The characteristics of Tanimbar Island local maize in Maluku Province

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Abstract. Local sticky corn (Zea mays Ceratina) originates from Tanimbar Islands Regency and Southwest Maluku Maluku Province. This research aims to determine both the superiority and yield ability of the local sticky Corn. It was carried out in the dry climate lowland agroecosystem, in MSC (Main Seed Center) Wesawak Village (Rainy Season) and Tumbur Village (Dry Season), South Tanimbar sub-district. A Randomized Block Design with 6 treatments and five replications was applied. Sticky corn as treatments consists of three local varieties (Pulp Tanimbar, Pula Tepa, and sticky Ungu Sulteng) and three new superior varieties (Pulmon Uri-1 composite, Pulan Ketan Hybrid, and sticky sweet Hybrid). The results showed that Tanimbar local sticky Corn had developed hereditary to adapt to a specific environment. It could also grow in two seasons >90% with low rainfall (1,000-1,500 mm/year) with early maturity <90 days (86.20 days) and resistant to major borer pests (stem and cob). However, it was susceptible to downy mildew with an average yield of 3.24 tha⁻¹ (range 2.44 to 4.04 t ha⁻¹) and a potential yield of 4.04 tha⁻¹. Besides, Tanimbar sticky corn has high carbohydrate, protein, and amylose contents (63.47%, 13.05%, and 26.68%, respectively), along with low-fat content (5.08%), soft texture of young, fluffier and delicious taste.

1. Introduction
Corn (Zea mays L.) is a food commodity developed in Indonesia, especially Maluku, that still cultivates local maize types. The West Southeast Malaku Regency has now become, according to The Government Regulation No.2 of 2019, on January 23, 2019, Tanimbar Islands Regency and Southwest Maluku. The community develops local maize as a staple food, and most farmers produce local sticky Corn. One type of local maize developed in several areas on the Tanimbar Islands Regency and Southwest Maluku is waxy corn (Zea mays Ceratina). This Corn was first discovered in China in 1909. It appeared to be different from other types of Corn due to specific genes regulating corn's character. Based on previous research, sticky Corn has a starch content of almost 100% amylopectin [1]. In some areas, the sticky Corn is used as boiled Corn because it tastes good [2]. In Japan, it is used as a source of amylopectin in food products, textiles, glue, and paper industries. The sticky Corn originated from China was discovered in 1908 and spread to other parts of the world, including Indonesia and the United States, in horse tooth/dent seed [3]. Other specific advantages of sticky Corn include early age and physiological maturity at 80 days, low amylose content <10%, and fluffier texture. According to Widowati et al. [4], lower content of amylose affect on the softer, smoother, and tasty of the corn. Local varieties of sticky maize cultivated from generation to generation produced seeds with decreasing cob sizes due to inbreeding depression, with 2 to 3 t ha⁻¹ productivity. The current sticky maize cultivation still uses local
varieties because they are very adaptive to specific environments and resistant to the main pests, including stem borer and cob. In Tanimbar Islands District, the sticky corn is widely cultivated and consumed in various forms for food diversification purposes in supporting food self-sufficiency.

The marketing prospects for young maize in West Southeast Maluku are quite good. The price of young Corn sold in the form of boiled/roasted Corn ranges from IDR 2,000 to 5,000 per cob. If the production covers one hectare with a total of 66,666 plants (after deducting 20% to approximately 50,000 cobs), the farmer's income is IDR 100,000,000 per planting season. Processed sticky corn can be made in various food types such as corn wajit (local food), fried corn, boiled corn, roasted corn, and ingredient in making cakes. Generally, sticky Corn is planted by farmers based on mass selection carried out during the planting period. It is harvested young at the age of 65 to 70 days, and part of the production is left to age and be used as seeds for the next production cycle. The shelf life can be up to 9 months as the seeds are more resistant than Hybrid and composite Corn. Mostly farmers get the seeds from mass selection or buy directly from other farmers or at the market. There were no breeders who specifically handle the production and sale of sticky corn seeds. The research objective was to determine the advantages and yields of local Tanimbar sticky corn.

2. Materials and methods
The sticky Tanimbar corn research was carried out in lowland agroecosystems in dry climate dry land at MSC (Main Seed Center), Wesawak Village (Rainy Season), and in Tumbur Village (Dry Season), South Tanimbar District. The test site was located at 5 to 20 m above sea level with the Entisol soil. The climate was classified as C3 climate, according to Oldeman and the rainy season was from December to May, while the dry season was from June to November [5]. Planting time and observation test locations are presented in Figure 1.

The materials used consisted of (1) sticky corn seeds (5 varieties), fertilizers (Urea and NPK Phonska), insecticides (Carbofuran 3 G and Dursban 500 EC), and (2) and field aid materials. The study used a randomized block design with six treatments and five replications. The sticky maize varieties consisted of three local varieties (sticky Tanimbar, sticky Tepa, and sticky Ungu Central Sulawesi) and three new superior varieties (sticky Uri-1 composite, sticky Ketan Hybrid, and sticky Hybrid Manis). Data analysis used statistical methods, including the analysis of variance/ANOVA (F-test) to determine the effect of treatment and t-test (DMRT) as well as the effects of the treatments using the Gomez (1995) procedure.

The plot size was 4.5 m x 5 m (22.5 m²). Land preparation was conducted with once plowing and twice harrowing. Two seeds per hole was planted with planting space 75 cm x 40 cm. Fertilization dose
was determined by using upland soil test kit or known as PUTK and the dose was 100 kg Urea + 200 kg NPK (15:15:15) for Tumbur village site, and 200 kg Urea + 400 kg NPK Phonska (15:15:15) for MSC (Wesawak village) site. The first fertilization was applied at 7 days after planting (DAP) with ½ dose of Urea and all NPK and the second fertilization was at 30 DAP.

Stitching was done at 10 DAP. Before planting, the number of plants to be grown was calculated to determine the growth rate. Soil compaction was done at the age of 30 days after second fertilization. Stem and cob borer was controlled by applying 3 G Carbofuran insecticide as 15 kg ha\(^{-1}\) per application through shoots at 21 and 42 DAP. Meanwhile, leaf borer pest was controlled with the Durban 500 EC insecticide (2 cc per 1 l water).

Harvesting was conducted by cutting the cobs, removing the husks, drying the cobs, and shelling until seed moisture content reached 14%. The observation of the main pests (stem borer and cob) is placed outside the plot treatments. The observation plot was 3 m x 4 m. Observation of qualitative and quantitative data, including growth components and yield components, were carried out on 10 sample plants per observation plot taken randomly and harvested field for yield and its components was taken from 3 m x 2 m plot size.

2.1. Quantitative data:
1. Growth components (10 sample plants) include: Percentage of growth (10 days to 14 days) => the number of plants grown divided by the total number of plants multiplied by 100 expressed in (%). Age 50% out hair, Harvest age (young and dry), Plant height and ear height, Stem diameter, Number of leaves per plant.
2. Yield components (10 sample plants) include: The length of the ear stalk, the length, the diameter of the ear, Number of seed/ear rows, Dried shelled seed weight in plant, Weight 1000 seeds.
3. Yields in hectares: Weight of dry shelled seeds (water content 14%), Average yields in hectares (conversion and dry seed weight in sample plot = 6 m\(^2\))
4. Major pest and disease resistance, including Stem borer pest (Ostrinia furnacalis), -Cob borer pest (Helicoverpa armigera), and Downy mildew disease (Peronosclerospora philippinensis).

Observation of pests/diseases was carried out in the Tanimbar Islands Regency (TIR) on a separate plot (without control) and placed next to the observation test plot. The criteria for stem borer and cob borer attacks were assessed by a score, as presented in Table 1. Observation of downy mildew was carried out at the Bajeng KP, Maros Cereal Research Institute, as the TIR did not find downy mildew. The downy mildew was assessed through scores, as presented in Table 1.

Qualitative data included the shape and color of the stem, the shape and color of the leaves, shape and color of flower, the color of hair, husk and anther, flower position, the shape and position of the cob, the shape of the seed line on the cob, and closure of the cornhusk.
Table 1. Criteria for morphological observation of sticky Tanimbar Corn in the field.

| No. | Characteristics          | Phenotype                                      | Scale |
|-----|--------------------------|-----------------------------------------------|-------|
| 1   | Harvesting Age           | Ripening early (75-90 days)                   | 3     |
|     |                          | Medium (90 – 120 days)                        | 5     |
|     |                          | Within (> 120 days)                           | 7     |
| 2   | The cornhusk closes      | Closure The cornhusk closes tightly so that several lobes can be tied together at the end of the ear | 1     |
|     |                          | The cornhusk closes tightly only to the end of the ear | 2     |
|     |                          | The cornhusk closes slightly loosely until the end of the ear only | 3     |
|     |                          | The cornhusk closes the ear of the ear well, the end of the ear is visible | 4     |
|     |                          | The cornhusk covers the cob very severely. Some of the seeds appear to be uncovered. | 5     |
| 3   | Pest Resistance          | Very resistant (0 – 10 %)                     | 1     |
|     |                          | Hold (> 10 – 20 %)                            | 2     |
|     |                          | Slightly resistant (> 20 – 40 %)              | 3     |
|     |                          | Vulnerable (> 40 – 60 %)                      | 4     |
|     |                          | Very vulnerable (> 60 %)                      | 5     |
| 4   | Disease Resistance       | Highly resistant (0 %)                        | 1     |
|     |                          | Hold (> 0 – 15 %)                             | 2     |
|     |                          | Slightly resistant (> 15 – 30 %)              | 3     |
|     |                          | Somewhat sensitive (> 30 – 45 %)              | 4     |
|     |                          | Vulnerable > 45 – 60 %                        | 5     |
|     |                          | Very Vulnerable (> 60 %)                      | 6     |

3. Results and discussion

3.1. History of local sticky corn Tanimbar development

Tanimbar Islands Regency and Southwest Maluku Regency are districts developing maize as a staple food, besides yams (Sweet Potatoes, Kembili, Cassava, Sweet Potatoes, and Taro). A local food survey by Sirappa et al. [6] revealed approximately 50 local corn accessions with different colors and shapes of seeds in the Southwest Maluku district (Kisar Island and Leti Island). Those seeds included white corn (9 acquisitions), white sticky corn (2 accessions), yellow corn (23 accessions), purple maize (7 accessions), red maize (3 accessions), orange maize (1 accession), mixed maize (2 accessions), and popcorn (3 accessions).

Southwest Maluku Regency (SMR) still uses old corn (seeds), which is used as corn rice and staple food, while Tanimbar Islands Regency as a community uses young Corn in roasted form Corn, boiled Corn, and fried corn. Based on the results of a local food survey by Sirappa et al. [6], in Southwest Maluku, there are two accessions of sticky maize which spread to Babar Islands, Kisar Island, Leti Island (SMR), and Tanimbar Islands. Thus, Tanimbar sticky corn is thought to have originated from Southwest Maluku Regency and developed from generation to generation in all sub-districts (10 sub-districts) in Tanimbar Islands Regency.

The crops’ cultivation system in the dry climate lowland agroecosystem in the Tanimbar Islands is known as "arin." Arin (local language Jamdena Timur) is the local name for the food crop cultivation system in the Tanimbar Islands Regency, Maluku Province [7]. It has a few main advantages: planting takes place without tillage or with minimal tillage and without synthetic external inputs such as synthetic pesticides and inorganic fertilizers. The cropping pattern in arin is a mixed cropping pattern and sequential cropping. Furthermore, Jambormias [7] explains that a farmer family manages at most three arin a year, called Kebun Baru (Jamdena Timur: Let Beber), Kebun Lama 1 (Jamdena Timur: Let Lolobar), and Kebun Lama 2 (Jamdena East: Let Wangim). The new plantation (Let Beber) was planted with Corn, upland rice, yams (yams, kumbili, taro, cassava, sweet potato, nuts (peanuts, red beans/cowpeas, peanuts wood), banana, and coconut. Old garden 1 (Let Lolobar) was generally planted with sweet potatoes and kumbili (Dioscorea esculenta), while the old garden 2 (Let Wangim) was used for the maintenance of coconut and banana trees.
The existence of maize in the arin system cannot be estimated; it is maybe as old as the arin system. The maize plant in the Tanimbar Islands Regency is estimated to have originated from Southwest Maluku Regency (the division district of West Southeast Maluku district which is now being renamed the Tanimbar Islands Regency. If asked to farmers > 50 years old now, he only states that local sticky corn is inherited from his father and grandfather (4 to 5 generations). If it is estimated that their current age is between 70 to 90 years, maize could have entered the arin system (Tanimbar Islands District) in the VOC’s early days (around the 16th century). The local Tanimbar sticky maize began to receive attention from the Tanimbar Islands District Agriculture Office when the program intervened to plant the new superior varieties and hybrids. New superior varieties and hybrids are less attractive because they require high input, while local maize varieties are grown with less input.

The genetic diversity is relatively low because farmers in the Tanimbar Islands Regency only plant sticky corn from generation to generation. Selaru Sub-district is the largest sub-district in the Tanimbar Islands Regency (TIR), which develops Tanimbar sticky maize. Adaut village was selected as a seed source for the selection to purify varieties. Adaut Village was chosen because, to date, the community had maintained Tanimbar sticky maize as a source of seeds and did not receive superior corn varieties (NSV and Hybrid) from government programs.

3.2. Component of growth and component of yield

3.2.1. Components of growth. The growth components observed in the two growing seasons, rainy season (RS) and dry season (DS), included the percentage of plant growth, plant height, ear height, stem diameter, number of leaves per plant, and plant age (age 50% hair loss, young harvest age, and dry harvest age). The percentage of plants growing is an initial parameter that determines a variety's ability to succeed in a specific environment. Plant height and ear height are significant for developing new varieties because certain areas are suitable for shorter crops, especially at high altitudes with strong winds. Meanwhile, tall plants are needed in areas prone to pest attack by rats and weasels. The difference in plant height can be caused by genetic differences between varieties [8].

![Figure 2. Growth of Tanimbar Glutinous Corn at 45 DAP, female and male flowers, A (corn stalks), B (young corn), and C (corn flower).](image)

Plant diameter and height are essential parameters affecting plant vigor. Large diameter plants, although with higher plant height, will have a stout vigor without quickly falling. On the other hand, small diameter plants with a higher plant height can fast lose vigor. The number of leaves is closely related to the yield; the more leaves means more the chlorophyll in the leaves to run the photosynthesis process, increasing dry seeds yield smoothly. Nugroho [9] stated that the higher the plant, the higher the yield per plant. Tall plants can provide greater yield per plant compared to shorter plants. The statistical analysis of the components of plant growth is presented in Table 2. It shows that planting maize in the rainy season produces higher growth components (growth percentage, plant height, ear height, stem diameter, and several leaves per plant) than planting in the dry season (in which plants are longer, and
vice versa). Sticky Tanimbar maize had a significantly higher percentage of growth in the rainy and dry seasons than all control varieties, except the local Tepa, which was not significantly different. This result indicates that the sticky Tanimbar maize variety is well adapted to specific environments.

The sticky Tanimbar maize variety had a significantly higher plant height and ear height than the Uri-1 composite superior comparison, while the local variety comparison was not significantly different. Tall plants are susceptible to root fall. According to Nurtirtayani & Suaidi [10], root fall is an important characteristic that needs to be considered and yield and maturity, because maize plants with a high percentage of root cut will affect yield. In line with that, Nugroho [9] stated that the plant’s height could cause root fall. Likewise, in terms of stem diameter both in the rainy season and in the dry season, the sticky Tanimbar variety was significantly superior to all of the compared varieties, except the superior Hybrid glutinous rice and the local Tepa comparator (which was not significantly different). The sticky-hybrid maize varieties had (significant) more leaf numbers than the comparator Uri-1 composite superior variety and local varieties comparators. Still, the comparator for the superior hybrid varieties was significantly less (Table 2).

The sticky Corn planted in the rainy season was 2-3 days longer than that planted in the dry season. It produced hair significantly faster than the comparison of local varieties and hybrid varieties but did not significantly differ from the comparison of Uri-1 composite superior varieties (Table 2). Thus, the sticky Tanimbar corn and the Uri-1 varietal comparator are classified as early varieties with an average harvesting age of two growing seasons, i.e., 86.20 days and 85.80 days, respectively. Meanwhile, the comparison of superior sticky rice varieties (101.60 days), Sweet Hybrid (100.80 days), and comparison of local varieties Tepa (91.00 days) and local Purple were classified as medium-aged varieties.

3.2.2. Yield components. The yield components observed in the two growing seasons (RS and DS) included ear length and diameter, ear stem length, number of rows per ear, dry shelled seed weight per plant, and 1,000 seed weight. The results of the statistical analysis of the yield components are presented in Table 3. It shows that, as the growth component, the yield components achieved in the first planting season (RS) were higher than the yield components achieved in the second planting season (DS). According to Bagaskara & Sugiharto [11], the length of the ear affects the number of seeds per ear; the longer the ear, the more the seeds produce. However, the tip filling is also determined by the lower the value of the resulting tip filling, the better, because it means full fill of the beans to the end of the cob.

The sticky Tanimbar maize has a significantly longer ear length compared to other varieties, but considerably shorter than the comparison of Sweet Hybrid new superior varieties (NSV) both in planting season I (RS) and planting season II (DS).

Meanwhile, there was no significant difference in ear diameter between the sticky corn varieties tested, both in planting season I (RS) and planting season II (DS). Robi’in [12] found that varieties with larger cob diameter and smaller janggel diameter had high yields. Furthermore, Priyanto et al. [13] stated the ear diameter and yield potential had a real correlation. Corn with a wide diameter and high yield potential are the characters chosen. Diameter affects the number of rows on the cob; the larger the diameter, the more rows on the cob. Husk covering, determining the yield components obtained. According to Warfield & Davis in Bagaskara & Arifin [11], husk cover is useful as natural protection against pests and diseases. The morphology of husk cover influences fusarium disease. Husk cover that does not cover the cob altogether causes the yield (grain yield) to decrease significantly.

Furthermore, Table 3 shows that the local variety of Tanimbar sticky maize has a significantly longer stem length than the hybrid new superior varieties (NSV) (Glutinous Hybrid and Sweet Hybrid). However, it was not substantially different from the Uri-1 composite NSV comparison and the local Tepa SMR comparator. It was significantly shorter than the Central Sulawesi’s, whether planted in the rainy season or in the dry season. The number of rows is a vital yield component during domestication and maize repair and is controlled by qualitative traits loci [14]. The sticky Tanimbar Corn also had a significantly higher number of seed rows per ear than the Uri-1 composite NSV and the Purple Central Sulawesi comparator. Still, it was not significantly different from other varieties, both in the rainy season and the dry season.
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Table 2. Average growth components of sticky Tanimbar and comparative varieties in planting season I (RS) and planting season II (DS), Tanimbar Islands Regency.

| Planting season/ Varieties | PPG (%) | PH (cm) | EH (cm) | SD (cm) | NLP | FA 50% (age) | YHA (age) | OHA (age) |
|---------------------------|---------|---------|---------|---------|-----|--------------|-----------|-----------|
| **Rainy Season (RS)**     |         |         |         |         |     |              |           |           |
| Local varieties           |         |         |         |         |     |              |           |           |
| sticky Tanimbar           | 93.07 a | 212.34 a| 87.70 a | 1.5 a   | 2.0 a| 50.20 bc     | 4.20 bc   | 59.40 c   |
| Uri-1 (NSV)               | 88.53 b | 158.04 c| 58.74 b | 1.72 b  | 1.19 d| 51.00 c      | 63.00 c   | 87.00 d   |
| Hybrid Sticky             | 76.20 c | 167.42 a| 55.72 b | 2.24 a  | 1.39 a| 56.00 c      | 67.80 a   | 102.80 b  |
| Sweet Hybrid              | 73.67 d | 179.94 a| 80.98 a | 1.88 b  | 1.41 a| 51.80 b      | 65.80 a   | 101.20 a  |
| Tepa SMR (Lokal)          | 91.87 a | 212.34 a| 90.70 a | 1.72 b  | 1.22 a| 54.00 ab     | 65.00 b   | 91.80 a   |
| Purple Central sulawesi   | 74.93 cd| 208.42 a| 82.08 a | 1.96 ab | 1.26 b| 57.60 a      | 65.20 ab  | 93.20 a   |
| **Dry Season (DS)**       |         |         |         |         |     |              |           |           |
| Local varieties           |         |         |         |         |     |              |           |           |
| sticky Tanimbar           | 86.87 a | 197.08 a| 83.70 a | 1.95 a  | 9.40 b| 49.00 bc     | 62.20 bc  | 85.00 c   |
| Uri-1 (NSV)               | 81.33 b | 154.04 c| 54.74 b | 1.52 b  | 7.96 d| 49.40 c      | 61.00 c   | 84.60 d   |
| Hybrid Sticky             | 70.20 c | 163.42 b| 51.72 b | 2.04 a  | 9.92 b| 52.80 c      | 66.20 a   | 100.40 b  |
| Sweet Hybrid              | 67.07 c | 175.94 b| 76.98 a | 1.68 b  | 10.16 a| 50.20 b      | 63.80 a   | 100.40 ab |
| Tepa SMR (Lokal)          | 84.87 ab| 208.34 a| 86.70 a | 1.52 b  | 8.82 b| 52.00 ab     | 64.20 b   | 91.80 a   |
| Purple Central sulawesi   | 76.93 cd| 204.42 a| 78.08 a | 1.76 ab | 8.68 c| 53.60 a      | 63.20 ab  | 91.60 a   |
| **Two Seasonal Average**  |         |         |         |         |     |              |           |           |
| Local varieties           |         |         |         |         |     |              |           |           |
| sticky Tanimbar           | 89.97 a | 201.08 ab| 85.70 a | 2.05 a  | 11.40 b| 50.60 bc     | 63.20 cd  | 86.20 c   |
| Uri-1 (NSV)               | 84.93 b | 156.04 c| 56.74 b | 1.62 b  | 9.96 d| 50.20 c      | 62.00 d   | 85.80 d   |
| Hybrid Sticky             | 73.20 c | 165.42 c| 53.72 b | 2.14 a  | 11.92 a| 54.40 c      | 67.00 a   | 101.60 b  |
| Sweet Hybrid              | 70.37 c | 177.94 bc| 78.98 a | 1.78 b  | 12.16 a| 51.00 b      | 64.80 b   | 100.80 ab |
| Tepa SMR (Local)          | 88.37 a | 210.34 a| 88.70 a | 1.62 b  | 10.82 c| 53.20 ab     | 64.60 b   | 91.00 a   |
| Purple Central Sulawesi   | 71.43 c | 206.42 a| 80.08 a | 1.86 ab | 10.68 c| 55.60 a      | 64.20 bc  | 92.40 a   |
| **Correlation Coefficient (%)** | 4.21 | 8.70 | 13.99 | 19.67 | 9.95 | 4.17 | 2.41 | 7.03 |

Notes: The mean number of columns followed by the same letter means that there are no significant differences at the 5% level of the DMRT test; PPG = percentage of plants grown; PH = plant height; EH = ear height; SD = stem diameter; NLP = number of leaves/plants; FA = flowering age 50%; YHA = young harvest age; OHA = old harvest age.

Figure 3. The shape of; A) the cornhusk (*kelobot*), B) the shape of the corncob, C) the shape of the seeds, and the color of the seeds.

The sticky maize of the local Tanimbar variety planted in both the rainy and dry seasons has a significantly higher dry seed weight per plant (water content 14%) compared to the Uri-1 composite
NSV variety and the local variety Tepa, Southwest Maluku Regency (SMR). Meanwhile, it was not significantly different from other comparators. Kernels weight is a vital yield component affecting the final yield of maize. The weight of corn kernels is associated with the duration of the filling period and the rate of accumulation of the kernel biomass [11]. Likewise, the weight of 1,000 sticky Tanimbar corn kernels was significantly higher than that of the local variety comparators (Tepa SMR and Ungu, Central Sulawesi), but not substantially different from the NSV comparators (Uri-1 composite, sticky rice hybrid, and sweet Hybrid), both in the rainy season and dry season (Table 3).

3.3. Pest and disease resistance

3.3.1. Major pest resistance. In Maluku, the significant pests attacking maize crops are the stem borer (*Ostrinia furnacalis* Guenee) and the cob borer (*Heliothis armigera* Hbn). Observation of those pests in maize was carried out at the Tanimbar Islands Regency (TIR) research location on a separate plot (without pest control) and placed next to the treatment plot. Observations were made simultaneously with the treatment plots in two planting seasons, namely the rainy season (December 2017 until March 2018) and the dry season (May until August 2018). The size of the plot of stem borer and cob scorer is 2 mx 3 m. Boring pest scoring was done by counting the affected plants divided by the healthy plants, multiplying by 100%. Statistical analysis of the scoring of stalk borer and corn cobs in the two growing seasons is presented in Table 4. It shows that in the rainy season, the pest attack level was higher than that of the dry season. The sticky Tanimbar Corn is resistant to borer attacks (stems and cobs) both in the rainy season and the dry season. Meanwhile, the composite NSV comparator Uri-1 was quite resistant - vulnerable, the hybrid NSV comparator (Sticky Hybrid and Sweet Hybrids) was weak - very vulnerable, and the local varieties (Tepa SMR and Ungu Sulteng) were resistant - susceptible to stem borer and cob borer, both seasons (Table 4).

3.3.2. Main disease resistance. maize plant disease has not been found in Maluku (including the District of Tanimbar Islands). Thus, the test for downy mildew disease (*Peronosclerospora philippinensis*) was carried out at the Bajeng Research Center, Maros Cereal Research Institute (Amran Muis), with planting on June 26, 2018, and the source of Anoman's inoculum (100% attacked). Observations were made at 30 days after planting and 50 days after planting on 215 growing plants. The results of the observations are presented in Table 5. They revealed that the prospective varieties of sticky Tanimbar Corn are susceptible to downy mildew disease (*Peronosclerospura philippinensis*).

3.4. Yield analysis of varieties
The research results in two seasons at two different locations showed that the plants' growth during the test was quite good. A combined analysis was carried out involving sticky maize varieties and location/planting season (Table 2) to determine the influence of genotype and environmental interactions. Table 2 shows that all parameters (agronomic characteristics, yield, and yield components) of sticky Tanimbar maize had genuine and significant differences for single factor varieties, except the ear diameter, which was not significantly different. A single environmental factor also had a considerable effect on all parameters, except that it was not significantly different on the ear's height and the dry harvest age. Likewise, the interaction between the varieties and the environment significantly affected all parameters, except ear height, dry seed harvesting age, and ear diameter. Meanwhile, dry shell seed weight per plant had no significant effect.

3.5. Potential and yield average
In the Tanimbar Islands Regency, the planting schedule for rice (dry land) and secondary crops is MT I (December to April) and MT II (May to August). Based on the average rainfall data for the last 10 years (2007-2016), MT I was classified as the rainy season (RS), and MT II was ranked as the dry season. In general, the prospective sticky Tanimbar maize varieties' results were reasonably uniform in both planting seasons (Table 7). The sticky Tanimbar maize provided higher yield potential than composite and local comparison varieties, but lower than hybrid varieties.
Table 3. Average components of corn yield varieties of sticky Tanimbar in two planting seasons (RS and DS), Tanimbar Islands Regency.

| Planting Season/ Varieties | PT (cm) | DT (cm) | PTT (cm) | JBT | BBPKT (g) | B1000B (g) |
|----------------------------|---------|---------|----------|-----|-----------|------------|
| Rainy Season (RS)          |         |         |          |     |           |            |
| Local Varieties            |         |         |          |     |           |            |
| sticky Tanimbar            | 18.21   | 5.58 a  | 11.13 B  | 13.17 a | 124.58 a  | 263.06 a   |
| Uri-1 (NSV)                | 17.04 d | 5.45 a  | 10.64 B  | 12.10 c | 105.35 c  | 260.88 ab  |
| Hybrid Sticky              | 18.04 c | 4.78 a  | 8.75 C   | 13.83 a | 110.44 c  | 271.75 a   |
| Sweet Hybrid               | 19.29 a | 5.55 a  | 9.35 C   | 13.83 a | 123.74 ab | 262.46 a   |
| Tepa SMR (Local)           | 16.89 d | 5.13 a  | 11.01 B  | 13.17 a | 112.72 bc | 254.56 b   |
| Purple Central Sulawesi (Local) | 18.13 b | 5.60 a  | 15.37 A  | 12.83 a | 121.79 ab | 248.30 b   |
| Dry Season (DS)            |         |         |          |     |           |            |
| Local Varieties            |         |         |          |     |           |            |
| sticky Tanimbar            | 15.01 b | 3.98 a  | 8.13 B   | 12.17 a | 118.58 a  | 261.06 a   |
| Uri-1 (NSV)                | 13.84 c | 3.85 a  | 7.64 b   | 11.10 c | 99.35 c   | 258.88 ab  |
| Hybrid Sticky              | 14.84 b | 4.38 a  | 5.75 c   | 12.83 a | 104.44 c  | 269.75 a   |
| Sweet Hybrid               | 16.09 a | 3.95 a  | 6.35 c   | 13.83 a | 117.74 ab | 262.46 a   |
| Tepa SMR (Local)           | 13.29 c | 5.13 a  | 8.01 b   | 12.17 a | 106.72 bc | 254.56 b   |
| Ungu Sulteng (Local)       | 14.93 b | 5.60 a  | 12.37 a  | 11.83 b | 115.79 ab | 248.30 b   |
| Two Seasonal Average       |         |         |          |     |           |            |
| Local Varieties            |         |         |          |     |           |            |
| sticky Tanimbar            | 16.61 b | 4.78 a  | 9.63 b   | 12.67 a | 121.58 a  | 262.06 a   |
| Uri-1 (NSV)                | 15.44 d | 4.65 a  | 9.14 b   | 11.60 c | 102.35 c  | 259.88 ab  |
| Hybrid Sticky              | 16.44 c | 4.58 a  | 7.25 c   | 13.33 a | 107.44 c  | 270.75 a   |
| Sweet Hybrid               | 17.69 a | 4.75 a  | 7.85 c   | 13.33 a | 120.74 ab | 261.46 a   |
| Tepa SMR (Local)           | 15.09 d | 4.73 a  | 9.51 b   | 12.67 a | 109.72 bc | 253.56 b   |
| Purple central Sulawesi (Local) | 16.53 b | 4.60 a  | 13.87 a  | 12.33 b | 118.79 ab | 247.30 b   |

Correlation Coefficient (%): 5.49, 9.23, 12.47, 6.64, 10.01, 6.80

Notes: The mean number of columns followed by the same letter means there is no significant difference at the 5% level of the DMRT test; PT = ear length; DT = ear diameter; PTT = length of ear stalk; JBT = number of seed rows per ear; BBPKT = weight of dry shelled seeds per plant; B1000B = weight of 1000 dry seeds.

3.6. Potential and yield average for rainy season (RS)
The results of the statistical analysis of RS are presented in Table 7. It showed that the yield of local sticky Tanimbar maize was significantly higher than those of the Uri-1 composite varieties and the local varieties (Tepa and Ungu), but substantially lower than the comparison of superior Hibrida varieties (Ketan Hibrida) and Sweet Hybrids. Tanimbar local sticky maize had an average yield of 4.04 t ha⁻¹ with a higher yield percentage (100.00%) than the Uri-1 composite superior variety (72.96) and the local Tepa varieties (83.13%), and local Ungu (81.51%). However, it was lower than the superior Hybrid (sticky rice, 112.82%) and Sweet Hybrid (124.33%). In the rainy season, the average yield of the prospective sticky Tanimbar maize variety was 4.04 t ha⁻¹ (range 3.80 t - 4.27 t ha⁻¹), and the potential yield was 4.27 t ha⁻¹.
3.7. Potential and yield average on dry season (DS)
The observation activity of the sticky Tanimbar Corn was also carried out in the dry season (MT II), namely in May to August 2018 in Tumbur village, Tanimbar Selatan sub-district. The yield of sticky maize in the observation test in the dry season was lower than that in the rainy season. This result is because the average monthly rainfall was <100 mm month⁻¹ in the dry season, while the rainy season had an average of >100 mm per month. According to Muhajir (1988) [15], corn plants' minimum water requirement is around 85-100 mm per month.

**Table 4.** Resistance of local varieties of sticky Tanimbar Corn to major pests stem borer (SB) and cob borer (CB) in two planting seasons, Tanimbar Islands Regency (TIR).

| Planting Season/ Varieties | Pest and Disease Resistance |
|----------------------------|-----------------------------|
|                             | SB (%) | Criteria | CB (%) | Criteria |
| **Rainy Season (RS)**       |         |          |        |          |
| Local Varieties             |         |          |        |          |
| sticky Tanimbar             | 14.28c  | HO       | 19.68c | HO       |
| Uri-1 (NSV)                 | 31.74b  | SR       | 40.56b | R        |
| Hybrid Stiky                | 46.32a  | R        | 53.54ab| R        |
| Comparison Variety          |         |          |        |          |
| Sweet Hybrid                | 53.30a  | R        | 65.62a | VR       |
| Tepa SMR (Local)            | 21.82bc | HO       | 25.40c | SR       |
| Purple Central Sulawesi (Local) | 50.34a | R        | 57.70a | R        |
| **Dry Season (DS)**         |         |          |        |          |
| Local Varieties             |         |          |        |          |
| sticky Tanimbar             | 10.28c  | HO       | 15.68c | HO       |
| Uri (NSV)                   | 27.74b  | SR       | 36.56b | SR       |
| Hybrid Stiky                | 42.32a  | R        | 49.54ab| R        |
| Comparison Variety          |         |          |        |          |
| Sweet Hybrid                | 49.30a  | R        | 61.62a | VR       |
| Tepa SMR (Local)            | 17.82bc | HO       | 21.40c | SR       |
| Purple Central Sulawesi (Local) | 46.34a | R        | 53.70a | R        |
| **Two Planting Seasons Average** |       |          |        |          |
| Local Varieties             |         |          |        |          |
| sticky Tanimbar             | 12.28c  | HO       | 17.68c | HO       |
| Uri (NSV)                   | 29.74b  | SR       | 38.56b | SR       |
| Hybrid Stiky                | 44.32a  | R        | 51.54ab| R        |
| Comparison Variety          |         |          |        |          |
| Sweet Hybrid                | 51.30a  | R        | 63.62a | VR       |
| Tepa SMR (Local)            | 19.82bc | HO       | 23.40c | SR       |
| Purple Central Sulawesi (Local) | 48.34a | R        | 55.70a | R        |
| **Correlation Coefficient (%)** | 26.73  | 24.91    |          |          |

Notes: The average number of a column followed by the same letter means no significant difference at the 5% level of the DMRT test. HO = Hold On, SR = slightly resistant, R = resistant, VR = very resistant.

**Table 5.** The resistance of Local Varieties of Sticky Tanimbar Corn to Downy mildew (*Peronosclerospora philippinensis*), Maros.

| Observation (DAP) | Number of Plants Growing | Number of Plants Affected by Bulai Disease | Attack Percentage (%) | Criteria |
|-------------------|--------------------------|-------------------------------------------|-----------------------|----------|
| 30                | 215                      | 121                                       | 56.3                  | Vulnerable |
| 50                | 215                      | 133                                       | 61.9                  | Very Vulnerable |

Note: Scoring for downy mildew was conducted at KP Bajeng, Cereal Crops Research Institute, Maros.
Table 6. Analysis of several agronomic characteristics of local varieties of Tanimbar Sticky Corn at two locations and two planting seasons.

| Source of plant parameters | Source of Diversity | Correlation Coefficient (%) |
|----------------------------|---------------------|-----------------------------|
|                            | Block Varieties (V) | Environment / Growing Season (E) | V X E |
| I. Growth Components       |                     |                             |       |
| 1. Percentage of growing plants (%) | nr ** ** ** | | 3.64 |
| 2. Plant Height (cm)       | ** **            | nr nr                       | 13.99 |
| 3. Cob Height (cm)         | ** **            | nr nr                       |       |
| 4. Age 50% Hair Out (days) | ** **            | nr nr                       | 4.17  |
| 5. Young Harvest (days)    | * **             | nr nr                       | 2.41  |
| 6. Dry Harvest Period (days) | ** **       | nr nr                       | 7.03  |
| 7. Stem Diameter (mm)      | nr *             | * *                         | 19.67 |
| 8. Number of leaves/plant  | ** **            | ** **                       | 9.49  |
| II. Yield Components       |                     |                             |       |
| 1. Length of panicle (cm)  | nr ** ** **      | **                         | 19.29 |
| 2. Ear length (cm)         | ** ** **         | **                         | 8.91  |
| 3. Panicle stem length (cm) | nr ** ** **   | **                         | 6.43  |
| 4. Cob Diameter (cm)       | nr Nr            | ** nr                       | 7.70  |
| 5. Earpiece length (cm)    | nr ** ** **      | **                         | 5.47  |
| 6. Number of Seed Lines/Cob| nr ** **         | **                         | 6.64  |
| 7. Weight of 1000 seeds (g)| nr ** **       | **                         | 6.80  |
| 8. The yield of dry shelled seeds (tha⁻¹) | nr ** ** | **                         | 10.52 |

Notes: nr = not significant, * = significant, ** = highly significant.

Table 7. The potential and average yield of Tanimbar Sticky Corn in the rainy and dry seasons and two planting seasons.

| Varieties                  | Rainy Season (RS) | Dry Season (DS) | Two Planting Seasons |
|----------------------------|-------------------|-----------------|----------------------|
|                            | Average | Percentage of | Average | Percentage of | Average | Percentage of |
|                            | comparator       | comparator      | comparator           | comparator           | comparator       |
| Stiky Tanimbar             | 4.04c    | 100.00        | 2.44c   | 100.00        | 3.24c   | 100.00        |
| Uri-1 (NSV)                | 2.95b    | 72.96         | 1.35b   | 55.25         | 2.15e   | 66.36         |
| Hybrid Stiky               | 4.56b    | 112.82        | 2.96b   | 121.21        | 3.76b   | 116.05        |
| Sweet Hybrid               | 5.03a    | 124.33        | 3.43a   | 140.28        | 4.23a   | 130.56        |
| Tepa SMR (Local)           | 3.36cd   | 83.13         | 1.76d   | 72.07         | 2.56d   | 79.01         |
| Purple Central Sulawesi (Local) | 3.29d   | 81.51         | 1.69cd  | 69.39         | 2.49d   | 76.85         |

Note: The average number for a column followed by the same letter means there is no significant difference at the 5% level of the DMRT test.

The results of the statistical analysis on DS are presented in Table 7. They showed that the prospective varieties of sticky Tanimbar were significantly higher than the Uri-1 composite variety and
the local varieties (Tepa and Ungu), but were considerably lower than the superior Hybrid variety (Ketan Hybrid) and Sweet Hybrids. Candidates for the sticky Tanimbar corn variety had an average yield of 2.44 t ha\(^{-1}\) with a higher percentage of yield (100.00%) than the Uri-1 composite variety with 1.35 t ha\(^{-1}\) (55.25%) and the local varieties Tepa 1.76 t ha\(^{-1}\) (72.07 %) and Ungu (1.69 t ha\(^{-1}\), 69.39%); but lower than the superior hybrid varieties, namely Hybrid Glutinous Rice 2.96 t ha\(^{-1}\) (82.50%) and Sweet Hybrid 3.43 t ha\(^{-1}\) (140.28%). In the dry season, the average yield of the prospective sticky Tanimbar maize variety was 2.44 t ha\(^{-1}\) (range 2.20 to 2.67 t ha\(^{-1}\)), and the potential yield was 2.67 t ha\(^{-1}\). Halluer et al. [16] said that the characters such as height, resistance, and those related to production are important, including ear height, ear diameter, ear weight, number of rows, the weight of 100 seeds, resistance to downy mildew, yield, harvest weight of cobs and possible results.

3.8. Potential and yield average of two planting seasons
Statistical analysis of the two growing seasons, presented in Table 7, showed significant differences between the varieties tested. Possible varieties of sticky Tanimbar maize were significantly higher than the Uri-1 composite superior variety and local varieties (Tepa and Ungu). Simultaneously, it was considerably lower than the hybrid superior (glutinous rice hybrid and sweet Hybrid). Candidates for the sticky Tanimbar corn variety had an average yield in two growing seasons of 3.24 t ha\(^{-1}\) with a higher yield percentage (100.00%) compared to the superior Uri-1 variety 2.15 t ha\(^{-1}\) (66.36%) and the local varieties, i.e., Tepa 2.56 t ha\(^{-1}\) (79.01 %) and Purple 2.49 t ha\(^{-1}\) (76.85%); but lower than the Hybrid superior, namely Hybrid sticky rice with 3.76 t ha\(^{-1}\) (116.05%) and Sweet Hybrid 4.23 (130.56%). The yield average for the sticky Tanimbar variety in the two growing seasons was 3.24 t ha\(^{-1}\) (range 2.44 - 4.04 t ha\(^{-1}\)), and the potential yield was 4.04 t ha\(^{-1}\).

3.9. Nutritional content
The prospective sticky Tanimbar corn varieties' nutritional content included fat, protein, carbohydrates, and amylose. Fat, carbohydrate and protein content were analyzed at the Ambon Industrial Research and Standardization Institute Laboratory. Meanwhile, amylose levels were determined at the Chemical and Biochemical Laboratory of the Department of Agricultural Product Technology, Faculty of Agriculture, Ambon University. The results of the analysis are presented in Table 9. It revealed that the prospective varieties of sticky Tanimbar Corn had fat (5.08%), protein (13.05%), carbohydrates (63.47%), and amylose (26.68%).

3.10. Benefits of sticky Tanimbar corn
In Tanimbar Islands District, the community developed local maize as a staple food, and most of the farmers developed local sticky corn. The development of sticky maize in TIR has improved from generation to generation and spread throughout the districts, namely in Tanimbar Selatan, Wertamrian, Wermaktian, Selaru, North Tanimbar, Yaru, Wuarlabor, Nirunmas, Kormomolin, and Molu Maru sub-districts. Local sticky Corn is consumed in various processed forms such as corn wajit, fried corn, boiled corn, roasted corn, and as an ingredient in cakes. In addition to being popular within the community, Tanimbar sticky corn has short cycles (<90 days) along with high carbohydrate (63.47%), protein (13.05%), fat (5.08%), and amylose (26.68%). It also has a soft texture, fluffier, and delicious taste. The other advantages are the relatively high economic value as boiled corn (3-5 cobs = IDR 10,000), adaptive to a specific environment, namely the average growth power in two locations and two growing seasons> 90%.
### Table 8. Morphology of Tanimbar Sticky Corn Varieties of Tanimbar Islands Regency.

| No. | Morphology                        | Phenotype                        |
|-----|-----------------------------------|----------------------------------|
| 1   | Rod shape                         | Round                            |
| 2   | Bark texture                      | Medium                           |
| 3   | Compensation Hold                | Resistance                       |
| 4   | Leaf shape                        | Long drooping leaf tips          |
| 5   | Leaf position                     | Not upright (>
30°– 60°)                  |
| 6   | Leaf surface                      | Downy                            |
| 7   | Upper leaf color                  | Medium green                      |
| 8   | Lower leaf color                  | Pale green                        |
| 9   | Position of male flower/panicle   | at the end of the stem           |
| 10  | Panicle shape                     | Medium                           |
| 11  | Types of panicle branching        | Open                             |
| 12  | Chaff Color                       | Green with weak anthocyanin      |
| 13  | Yellow anther                     | with purple mix                  |
| 14  | Hair Color with a purple blend    | Green                            |
| 15  | Position of the ear on stem       | Mid stem (< 50 %)                |
| 16  | Medium cob shape, round           | Medium and round                 |
| 17  | A row of seeds per ear            | Straight and tight               |
| 18  | Closure the corncob               | closes tightly                   |
| 19  | Seed shape                        | Round                            |
| 20  | Seed color                        | White                            |
| 21  | Types of seeds                    | Sticky                           |
| 22  | Color of bare corn cob            | Sticky                           |

### Table 9. Corn nutrition content of local sticky Tanimbar varieties.

| Test Parameters   | Results of the Test | Unit | Location                                                                 |
|-------------------|---------------------|------|--------------------------------------------------------------------------|
| Fat               | 5.08                | %    | Laboratory Baristand Ambon                                             |
| Protein           | 13.05               | %    | Laboratory Baristand Ambon                                             |
| Carbohydrates     | 63.47               | %    | Laboratory Baristand Ambon                                             |
| Amylose           | 26.68               | %    | Laboratory Chemistry and Biochemistry, Dept of Agricultural Product Technology, Univ Pattimura, Ambon |

### 4. Conclusions
The sticky Tanimbar local maize is a superior corn in the Tanimbar Islands Regency area. It has been developed from generation to generation. It is adaptive to specific environments, namely the average growth power in the two growing seasons > 90% with low rainfall (1,000 mm to 1,500 mm year<sup>−1</sup>), maturing < 90 days (86.20 days), resistant to main pests, especially borer (stem and cob). However, it is susceptible to downy mildew with an average yield of 3.24 t ha<sup>−1</sup> (range 2.44 to 4.04 t ha<sup>−1</sup>) and a potential result of 4.04 t ha<sup>−1</sup>. Tanimbar sticky corn has the advantage of being demanded by the community with high carbohydrates and protein, low fat (5.08%) and amylose contents. It also has a soft young texture, fluffy and suitable corn taste.

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