and harvest index

Significant variation was recorded for at Yield components, yield and harvest index different parts at mature stage due to different mulches materials (Fig. 2, 3 and 4). Highest cob length, cob diameter, Cob wt. plant^{-1}, No. of cob plant^{-1}, No. of row cob^{-1}, No. of seed row^{-1}, No. of seed cob^{-1}, No. of seed plant^{-1}, Seed wt. cob^{-1}, Seed wt. plant^{-1},1000 seed wt., was recorded at (22.13cm, 5.07cm, 910.68gm, 3.03, 15.57, 37.87, 589.68, 1791, 167gm, 506.46gm, 335.5gm) from mulch treatment T_3, which was statistically similar to treatment T_2. In the case harvest index, highest (1.01) from T4, which is statistically similar with T_3 and lowest (0.82) from T_1, which is statistically similar with T_5.

Conclusion

From the above summary of the study, it can be concluded that among the different mulch materials, the rice straw mulching performed superior growth, the yield contributing characters of white maize.

Considering the situation of this experiment, further studies in the following areas may be suggested: a. such study may be conducted in different agro-ecological zones (AEZ) and seasons of Bangladesh for exploitation of regional adaptability and other performances; b. Some other maize varieties and different mulches materials may be included in the future program for more confirmation of the results.

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Competing interests

There are no competing interests in this research article.

Authors' contributions

This work was carried out by PAB. Author PAB designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript, managed the literature searches, read and approved the final manuscript

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