Morphological characteristics and resistance to the pest of local corn variety of “Jago Leke” genetic resources in West Nusa Tenggara

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Abstract. Jago Leke is a local variety of sticky corn in the City of Bima which is very familiar and spread in the Province of NTB, especially on Sumbawa Island. This corn has a fluffier and sweet taste. However, at present its existence is in danger of being displaced by hybrid corn, which in recent years has been mass-cultivated in almost all areas on the island of Sumbawa. The purpose of this study was to determine the morphological characters and resistance to pests of sticky corn of the Jago Leke variety in an effort to preserve potential genetic resources. The method used in this research is observation and interviews. The results showed that the jago leke seed had an early maturity of 60 days, reddish stem color, shorter plant height than corn in general, small cobs, and red young cob hair. The main plant pest organisms that attack this jago leke plant are grasshoppers, stem borers, leaf blight, and leaf rust. Plant pest organism attack symptoms occur in both the vegetative and generative phases with different attack intensities.

1. Introduction
Corn (Zea mays L.) is the second strategic commodity after rice because corn is one type of cereal that has high economic value. Apart from being food and feed, corn is also widely used as energy raw material and other industrial raw materials whose needs are increasing every year [1].

Glutinous corn or waxy corn (in Bima language called jago leke or jago fare keta) is one type of corn that has a special character, namely starch in the form of 100% amylopectin which has a sweet and fluffier taste that other corn does not have, so it is much favored by the public. Since the time of the ancient ancestors, the people of Bima have cultivated jago leke widely, and it can even be said to be the main consumption ingredient after rice. However, along with the times and the increasing variety types of food, the use of jago leke has shifted its priority from being the main food substitute for rice during the famine season, but now being consumed as a snack for boiled corn or grilled corn. Besides being widespread in almost all regencies on the island of Sumbawa, jago leke variety has also been spread on the island of Lombok, such as in several areas in Jerowaru District, East Lombok Regency. In recent years, local farmers always cultivated jago leke intercropped with legumes such as green beans and rice beans on their farms, where Jerowaru is an area with dry, rainfed land.

It is felt that the existence of jago leke is threatened considering that almost all corners of the area on the Sumbawa island from the east to the west are areas with great potential as corn development
areas, and in the last two years the community has planted hybrid corn on a large scale in an effort to achieve corn self-sufficiency national. This is feared to threaten the loss of local maize genetic resources, especially in NTB. For this reason, it is considered important to carry out conservation or preservation of this variety, namely through characterization and evaluation of potential local varieties.

High genetic diversity is one of the important factors for assembling new high yielding varieties. Certain traits are often not found in existing gene sources so that other technologies need to be applied [2]. To get the desired character, one of the steps taken is to increase the source of its genetic diversity [3], because genetically the ability of plants to grow well in an environment is determined by the composition of the genes in the genotype [4].

An efforts to improve the desired genetic character through a breeding program need to add new germplasm to increase diversity in the population [5]. For this reason, this study was conducted with the aim of knowing the morphological character and resistance to pests of the Jago Leke glutinous corn variety as the germplasm of Bima City in an effort to preserve potential genetic resources.

2. Methodology

The study was conducted from February to June 2017. The methods used were observation and interviews. Stages of activities include:

1. Plant characterization, carried out on farm in the land of the farmer's land, Bima City.
2. Rejuvenation and growth evaluation were carried out at Narmada experimental garden, BPTP NTB.

The required data of location is the climate data which includes data on average monthly rainfall, temperature and humidity. Climate data uses secondary data from BMKG NTB. Table 1 is the climate data for the location of corn cultivation. Differences in the character of corn plants at different age levels will show different growth, because in addition to genetic factors, growth is influenced by environmental factors. Good corn plant growth is highly dependent on genetic factors, growing environment and cultivation practices [4].

Spacing used for the cultivation of maize varieties Pulut is 75x40cm. Basic fertilization was carried out in the form of organic compost at a dose of 5 tons/ha at the time of planting, urea fertilization at a dose of 450 kg/ha, SP36 at 150 kg/ha, and KCl fertilizer at 100 kg/ha at the age of 10 days after planting, dose of urea as much as 250 kg/ha at the age of 30 days. Weeding is done to reduce weed populations and hoarding is done to strengthen the plants. The Jago Leke planting area is 100 m2.

Table 1. Climatic data of planting locations.

| Climatic data          | February | March | April | May | June |
|------------------------|----------|-------|-------|-----|------|
| Monthly rainfall (mm)  | 155      | 174   | 126   | 30  | 63   |
| Temperature (°C)       | 26,8     | 28,0  | 27,2  | 27,2| 26,2 |
| Humidity (%)           | 86       | 88    | 85    | 82  | 83   |

Source: BMKG (2017)

The data needed are primary data and secondary data. Primary data is plant data, namely data on plant characteristics obtained directly from samples of corn plants of the Jago Leke variety. Quantitative data is expressed with its real value. The type of plant data taken refers to the maize characterization guide published by the Agricultural Research and Development Agency, National Germplasm Commission, Ministry of Agriculture [7]. The sample plants used were 20 plants which were assumed to represent the total population.

The plant sampling method uses a systematic random sampling technique, namely taking samples in groups by dividing the total population by the number of samples [8]. The characterization method used the corn plant descriptor guidelines in the Maize Characterization Guide published by the Agricultural Research and Development Agency, National Germplasm Commission, Ministry of Agriculture [7]. Then the data is presented descriptively which is presented in the form of photos and scoring results.
3. Result and Discussion

3.1. Morphological characteristics of Jago Leke

Jago leke is local corn variety of Bima which has been very familiar since the days of their ancestors until now. This corn is delicious to be consumed as young corn, either as boiled corn or grilled corn, while old corn as fried corn or sombu (old glutinous corn boiled and served with grated coconut and sugar). This corn knows no season, it is always available in all seasons. Its fluffier and sweet taste makes this corn favored by all people from adults to children.

Visually, Bima’s local glutinous corn plant can be easily distinguished from new superior varieties of maize. Prominent morphological characteristics such as reddish stem color, shorter plant height than corn plants in general, smaller cobs, and young red cob hair. More complete morphological characters are presented in tables 2, 3, 4 and 5.

Table 2. Data character of stems and leaves of jago leke.

| No  | Variable                                    | Information  |
|-----|---------------------------------------------|--------------|
| 1   | Male flowering age (days)                   | 34           |
| 2   | Female flowering age (days)                 | 38           |
| 3   | Plant age (days)                            | 60           |
| 4   | Plant height (cm)                           | 176.5        |
| 5   | Cob height (cm)                             | 63.6         |
| 6   | Leaf length (cm)                            | 83.3         |
| 7   | Leaf width (cm)                             | 8.8          |
| 8   | Number of leaves above the cob position     | 6            |
| 9   | Total number of leaves per plant after flowering | 12      |
| 10  | Leaf orientation after flowering            | Hang         |
| 11  | Shape the tip of the first leaf             | Pointed      |
| 12  | Angle between leaf blade and stem           | Small (±25°) |
| 13  | The direction of the leaf blade and stem    | Curved       |
| 14  | Presence of ligula                          | Nothing      |
| 15  | Stem color                                  | Reddish      |
| 16  | Hair on the leaf midrib                     | Medium       |
| 17  | The number of green leaves in mature plant  | High         |

The tasseling on jago leke plant is 34 days and the age of the female flower is 38 days. Meanwhile, in the local black corn variety of North Sumatera, the male flowering age is 39 days, and the female flowering age is 40 days. The existence of differences in the age of flowering in each variety is thought to be due to genetic differences in each variety. [9] states that the fast and slow emergence of flowers on each plant is different, depending on each genetic trait of each variety. This shows that the character is more influenced by genetic factors than environmental factors.

Plant height is the basis for measuring plant growth as stated by [10], plant height is an indicator of growth as well as a parameter used to measure and determine the effect of the treatment applied in the experiment or as an indicator to determine the effect of the environment. Based on the results of the study, the average height of the maize varieties of Jago Leke was 176.5 cm. Corn plant height varies according to environmental conditions. Low rainfall results in a lack of groundwater availability so that corn plants experience drought stress which results in stunted corn plant height growth [11]. Drought stress significantly affects plant height. In addition to rainfall, population density can also affect plant height [12]. Based on the results of research from [13] corn plants with a number of 90,000 plants/ha are 2-3 cm higher than corn plants with 60,000 plants/ha.

Cob height is one of the important morphological characters and growth parameters for corn plants related to pest attack. The low position of the cobs will cause the corn to be easily attacked by rat pests. The height of the corn cobs in this study was 63.6 cm. In addition to plant height, cob height can also be affected by population density with a difference of 2-3 cm [13]. This is also supported by [14], the plant height is positively correlated to cob height, meaning that the higher the corn plant, the higher the cob location. Apart from being a parameter related to pest attack, cob height is also
correlated with yield, as stated by [15] cob height is one of the characters that correlates with yield and has a positive correlation with seed moisture and yield. According to [16], in sweet corn, the character of plant height and cob position height had a significant positive correlation with yield.

The leaf blade is the elongated part of the leaf like a ribbon with a tapered tip. In general, the Poaceae family, especially in corn plants, has pointed leaf tips. Likewise, the corn varieties of Jago Leke from the results of the study have pointed ends. The length of this variety is 83.3 cm. According to [13] the size of this leaf can determine the distribution of light in the corn canopy, thus affecting the yield of corn seeds.

The width of the corn leaves of the Jago Leke variety is 8.34 cm on average. Leaf width is also one of the characters as well as a growth parameter that is often used in research. The existence of leaves which are very important for the photosynthesis process makes leaf width as a parameter in the growth of corn plants. Leaf length is always correlated with leaf width in each variety, meaning that the increase in leaf length is accompanied by an increase in leaf width, with a difference of approximately 78 cm [11].

The number of leaves of Jago Leke variety in the normal range consists of 12 leaves, but other maize plants have 13 to 15 leaves depending on the height of each plant. Low plant height can affect the number of leaf blades. This is supported by [17] in his research that plant height affects the number of leaves, meaning that the higher the plant, the more the number of leaves.

The direction of the leaf blade and the angle between the leaf blade and the stem (axillary angle) are morphological characters of corn leaves, but these characters do not show a significant value to plant growth. Based on the results of the study, the direction of the leaf blades of the Jago Leke leaf toward the leaf blade is curved with a large angle between the leaf blade and the stem is included in the small category (± 25°). The direction of the leaf blade and the angle of the axilla can be affected by the phototropism of the plant itself. According to [18], the character of the direction of the leaf blade and the angle of the axilla of the plant is caused by phototropism. Phototropism is movement in plants that is influenced by the direction of the stimulus in the form of incoming light.

| No  | Variable                                      | Information        |
|-----|-----------------------------------------------|--------------------|
| 1   | Panicle length (cm)                           | 43                 |
| 2   | Flower stalk length (cm)                      | 26.35              |
| 3   | Panicle branch distance (cm)                  | 11.35              |
| 4   | Panicle type                                  | Primary – secondary|
| 5   | Number of primary branches on panicles        | 10.1               |
| 6   | Number of secondary branches on panicles      | 4                  |
| 7   | Number of tertiary branches on panicles       | 0                  |
| 8   | The direction of the lateral branch of the panicle | Slightly curved |
| 9   | Angle between main axis and lateral branch    | Medium (±50°)      |

Panicle or male flower is one part that can affect the yield of corn. The panicle phenotype character of Jago Leke corn was having a panicle length of 43 cm and a stalk 26.35 cm, a primary-secondary panicle branching type with a slight curved panicle branch direction with an angle of ± 50° (Table 3). When compared with local maize [19], Jago Leke corn has a panicle length and a longer stalk with a smaller panicle branch angle.
Tabel 4. Data character of jago lekecob.

| No | Variable              | Information     |
|----|-----------------------|-----------------|
| 1  | Cob length (cm)       | 10 – 14         |
| 2  | Cob diameter (cm)     | 3 – 4           |
| 3  | Top cob shape         | Conical astigmatism |
| 4  | Grain color           | White           |
| 5  | Grain row arrangement | Regular         |
| 6  | Number of rows        | 10 – 14         |
| 7  | Number of grain per row | 24            |
| 8  | Grain length (cm)     | 0.8 – 1.1       |
| 9  | Grain width (cm)      | 0.7 – 0.9       |
| 10 | Grain thickness (cm)  | 0.5 – 0.6       |
| 11 | Surface shape of top grain | Round        |

The characteristics of cobs and seeds are closely related to productivity, so they are considered important in maize breeding. The length and diameter of the cob in this study were 10-14 cm and 3-4 cm, respectively. The length and diameter of the cob differ in each corn variety according to its tolerance to environmental stresses. This is based on research from [20] which reported drought conditions affect the length and diameter of the corn cobs. Environmental stress that can affect the length and diameter of the cob is drought stress which is the result of low rainfall.

The length and diameter of the cobs may be affected by the environment, but this is different from the number of seeds per row. The number of seeds per row on the cob can vary for each variety, according to the genetic expression of the variety itself [11]. The number of seeds per row in Jago Leke variety is 24 seeds with a row of 10-14 rows, depending on the size of the cobs.

The genetic expression of each variety causes variations in the shape and size of corn kernels. According to [21], based on the structure and shape, corn can be classified into 8, two of which are popcorn and horse tooth corn. Popcorn (Z. mayseverta) is corn with a type of corn that has small seeds, while horse tooth corn (Z. maysindentata) is corn with large, flat and grooved seeds. These various shapes and sizes of corn can cause variations in the number of seeds per row so that you can find corn with almost the same cob length but the number of seeds per row is different due to different varieties. There is a diversity in the number of seeds per row of four varieties of corn. The seed weight varies according to each variety [22].

![Figure 1. Local corn plants (left), corn with husk/kelobot (middle), cobs (right)](image-url)
3.2. Plant pest organisms of Jago Leke

Plant pest attacks that are commonly found in the Jago Leke planting include grasshoppers, stem borers, leaf blight, and leaf rust. Symptoms of pest attacks occur in both the vegetative and generative phases with different attack intensities. According to [23], pests and diseases that attack maize during the vegetative period of 0-14 days after planting are seed flies, caterpillars, grub (ureth), downy mildew, and dwarf mosaic virus. Furthermore, at the age of 15-42 days after planting, pests and diseases that attack corn are stem borer, armyworm, corn planthopper, leaf spot, and leaf blight. While in the generative phase, pests and diseases that can attack corn are cob borer, stem rot, and cob rot. The dominant plant pest organism which attack jago leke presented in table 5.

Table 5. Plant pest organism of jago leke

| No | Plant pest organism                     | Symptom                                      | Attack rate | Control       |
|----|----------------------------------------|----------------------------------------------|-------------|---------------|
| 1  | Grasshoppers (*Locusta* sp.)           | Leaf holes and leaf margin missing           | Low         | Chemically    |
| 2  | Stem borer (*Ostrinia furnacalis*)     | Bore holes on the stem and attack on leaves | Medium      | Chemically    |
| 3  | Leaf Blight (*Helminthosporium turcicum*) | Small spots and patches that grow to be elongated | Very low    | -             |
| 4  | Leaf Rust Disease (*Puccinia polysora*) | Yellow powder spot.                          | Very low    | -             |

Grasshopper attacks on corn plantations began to appear at the age of 12 days after planting. Symptoms are visible in the form of hollow leaves or loss of leaf margins (Figure 2). Grasshopper is one of the nuisance insects that are often found in corn plantations. Grasshoppers attack plants by eating young corn plants, causing hollow leaves or reduced leaf parts. Even in conditions of severe attack, it can cause only the leaf bones to remain. Grasshopper attacks can be controlled in several ways, including technical culture, such as planting alternative crops that grasshoppers don't like; mechanical physical, by catching or gathering groups of locusts; and biological, such as spraying using neem extract [24, 25]. In this case, grasshopper had very low intensity and it can be controlled chemically.

Figure 2. Symptoms of grasshoppers attack on corn plants: a) leaf holes, b) leaf margins missing, and c) individual of green grasshoppers.

The stem borer attack on Jago Leke can be seen by the presence of symptoms in the form of bore holes on the stem and the presence of powder coming out of the drill holes (Figure 3). In addition to stems, this pest can also attack the leaves. The stem borer attack is the most dominant pest found in the planting area and causes heavy damage in the form of broken parts of the corn plant stem. When compared to other pest attacks, stem borers can cause the highest level of damage. So in this case, the jago leke is susceptible to stem borer. [26] explains that stem borer is an important pest on maize in Indonesia, even in some Asian countries. This borer can attack corn plants on the leaves, stems, and
flowers (male and female). The resulting yield loss ranges from 20-80%. [27] research showed the highest maize stem borer attack rate occurred when the plant was 50 days old, while the lowest was at 60 days.

Efforts to control corn stem borer can be done by utilizing natural enemies such as parasitoids, predators, and pathogens [26]. [28] showed that the use of the pathogenic Nuclear Polyhedrosis Virus (NPV) at a dose of 3000 ppm could cause the death of stem borer larvae by 86.08% on a laboratory scale. In this study the control was carried out chemically.

![Figure 3](image3.png)

**Figure 3.** Symptoms of stem borer attack on corn plants: a) bore holes on the stem, b) attack on leaves and c) larvae of corn stem borer.

Leaf blight is caused by the pathogen *Helminthosporium turcicum*. Early symptoms can be seen by the presence of small spots on the leaves. The spots then developed into necrotic with increasingly elongated (elliptical) shape (Figure 4). [29] stated that the symptoms of widespread spotting can cause leaf tissue to die due to the union of one spot with another. The disease develops well in the generative phase. Efforts that can be made to control corn leaf blight include the use of resistant varieties, eradication or destruction of infected plant parts, and spraying with fungicides. In this study no control measures were taken because the attack rate was relatively low.

![Figure 4](image4.png)

**Figure 4.** Symptoms of leaf blight on corn plants: a) small spots and b) patches that grow to be elongated.

Leaf rust disease is caused by the pathogen *Puccinia polysora*. Symptoms caused are in the form of small spots on the lower and upper leaf surfaces (Figure 5). [30] explained the attack of *P. polysora* on maize showed the presence of pustules (pimples) on the upper and lower surfaces of the leaves. Lesions or sores may develop on the stems and leaflets. When the pustules burst, the spores are dispersed by the wind and have the potential to cause further infection. In this study no control
measures were taken due to the low level of attack. However, control efforts that can be done include the use of resistant varieties and the destruction of all infected plant parts and weeds around infected plants.

![Figure 5. Symptoms of leaf rust disease on corn plants](image)

4. Conclusion
Jago leke has an early age of 60 days, reddish stem color, shorter plant height than corn plants in general, small cobs, and white grain with regular grain row arrangement. Jago leke tends to be vulnerable to stem borers with medium attack levels.

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