ISSN No:-2456-2165

# Morpho-agronomic Evaluation of Maize Genotypes in Kharif-II Season for Corresponding Rice–Wheat–Maize Cropping Pattern at Bandarban Hill Tracts of Bangladesh

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**Abstract:- Four commercial maize varieties from local companies and one from Bangladesh Wheat and Maize Research Institute, Gazipur were evaluated in April-June'2019 at Caritas Bangladesh beneficiary's field located Alikadam upazila of Bandarban district of Bangladesh. This research aimed to identify the potential maize varieties for corresponding in a Rice-Wheat-Maize cropping pattern ensuring better crop production for food security. At Alikadam, among four commercial varieties ACI - 2 observed as best considering good yield despite its Insect susceptibility at seedling stage. Different morpho-agronomic parameters of the mentioned four maize varieties at Alikadam compared. Significant difference not found among the varieties when Days to silking and Plant aspect were considered. However, significant differences were observed in three parameters, Days to harvest, Days to anthesis and Number of cobs. In Ear height, Jissan-555 stands with highest performance and observed significant differences among the other varieties.**

## I. INTRODUCTION

According to Waddington et al (2009) suitable and moderately suitable lands are available for maize production in CHT region (Plate 1). Traditionally maize is growing here but the maize cultivation system at CHT is little different compare to composite or hybrid wheat production system. At CHT maize is growing in Jhum Cultivation or small patches of land near farmer's house but for large scale production maize needs to cultivate in block or plot system. This system is new to most farmers in CHT, they needed time to learn how best to fit it into an intensive cropping patterns involving 3 different crops per year, manage it using the best production practices and handle its post-harvest processing (CIMMYT,

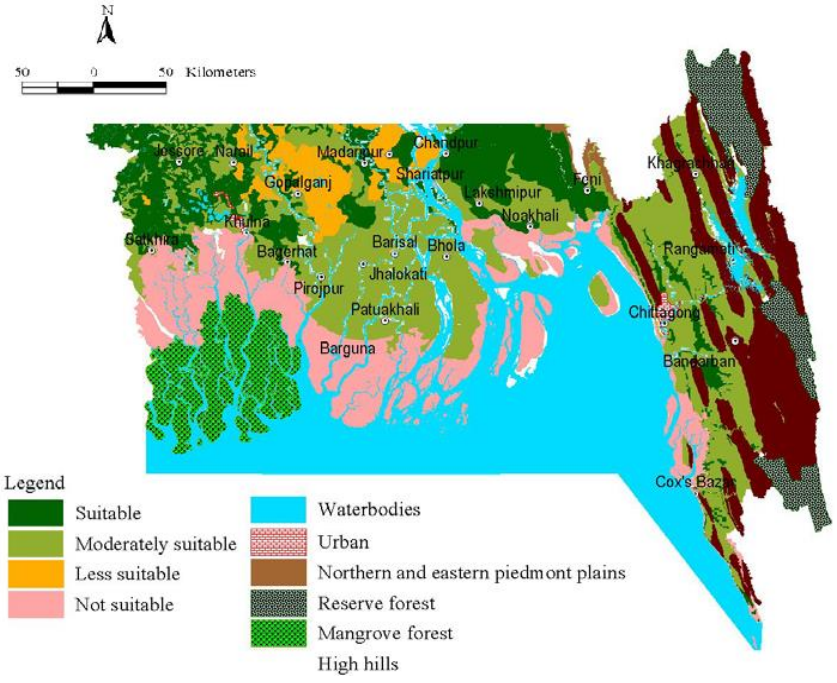


**Plate 1: Maize suitability map of Bangladesh. Most of the country is moderately or very suitable for maize cultivation, based on soil and climate**

**Source: Waddington, et al. Bangladesh Country Almanac**

ISSN No:-2456-2165

Bangladesh 2005). Planted with maize, farmers employed new production practices and attained higher yields in areas that had received whole-family maize training in comparison to farmers in areas without training (Hasan et al., 2007 and CIMMYT, Bangladesh 2006). It also expected that through proper training to the farmers at CHT as well as Alikadam region it is possible to grow HYV of maize for good return. Maize is successfully growing at Alikadam Upazilla of Bandarban district for period of more than 150 years. However, the history of HYV maize is very new. In Bangladesh, maize is growing in all seasons such as Rabi, Kharif-1 and Kharif-2. However, most of the maize varieties are grown in Kharif -1 season in Bangladesh. In Alikadam farmers are growing maize only in Rabi season and few are in Kharif-1. But our attempt was growing maize in Kharif-2 season with the intension for obtaining green or raw maize in Kharif-2, when its demand is very high. In April, 2019 four commercial maize varieties were grown at Alikadam Upazilla of Bandarban District for a comparison of green maize yield potential of these varieties. All of these varieties are well adapted in all agro-ecological zones of Bangladesh. However, it was the first time that these varieties were use in a maize varietal screening process at Bandarban Hill Districts. In the present research investigation, it will try to find out the potential maize verities for raw or green maize production.

**OBJECTIVES**

The main objectives of this experiment were:

1. To identify the potential maize varieties with good yield, these can match in Rice-Wheat-Maize cropping pattern at Lama and Alikadam.
2. To ensure maize sustainability at Bandarban hill district during non-traditional growing season.

## II. METHODOLOGY

***Plant Materials***

Four Commercial maize varieties:

1. ACI-DON 2. Jissan-555 3. Supper Sain 4. BARI Vutta 13

***Methods***

**Planting date** **:** 16 April' 2019

**Locations** **:** Alikadam Upazilla, Bandarban District, Bangladesh

**Plot size** **:** 20 m × 10 m = 200 square meter

**Row-to-Row distance** **:** 75 cm

**Plant-to-Plant distance** **:** 50 cm

**Crop management** **:** ***Fertilizer-***

| **Name of the Fertilizer** | **Amount of Fertilizer /Plot** | **Applying method** |
|---|---|---|
| UREA | 6 KG | One third (1/3rd) of Urea and Two third (2/3rd) Potash together with all other fertilizer and vermicomposting completed prior to sowing. The rest of the urea should be applied in two equal splits at the stem elongation stage (8-10 leaf stage: 20-25 DAS) and at the tasseling stage (45-50 DAS). The rest of the potash should be applied along with the second dose of N at stem elongation stage.<br>***Planting System***<br>Row to Row Distance : 75 cm<br>Planting Depth : 3 to 4 cm<br>Plant to Plant Distance : 50 cm<br>*Plant 2 seeds together and later on the weak plant will be removed after 10 days |
| TSP | 3 KG | |
| MP | 2.5 KG | |
| GYPSUM | 2.5 | |
| ZINC | 150 GM | |
| BORIC ACID | 100 GM | |
| COMPOST | 50 KG | |
| VERMIC0MPOST | AS PER CARITAS DOZE | |

**Number of Replication** **:** 4

**Design** **:** Randomized Block Design

**Recorded data** **:**

i. Days to Heading (Days)
ii. Days to Maturity (Days)
iii. Days to Grain Filling (Days)
iv. Number of Tillers (Nos)
v. Plant Height (cm)
vi. Grain per Spike (Nos)
vii. Thousand Grain Weight (gm)
viii. Yield per Plot (Kg)

## III. EXPERIMENTAL LAYOUT

**Planting Diagram**


| MAIZE EXPERIMENTAL LAYOUT | | |
|---|---|---|
| 10m X 10m<br>BARI Maize-13 (R-I) | 1 m | 10m X 10m<br>Jissan-555 (R-I) |
| 1m | | 1m |
| 10m X 10m<br>ACI Don (R-I) | | 10m X 10m<br>Supper Sain (R-I) |
| 1m | | 1m |
| 10m X 10m<br>Jissan-555 (R-II) | | 10m X 10m<br>BARI Maize-13 (R-II) |
| 1m | | 1m |
| 10m X 10m<br>Supper Sain (R-II) | 1 m | 10m X 10m<br>ACI Don ( R-II) |

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## IV. DATA COLLECTION

**1. Plant stand (PLST)**

Total number of plants/plot obtained soon after thinning.

**2. Days to anthesis (DYANTH)**

Number of days from planting to the date when 50% of the plants in a plot have tassels shedding pollen.

**3. Days to silking (DYSK)**

Number of days from planting to the date when 50% of the plants in a plot have emerged silks.

**4. Ear height (EHT)**

Average height in cm from the base of the plant to the node bearing the upper ear (or estimate the distance visually for the whole plot using a meter stick).

**5. Plant aspect (PASP)**

Take plant aspect after silking, before harvest, when plants are still green but ears are fully developed. This is a general score for the appearance of the plants in the plot, considering factors such as relative plant and ear heights, uniformity, reaction to diseases and insects, lodging, etc. PASP is rated on a scale of 1 to 5 where 1 = excellent overall phenotypic appeal and 5 = poor overall phenotypic appeal. (A 1– 9 rating scale may also be used.)

**6. DISEASE IDENTIFICATIONS**

Use a score of 1–5 or 1–9 where 1 = no rust and 5 or 9 = severe rust. Ideally, you should score about 10 plants in each plot.

Rust *polysora* or *sorghi* (RUST)
Blight *maydis* or *turcicum* (BLT or BLIGHT)
*Curvularia* (CURV) and MSV (STREAK)
Downy mildew (DM)

**7. INSECT IDENTIFICATIONS**

Based on the extent of tunneling observed on the ears at harvest: 1 = little or no damage, 5 = extensive damage. Consider both the number of damaged ears and the extent of damage on each ear.

***Termite damage (TERM)***
***Ear borer damage (EBORER)***

**8. Stalk lodging (SL or SLRAT)**

This is the number or percentage of plant stalks broken below the ear. A plant may be both root lodged (leaning from the base) and stalk lodged (broken below the ear). Data for root and stalk lodging should be taken no earlier than a week before harvest.

**9. Plants at harvest (PHARV).**

This refers to the total number of plants/plot at harvest. Include barren plants as well as plants with ears. It is important to obtain accurate counts, because the data will be used in calculating the percentage lodging and ear number/plant. The data will also be used to determine if adjustments are needed for plant stand.

**10. Ear number (EHARV).**

This is the total number of ears at harvest that bear kernels. Include the second ears as well as the top ears.

## V. RESULTS AND DISCUSSION

For green corn production all data taken was not necessary since it is harvesting before physiological maturity. When we considered Days to Silking and Plant Aspect, we did not find significant difference among the varieties (Table 1 & Figure 1) and highest anthesis time observed in Supper Sain and lowest anthesis time was observed in ACI Don.

| Variety | Days to anthesis (DYANTH) | Days to Silking (DYSK) | Ear Height (EHT) | Plant Aspect (PASP) | Days to Harvest (Days) | No of Cob | Disease | Insect |
|---|---|---|---|---|---|---|---|---|
| BARI Maize-13 | 63 b | 57 | 56 bc | 1.75 | 97 b | 132.5 d | Not found | Cater Piller |
| Jissan-555 | 65.5 a | 57.5 | 57.5 a | 2.25 | 97.5 b | 147.5 c | Not found | Cater Piller |
| Supper Sain | 63.5 ab | 58 | 55.5 c | 2.5 | 100 a | 313 b | Not found | Cater Piller |
| ACI Don | 61.5 b | 56.5 | 57 ab | 2.75 | 93.5 c | 373.5 a | Not found | Cater Piller |
| CV | 1.07 | 1.01 | 0.72 | 22.93 | 0.6 | 0.84 | | |
| LSD | 2.16 | - | 1.23 | - | 1.84 | 6.46 | | |
| Significance level (0.05) | * | ns | * | ns | ** | *** | | |

**Table 1: Evaluation of different agronomic parameters of four maize varieties planted at Alikadam, Bandarbon, Bangladesh**

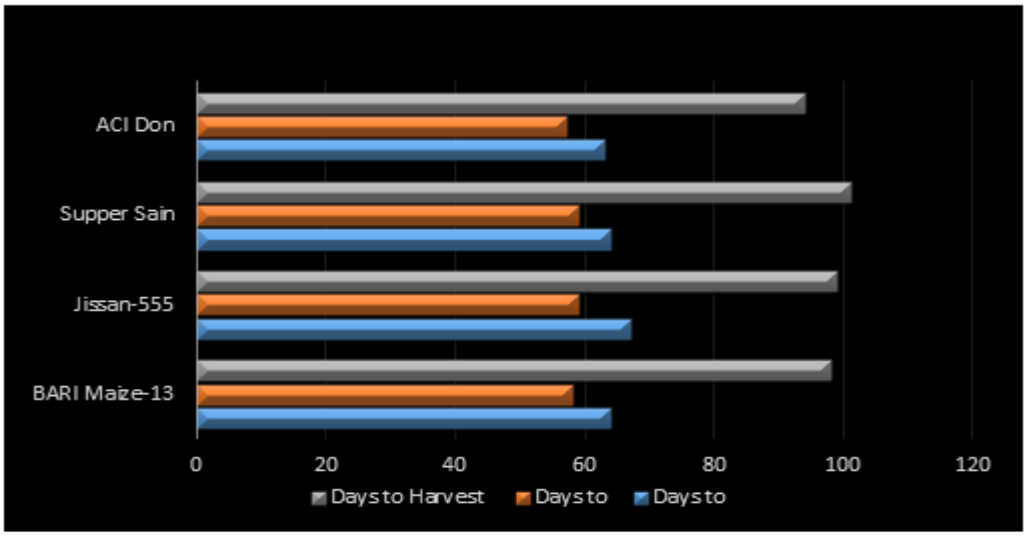


**Figure 1**: Comparison of Anthesis, Silking and Harvesting days of four maize varieties at Alikadam

However, significant difference was observed in three parameters, Days to harvest, Days to anthesis and Number of cobs. ACI Don performed highest number of cobs among the varieties and it is highly significant compare to other varieties (Table 1 & Figure 2).

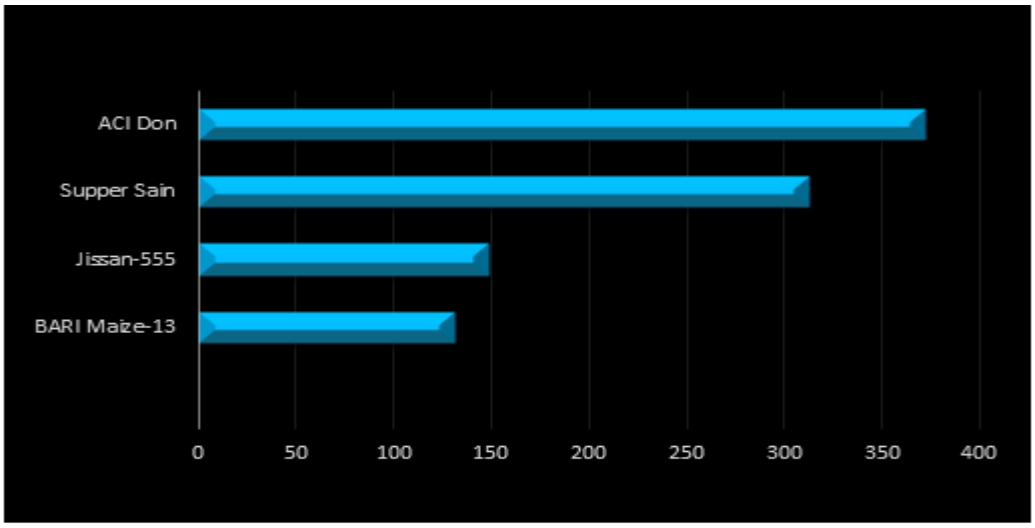


**Figure 2:** Comparison of number of cobs among four maize Varieties at Alikadam

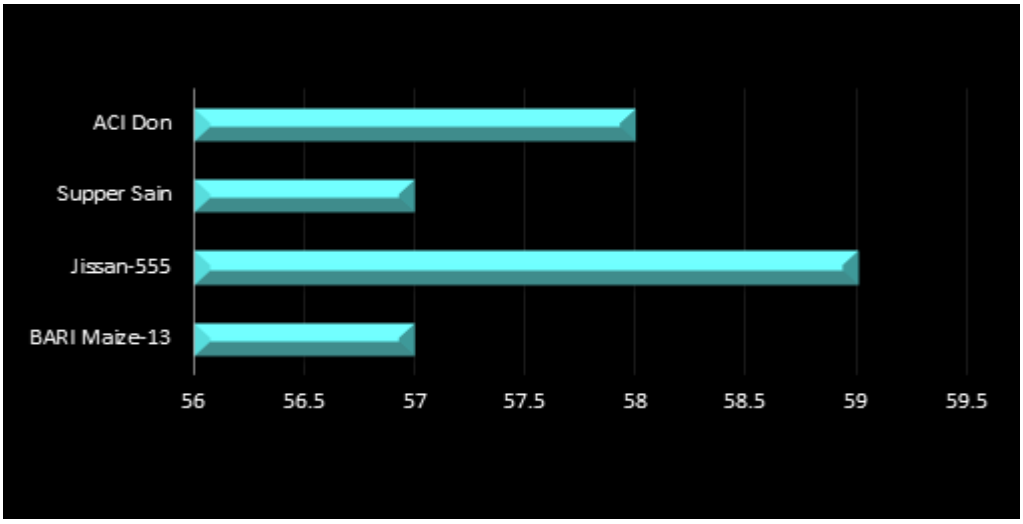


**Figure 3: Comparison of ear height (Cm) of four maize varieties at Alikadam**

ISSN No:-2456-2165

Supper Sain was also performed good and significant difference was observed with the other varieties with Supper sain when we considered number of cobs. When Ear Height was considered, Jissan-555 stands with highest performance and observed significant differences among the other varieties (Table1 & Figure 3). Insect damage observed severe from planting to harvest stage in all four varieties but surprisingly no disease was observed in all four varieties from planting to harvesting time. It is assuming that may be these varieties are resistant or the level of tolerance against the major maize diseases such as rust, blast and downy mildew is very high. In addition, it is also assumed that there were possibilities if we harvest at physiological maturity stage the disease infestation might be appeared but we harvest it at hard dough stage so the varieties escape the disease infestations. Two varieties, Supper Sain and ACI-Don performed significantly higher cob yield compare to BARI-Maize-13 and Jissan-555. Despite of that it is not suggested to grow these varieties until their physiological maturity stage, because during the Kharif-2 season the price of green corn is higher compare to any other times in the year. So, the farmers can get good price of their maize crop. However, the crop was observed not good like it was expected. This was happened due to damage by cattle's and poor crop management. In addition, composite sweet corn using this season might be used for more profit.

## VI. LIMITATIONS AND MODIFICATIONS

Major problem was to motivate the farmers for growing maize in Kharif-2. They were worried about the delay of rice planting. Insect infestation was little higher compare to rabi season. However, it is common for advance or delay cropping of any crop variety. A negative attitude was observed among few farmers and in fact the management was very poor. Despite of that an impressive scenario was observed during green cob harvest stage. Few local venders show their interest for buying these cobs with very attractive price (more than double compare to normal price). To the successful completion of the total experiment in the upcoming season a group of advance farmers are selected. In addition to overcome these limitations, a proper training will be provided before planting and harvesting maize in 2020 Kharif-2 season.

## VII. SUGGESTIONS

It was informed that using commercial maize some ethical issues are relevant with the organizational policies. However, commercial maize varieties were used with the intension for highest yield but the used varieties didn't manage to perform excellent. During kharif-2 the micro climatic conditions were not favorable for excellent yield. In addition, the seeds were expensive and the farmers have to depend on the seed companies because they cannot preserve the seeds for next season because of crucial technical issues. For instance, if they use these seeds in next season, seeds will be segregated and instead of uniform plants farmers will observe different types of plants since $F_1$ hybrid seeds were used. To solve these problems, it is recommending to use BARI-sweet corn-1 or BARI-Khoi Vutta-1 (Popcorn-1). It is also recommended for following double crop such as using leafy vegetables immediate after wheat harvesting in the rows of corn. In this case the farmers need to be very sincere and punctual for plantings these two varieties together with leafy vegetables otherwise a delay of 10-12 days may hamper upcoming wheat planting in these regions. However, a little sincerity can give them more benefit and they can use the same seeds in next season since these varieties are composite not hybrid. Yield will be little less but the market price will be good and these are more nutritious compare to field Maize.

## VIII. CONCLUSION

Among three experiments, the first was executed from 15 November' 2018 to 30 March 2019. The second experiment carried on in April' 2019. Initially using a random sampling method, a sample size of 8 farmers was selected from Alikadam upazilla of Bandarban hill district, Bangladesh. However, after completion of second season it will give emphasis on advanced farmers. Otherwise, it will really difficult to get the actual yield potentiality of the used three crops varieties. Each experimental cycle consists of 3 experiments; the first cycle is being carried out in 2018-19 cropping season. The second cycle is expected to be carried out in 2019-20 cropping season. It is expected that after completion of the two cycles, potential wheat, maize and rice varieties will be identified for the proposed rice-wheat-maize cropping pattern. All of the wheat varieties used in this study have good history of tolerance against several biotic and abiotic stresses such as heat, drought, rust, blast and different fungus. Wheat will become one of the major components for a sound agro-ecology and climate resilient crop in hill districts. In CHT, maize best adapted to cropping during the Rabi season, Small amounts are planted during the pre-monsoon Kharif-1 season and on hill slopes in eastern Bangladesh during Kharif-2 (monsoon) season. There is potential for it to be grown more widely in many parts of CHT during the Kharif-1 and during Kharif-2 on hillsides in the Chittagong Hill Tract areas. This experiment conducted at Caritas beneficiary's plot which could be considered as demonstrations plots and the surrounding farmers will be encouraged to adapt green maize cultivation. Maize cultivation by using climate resilient varieties could have great impact on the food and nutrition security, socio-economic development of the people of Alikadam Upazilla of Bandarban district.

## ACKNOWLEDGEMENT

The authors are thankful to CARITAS Bangladesh for providing facilities to execute this experiment through the financial support of Secours Catholique-Caritas France (SC-CF) and French Development Agency (AFD) together with the technical support of Regional Research Station (RRS) of Bangladesh Wheat and Maize Research Institute (BWMRI), Gazipur, Bangladesh.

## REFERENCES

[1]. CIMMYT, Bangladesh. Maize whole family training. In: Food Security in Bangladesh: Improving Wheat, Maize and Papaya Production and Impacts of Arsenic Contamination. Project Annual Report for 2006: 31-44.
[2]. CIMMYT. Bangladesh. Maize whole family training. In: Food Security in Bangladesh: Improving Wheat, Maize and Papaya Production and Impacts of Arsenic Contamination. Project Annual Report for 2005: 45-66.
[3]. Ewards, J. T., L. C. Purcell and E. D. Vories. Light interception and yield of short-season maize hybrids. I. the Midsouth. Agronomy Journal, 2005, 97: 225-234.
[4]. Hasan, M. M., S. R. Waddington, M. E. Haque, et al. Contribution of whole family training to increased production of maize in Bangladesh. Progressive Agriculture (Bangladesh), 2007, 18(1): 267-281.
[5]. Waddington, S. R., F. Khatun, N. E-Elahi, et al. Maize in Bangladesh. Presentation at the Rice-Wheat Consortium for the Indo-Gangetic Plains 14th Regional Technical Coordination Committee Meeting, February 14-15, 2007, Kathmandu, Nepal.
[6]. Waddington, S. R., N. E-Elahi and F. Khatun. The Expansion of Rice-maize Systems in Bangladesh. Invited Oral Presentation in the Symposium on Emerging Rice-Maize Systems in Asia. ASA-CSSA-SSSA 2006 International Annual Meetings, 12-16 November 2006, Indianapolis, Indiana, USA.