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Characterization of Phenology and Growth Phases of Local Sorghum (*Sorghum bicolor* L. Moench) from East Sumba

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Abstract

Sorghum is one of the cereal crops currently being widely developed as an alternative food in Indonesia. One of the approaches is through research in the field of plant breeding. To initiate the development of more advanced research, with future research focused on developing local cultivars as part of local wisdom that preserves sustainability and genetic diversity, information is needed regarding the phenological characteristics and growth phases of sorghum plants as conducted in this study. The plant materials used were two local sorghum genotypes of East Sumba, namely Watar Hammu Manippa Tadda and Watar Hammu Mitting Nggangga. A descriptive research method was used to provide a detailed description of the characteristics of sorghum plants. The research was conducted from June to December 2024 at the Science Techno Park (STP), Faculty of Agriculture and Business, Satya Wacana Christian University, Wates Village, Getasan District, Semarang Regency, at an altitude of 1118 meters above sea level. The results showed that the local East Sumba sorghum genotypes, Watar Hammu Manippa Tadda and genotype Watar Hammu Mitting Nggangga, have similar phenological charactersisitics in terms of leaf, stem, and root, while their seed characteristics and panicle shapes of the two types are different, with clear distinctions in seed and panicle morphology serving as important differentiating traits. Based on the growth phase, there are no significant differences between the two genotypes. The research results indicates that both genotypes have strong potential as breeding materials, with breeding efforts best directed toward combining the superior traits of each genotype, maintaining local adaptation while improving seed productivity and quality. This study provides detailed information on the phenological characteristics and growth phases of two local sorghum varieties from East Sumba. Information related to plant phenology is an important foundation for developing sorghum breeding research in Indonesia. Knowing the characteristics of the plant also supports the optimal use of sorghum as a food source or alternative feed.

Keywords: *Growth phas, phenology, plant breeding, sorghum.*

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INTRODUCTION

Sorghum (Sorghum bicolor L. Moench) is a cereal plant that has the potential to become an alternative food source because it contains carbohydrates and other nutrients that are adequate as food crops. Apart from being a food source, sorghum stem biomass can also produce sap which can be used as a raw material for making bioethanol. Sorghum is known to be resistant to pests and diseases and can be cultivated well on dry and flooded land and can also adapt well to marginal land conditions (Dewi, 2017). In Indonesia, sorghum plants have actually been known and cultivated for a long time in several regions such as in several islands of Java, NTB and NTT, it's just that their utilization is not optimal. So far, sorghum plants have only been used as edge plants to divert bird pests.

A number of studies to increase sorghum production have been carried out by various institutions, including BATAN (Sihono et al. 2022), USDA (Dial 2012), Plant Research Center (Subagio 2014) and many more national and international agencies that continue to develop sorghum varieties to increase the yield of sorghum plants. Some Indonesian farmers in Kendari, Southeast Sulawesi; Sumba, NTT; and Sidrap,

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South Sulawesi have developed sorghum for various purposes such as animal feed, flour, and syrup (Wicaksana and Rachman 2018). Even the development of sorghum cultivation in Flores has also been synchronized with the potential of natural tourism, so that the region can become an agro-tourism area. Sorghum has also been widely developed into various processed products such as pop gum, sorghum rice (Lestari 2019), and can be processed into flour as an alternative to the use of wheat as a raw material for wheat flour (Sanyoto et al. 2021). Sorghum grass can also be used as silage or material for animal feed and also processed into renewable fuel (Dewi, 2017).

Seeing the great potential of sorghum as an alternative food crop, the Ministry of Agriculture continues to promote research and development related to technology or the creation of superior varieties of sorghum to support food diversification programs in Indonesia (Indra, 2022). The phenology of sorghum plants needs to be known as a basis for sorghum cultivators or plant breeders in cultivating and developing superior varieties of sorghum. Plant phenology is the science of the timing and occurrence of the phases of plant growth that occur naturally (Debataraja et al., 2022). The phenology of a plant is influenced by environmental factors such as air humidity, temperature, and rainfall (Mahdya et al., 2020).

Sorghum phenotypic is important to know because it can determine the specific function of sorghum, namely the suitability of sorghum plant varieties whether as animal feed or as food crops. By knowing sorghum phenology, it can also be known how recommendations for sorghum cultivation include nutrient and water management, as well as pest and disease control in sorghum plants in each growth phase. Research on sorghum plants that has been carried out so far has used local sorghum varieties from the East Nusa Tenggara region. This happens because most of the NTT region has dry land with a dry climate so that people tend to cultivate sorghum because it is tolerant of dry environmental conditions (Wicaksana & Rachman 2018).

The problem faced in the development of sorghum is the limited information on the phenology of local sorghum plants in East Sumba, so for this reason it is necessary to conduct further research on the phenology of local sorghum plants in East Sumba. Especially in environmental conditions that are different from the area of origin, namely East Sumba, so that later East Sumba local sorghum varieties can be developed in areas with different environmental conditions such as in highland areas with lower temperatures. This research is also useful for the development of genotypes into superior variety candidates. This research aims to obtain data on specific growth phases and phenology in local sorghum from East Sumba genotypes Watar Hammu Manippa Tadda and Watar Hammu Mitting Nggangga.

MATERIALS AND METHOD

Place and Time

This research was conducted at the Science Techno Park (STP), Faculty of Agriculture and Business, Satya Wacana Christian University, Wates Village, Getasan District, Semarang Regency, with an altitude of 1118 meters above sea level. Getasan has an average rainfall of 270 mm with an average rainy day of 17 rainy days. The research was conducted during June - December 2024, began in the middle of the dry season and continued into the early rainy season. These conditions were chosen to match the sorghum's region of origin, East Sumba, which has a relatively dry climate throughout the year. When entering the grain filling phase, the soil was sufficiently moist and water was available for the plants, allowing the loading and unloading mechanisms in the sorghum plants to function optimally. Sorghum cultivation in both the dry and rainy seasons has its own advantages that can be utilized to improve the success of cultivation. The dry season, with higher light intensity and lower rainfall, supports optimal photosynthesis, thereby accelerating sorghum plant growth and reducing the risk of pest and disease attacks that usually develop under humid conditions. Meanwhile, the rainy season, with higher humidity and sufficient rainfall, helps meet the water needs of the plants, especially during the panicle formation and grain filling.

Materials and Tools

Data collection was obtained from direct observation in the field, namely by cultivating sorghum plants. This experiment used genotypes Watar Hammu Manippa Tadda and Watar Hammu Mitting Nggangga which were planted in 4 experimental blocks. The population in this study were sorghum plants and the samples used in this study were 32 sorghum plants in each genotype which were divided into 4 experimental blocks. The planting distance of each plant is 50 x 50 cm.

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Research Methods

Observations on plants were carried out by recording the time of each growth phase in plants, namely phase 0 (germination) to phase 9 (Physiological Maturity). In this study, observations were also made on the phenology of sorghum plants. Documentation was carried out using a dark photo background to minimize the occurrence of color changes in the photo results. The plant phenotype observed was the color of the leaf blade, leaf surface, leaf margin, panicle shape type, seed description, root description and stem cross section, leaf angle, stem diameter, leaf width, leaf length, leaf chlorophyll content, maximum tiller number and 1000-grain weight.

Tabel 1. Plant Phenotype Observation Variables and Methods

Karakter	Observation Method
Leaf angle (^{0})	Observations were made using a bow placed on the leaf bone at the base of the leaf.
Leaf color	Observations were made using the RHS Colour Chart to match the color of the sorghum leaves.
Leaf width (cm)	Measurements were taken using a ruler at the widest part of the sorghum plant.
Leaf length (cm)	Measurements were taken using a meter, the leaves were measured from the base of the leaf to the tip of the leaf following the leaf bone.
Leaf chlorophyll content (unit)	Measurements were taken using a SPAD chlorophyll meter by averaging the results of measurements at the tip, middle and base of the leaf.
Description of leaf shape	Observations were made by observing the shape of the leaf surface, leaf tip and leaf base.
Total dissolved solids (^{0}Brix)	Measurements were taken using a refractometer on the upper part of the stem that had water content
Trunk diameter (mm)	Measurements were taken using a caliper at the largest part of the 3rd leaf internode.
Cross-section of the rod	Observations were made by cutting the stem transversely and observing the xylem and phloem.
Description of seed shape	Observations were made by looking at the shape and color of the seeds.
Root shape decryption	Observations were made by observing the shape and color of the roots.
1000-grain weight	Measurements were made by taking 100 seeds randomly, then the seeds were weighed using a digital scale and the weight was recorded as X grams. This process was repeated three times (thus obtaining Y and Z data). Next, the weight of 1000 items is calculated by the formula: $\frac{X+Y+Z}{3} X\ 10$
Panicle description	Observations were made by observing the type and shape of panicles.

RESULTS AND DISCUSSION

The two genotypes of local sorghum plants of East Sumba are cultivated in different environments from their areas of origin, having phenological differences including growth phases, leaf morphology, stem morphology, root morphology, panicle shape and also seed morphology. The genotype Watar Hammu Manippa Tadda originated from Pulu Panjang Village, Nggaha Oriangu Subdistrict which is located on the island of Sumba, precisely in the Southwest part of East Sumba Regency Province (Rivki et al. 2020a) and

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the genotype Watar Hammu Mitting Nggangga originated from Palanggay Village, Pahunga Lodu Subdistrict (Rivki et al. 2020b). The two locations of origin of the genotypes used both have short rainfall and long dry seasons. D, Yusuf et al., and Maiyuslina (2015) stated that internal factors such as hormones and genes can inherit traits in plants and external factors such as environmental conditions which include water, nutrients, humidity, temperature and light can affect plant characteristics.

Leaf Phenology in the Maximum Vegetative Phase of Sorghum Plants

Leaf Color and Chlorophyll

Based on the results of observations made in figure 1, it shows that the local East Sumba Sorghum genotypes *Watar Hammu Manippa Tadda* and *Watar Hammu Mitting Nggangga* have the same color, namely *green group NN137, 'Greyish Olive Green A'*. Leaf color is influenced by the chlorophyll content in the leaves, this is in accorandce with research conducted by Andniswari *et al*., (2019) who observed changes in leaf color by observing changes in chlorophyll content which showed that generally leaf chlorophyll decreased in number when the leaves changed color from green to other colors.

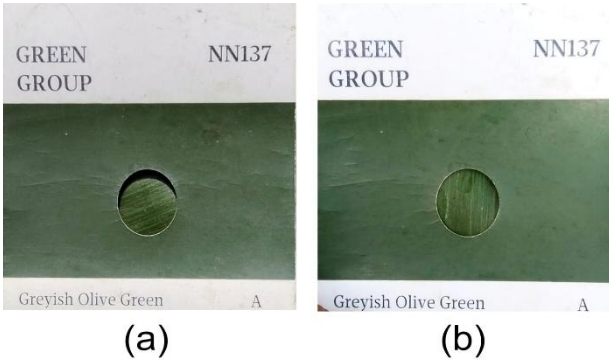

Figure 1. Leaf Color Grouping of Sorghum Genotypes, a. *Watar Hammu Manippa Tadda*; b. *Watar Hammu Mitting Nggangga*

Based on the measurement of leaf chlorophyll using the SPAD chlorophyll meter, the two genotypes showed almost the same SPAD value, namely East Sumba local sorghum genotype *Watar Hammu Manippa Tadda* showed an average value of 56.15 SPAD and East Sumba local sorghum genotype *Watar Hammu Mitting Nggangga* showed an average value of 60,88 SPAD. The SPAD results observed in this study were higher compared to the research conducted by Siregar *et al.*, (2020) where the SPAD measurement carried out on sorghum plants of the GH-33 genotype was 50.10 SPAD, as well as research conducted by Usnawiyah *et al.*, (2021) on sorghum plants of the Numbu variety which showed the highest level of leaf greenness as indicated by the SPAD value, the average was 25.4 ± 0.78 while the lowest was found in the Samurai 2 variety which was 20.4 ± 0.80. Usnawiyah *et al.* (2021) stated that a high SPAD value indicates a greater photosynthate production from photosynthesis, which can lead to an increase in sorghum harvest value.

Leaf Surface

The leaf surface of the *Watar Hammu Manippa Tadda* genotype and *Watar Hammu Mitting Nggangga* genotype both have slippery leaf surfaces (Figure 2). The slippery surface of sorghum leaves is thought to be due to the waxy content that makes sorghum plants resistant to drought stress. Zubair and & Padjadjaran (2018) explained that sorghum has silica in the endodermis and also a waxy layer on the leaves to reduce water evaporation when exposed to high temperatures and intense sunlight, and when experiencing water shortages. The presence of this silica and waxy coating helps prevent sorghum leaves from wilting quickly.

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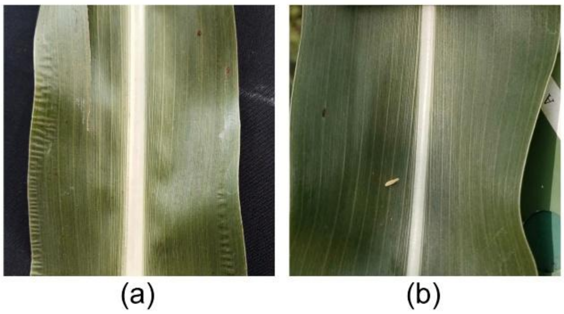

Figure 2. Leaf Surface of Sorghum Genotypes, a. *Watar Hammu Manippa Tadda*; b. *Watar Hammu Mitting Nggangga*

In this study, it is also known that there are fine hairs at the tip of the leaf which can be seen from Figure 3 and also fine hairs around the leaf tongue area (Figure 4). Shahzad (2021) states that fine hairs on the surface of plants including leaves are called trichomes, where the density of hairs has an influence on the biological behavior of insect pests, especially as a barrier to prevent sucking insects from sticking the stylet used to suck nutrients from plants, and blocking ovipositor tools in insect pests in the process of laying eggs. Based on research by Praptiningsih *et al.,* (2017) on corn plants, it has physical defense characteristics such as hair, trichomes, spines, and leaf thickness, which can affect preferences and kill or inhibit the development of *Spodoptera frugiperda*. Trichomes on maize leaves also play an important role in preventing *S. frugiperda* larvae from feeding on the leaves and act as a physical barrier on the leaf surface. Through this, it is suspected that the two local sorghum genotypes of East Sumba have resistance to pest attack because the hairy leaf surface in the area around the leaf tongue tends to be disliked by pests. Apart from being resistant to pests, Jumiati and & Andrias (2020) stated that fine hairs or trichomes have an important role in reducing evaporation, so the presence of trichomes at the base of sorghum leaves of the *Watar Hammu Manippa Tadda* genotype and the *Watar Hammu Mitting Nggangga* genotype is thought to play a role in the resistance of sorghum plants to drought stress conditions.

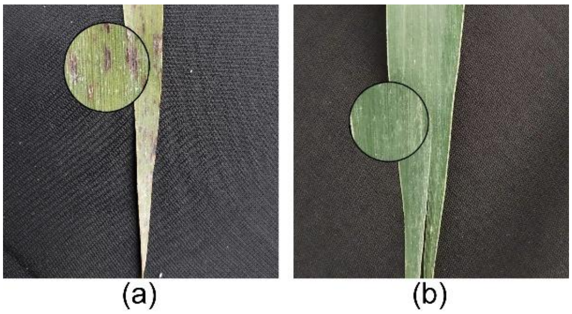

Figure 3. Leaf Tip Surface of Sorghum Genotypes, a. *Watar Hammu Manippa Tadda*; b. *Watar Hammu Mitting Nggangga*

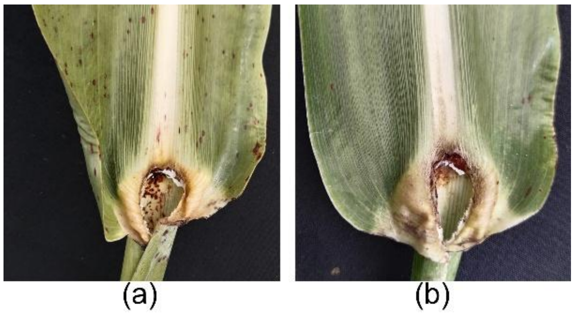

Figure 4. Tongue Leaf Surface of Sorghum Genotypes, a. *Watar Hammu Manippa Tadda*; b. *Watar Hammu Mitting Nggangga*

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Leaf Edge

The edges of the leaves on the local East Sumba Sorghum genotype *Watar Hammu Manippa Tadda* and the genotype *Watar Hammu Mitting Nggangga* do not have too much difference, where the edges of the leaves on the two genotypes are finely serrated on 2/3 of the length of the leaf at the tip, while on 1/3 of the length of the leaf at the base the edges are flat. The *Watar Hammu Manippa Tadda* genotype has tighter and sharper serrations than the *Watar Hammu Mitting Nggangga* genotype. The serrated leaf edge shape possessed by the two sorghum genotypes is thought to be resistant to plant pests that have a biting and chewing mouth type.

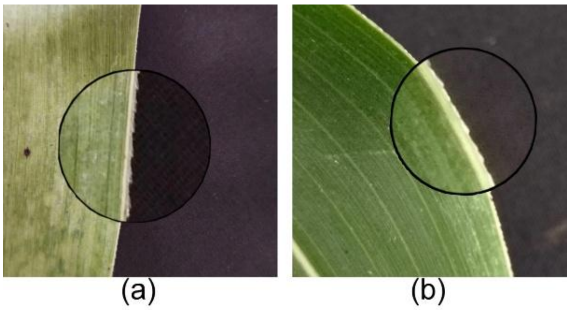

Figure 5. Leaf Edge of Sorghum Genotypes, a. *Watar Hammu Manippa Tadda; b. W atar Hammu Mitting Nggangga*

Leaf Tilt Angle

Sorghum plants generally have a parallel leaf bone shape. East Sumba local sorghum genotype Watar Hammu Manippa Tadda has an average leaf inclination angle of 300 while genotype Watar Hammu Mitting Nggangga has an average leaf inclination angle of 250. The angle of the leaves on the plant affects the effectiveness of land use because the smaller the angle of the leaves, the plant leaves will be upright so that the plants can be planted more densely. In addition, the more upright the leaves allow plants to get maximum sunlight on the entire surface of the leaves, which can maximize the photosynthesis process.

According to Fahrindra et al., (2024), a small leaf angle can increase the efficiency of sunlight energy conversion. This energy absorption efficiency allows the photosynthesis process to run more optimally, which then contributes to an increase in crop yields. Conversely, if the angle of the leaves is getting bigger, it allows the reception of sunlight on the leaves to be uneven so that the surface of the leaves that are not exposed to sunlight becomes moist and has the potential to become a place for parasites such as fungi, pests and other pathogens to develop. This is explained by Putri et al., (2019) which states that leaves that receive low sunlight, namely the lower leaves, result in these leaves potentially being parasitic leaves that only function as assimilate users. As a result, the assimilate that should be allocated to economically valuable parts of the plant is reduced.

This study shows that the East Sumba local sorghum genotype Watar Hammu Manippa Tadda has a greater average leaf inclination angle than the Watar Hammu Mitting Nggangga genotype, this indicates that the Watar Hammu Mitting Nggangga genotype is more efficient in land use and more efficient in the use of solar energy for photosynthesis because the small angle allows even irradiation on the leaf surface of the *Watar Hammu Mitting Nggangga* genotype.

Leaf Width and Length

East Sumba local sorghum genotype *Watar Hammu Manippa Tadda* has an average leaf width of 8.23 cm and leaf length of 96.67 cm while the genotype Watar Hammu Mitting Nggangga has an average leaf width of 6.1 cm and leaf length of 79 cm. Sorghum leaves have parallel leaf bones. The length and width of sorghum leaves affect leaf area, so that it can determine whether a sorghum genotype is more appropriate for use as animal feed because it has more forage or it is more appropriate to process the seeds as feed ingredients.

Harmini (2021) explained that Sorghum can be classified into several types, namely grain sorghum, single cut forage sorghum (used for silage), dual-purpose sorghum (mainly for industrial purposes), and multicut forage sorghum (utilized as forage). Based on its phenology, East Sumba local sorghum Genotype Watar Hammu Manippa Tadda and Genotype Genotipe Watar Hammu Mitting Nggangga are included in the multicut forage sorghum type, which is sorghum that is suitable for cultivation as forage for animal feed because its vegetative growth is quite long, the growth cycle is fast and has a lot of forage which can

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be seen from the size of the stem and leaves. Thus, it contributes positively to increasing the amount of fresh biomass. Harmini (2021) also stated that plant height, stem diameter, and number of leaf blades are some indicators of sorghum production as an Animal Feed Plant (AFP).

Stem Phenology in the Maximum Vegetative Phase of Sorghum Plants

Sorghum plants have stems that consist of a series of series between internodes and also books. Sorghum stems have a cylindrical shape with a diameter that varies according to the genotype. In this study, it is known that the East Sumba local sorghum genotype *Watar Hammu Manippa Tadda* has an average stem diameter of 20.57 mm while the *Watar Hammu Mitting Nggangga* genotype has an average stem diameter of 12.75 mm. This indicates that the East Sumba local sorghum genotype *Watar Hammu Manippa Tadda* has better growth compared to the *Watar Hammu Mitting Nggangga* because, the larger the stem diameter of a plant allows better plant growth, this happens because the diameter of the stem is able to support the plant more strongly so that it does not easily collapse.

Sorghum stems have internodes in a row, where each internode has a groove that is located beseling and contains water which is high in sugar content. Total soluble solids in local East Sumba sorghum genotype *Watar Hammu Manippa Tadda* is 5,8 ^{0}Brix while in the genotype *Watar Hammu Mitting Nggangga* is 9 ^{0}Brix. The brix level in sorghum stems is influenced by environmental conditions, especially temperature and irrigation, lack of liquid causes the concentration of sugar in the stems to be high so that the measured brix value is also higher. A less than optimal environment such as temperature affects the metabolic process of sorghum plants resulting in low sugar content in sorghum stems (Indra *et al.,* 2024). Based on the Brix value, it is suspected that the *Watar Hammu Mitting Nggangga* genotype has the ability to adapt to a higher environment compared to the *Watar Hammu Manippa Tadda* genotype.

Aryani F et al. (2022) explains that in each stem segment there is a root band and above it there is a growth ring that can produce a new stem if the top of the stem is damaged. As show in figure 6. The transport tissue in the center of the sorghum stem is thicker than the base or tip. The stem will be wrapped around by new leaves which will then fall off as the leaves dry and age. Branching from sorghum leaves occurs more often at the top of the plant than at the base near the roots.

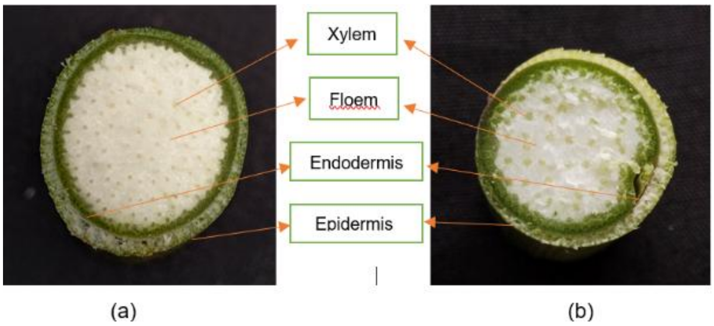

Figure 6. Ross-section of sorghum stem (a) *Watar Hammu Manipa Tadda* and (b) *Watar Hammu Mitting Nggangga*

Panicle Phenology in the Maximum Vegetative Phase of Sorghum Plants

East Sumba local sorghum genotype *Watar Hammu Manippa Tadda* and genotip *Watar Hammu Mitting* Nggangga have an upright panicle shape. The panicle stalk of the *Watar Hammu Manippa Tadda* genotype is longer than that of the *Watar Hammu Mitting Nggangga* genotype so that the *Watar Hammu Mitting Nggangga* genotype has a compact panicle density while the *Watar Hammu Manippa Tadda* genotype has a loose panicle density. Setiyagama *et al.,* (2017) stated that the type of sorghum race can be identified through its panicle shape. Panicle density is also an important characteristic to distinguish different sorghum genotypes.

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Figure 7. Panicle Shape of Sorghum (a) *Watar Hammu Mitting Ngangga* and (b) Watar Hammu *Manipa Tadda*

Seed Phenology in the Maximum Vegetative Phase of Sorghum Plants

East Sumba local sorghum genotype *Watar Hammu Manippa Tadda* has a larger seed size compared to the *Watar Hammu Mitting Nggangga* genotype. The *Watar Hammu Manippa Tadda* genotype has an average seed length of 5.91 mm and seed width of 4.06 mm while the *Watar Hammu Mitting Nggangga* genotype has an average seed length of 5.78 mm and seed width of 3.95 mm. The weight of 1000 grains in East Sumba local sorghum genotype *Watar Hammu Manippa Tadda* is 24.3 grams and the weight of 1000 grains in the genotype *Watar Hammu Mitting Nggangga* is 22.6 grams. Arif *et al.,* (2022) stated that the weight of 1000 seeds gives an idea of the potential of plants to produce quality seeds.

The East Sumba local sorghum genotype *Watar Hammu Manippa Tadda* has a black seed color with light brown hairs on the seed tip while the *Watar Hammu Mitting Nggangga* genotype has a solid black seed color throughout the seed surface. The *Watar Hammu Manippa Tadda* genotype has a rounder seed shape than the *Watar Hammu Mitting Nggangga* genotype which has a more oval seed shape.

(a) (b)

Figure 8. Seed sorghum genotypes (a) Watar Hammu Manippa Tadda and (b) Watar Hammu Mitting Nggangga

Root Phenology in the Maximum Vegetative Phase of Sorghum Plants

Sorghum has fibrous roots and has adventive roots in the lowest stem segment above the soil surface. Lestari (2019) stated that sorghum's tolerance to drought stress is due to the presence of silica deposits in the endodermis of sorghum roots, which function to protect the roots from damage due to dry conditions. In addition, the root system is fine and located deep enough to make sorghum able to absorb water intensively.

Roots in both genotypes of East Sumba local sorghum have the same shape, based on the results of the study it is known that the East Sumba local sorghum genotype Watar Hammu Manippa Tadda has a root length of 38 cm and a root width of 60 cm while the genotype Watar Hammu Mitting Nggangga has a root length of 37 cm and a root width of 65 cm. The roots of the East Sumba local sorghum genotype *Watar Hammu Manippa Tadda* have a larger root size, this happens because physiologically the East Sumba local sorghum genotype *Watar Hammu Manippa Tadda* has a larger size compared to the *Watar Hammu Mitting Nggangga* genotype both from the stem diameter, plant height and leaf area. So that the *Watar Hammu Manippa Tadda* genotype has larger roots to support the establishment of plants.

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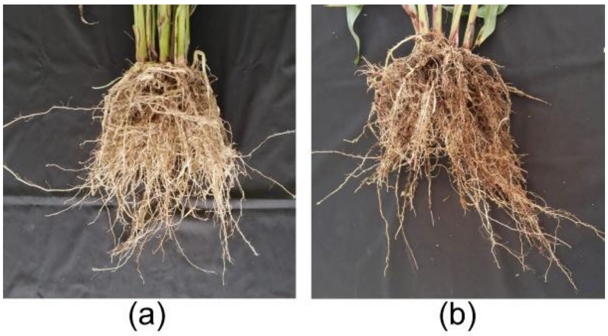

Figure 9. Rooting of Sorghum Genotypes, a. Watar Hammu Manipa Tadda; b. Watar Hammu Mitting Nggangga

Growth Phase of Sorghum Plants

Observations of the growth phase of sorghum plants followed the standards of Vanderlip (1993) which divided the growth of sorghum plants into 10 growth phases, namely phase 0 - phase 9. The results of observations of growth phases were observed on the day after planting until entering the Physiological maturity phase (Table 2). The growth phase of local East Sumba sorghum plants of the *Watar Hammu Manippa Tadda* genotype had a longer growth phase during the vegetative phase compared to the growth phase of the *Watar Hammu Mitting Nggangga* genotype. By knowing the growth phase of sorghum plants, it is hoped that it can be a recommendation regarding fertilization and better cultivation of sorghum plants.

Recommendations for fertilizing sorghum plants, should be done twice, namely at the time of the emergence of the 3rd leaf and in the growth point differentiation phase. In the growing point differentiation phase, namely on days 38-45 for the Watar Hammu Manippa Tadda genotype and days 40-43 for the Watar Hammu Mitting Nggangga genotype, it is a phase where the absorption of nutrients by plants occurs optimally so that stem growth takes place quickly along with plant growth, in this phase the need for nutrients and water is very high. By applying fertilizer at the growth point differentiation phase, it will be very helpful in ensuring optimal plant growth (Aryani F et al., 2022).

Recommendations for sorghum cultivation in Indonesia are to adjust the sorghum planting time to the season in Indonesia, in Indonesia generally the rainy season occurs from October to March and the dry season occurs from May to September (Setiawan 2021). The effect of season on sorghum planting time is related to the availability of water, where water plays an important role in the seed germination process, so that in the germination phase sufficient water is needed to meet the water needs of the planted seeds. Sorghum planting in the dry season is also vulnerable to bird pests and less than optimal seed filling due to limited water availability (Murandingsih and & Uran, 2021). With this, sorghum planting should be carried out in the rainy season, so that it is more efficient in meeting the water needs of sorghum seeds. Meanwhile, in the generative phase sorghum requires low rainfall because high rainfall near harvest in sorghum plants can cause sorghum seeds to germinate before harvest, seed rot and pest attacks on sorghum seeds (Aryani F et al., 2022).

Tabel 2. Sorghum Growth Phase

Code	Phase	Phase Age (day after planting)	
		W.H Manippa Tadda	***W.H Mitting Nggangga***
F0	Emergence	4-7	3
F1	Three-Leaf	12-15	14-15
F2	Five-Leaf	24-30	25-29
F3	Growth point differentiation	38-45	40-43
F4	Flag leaf visible	52-62	53-57
F5	Booting	62-75	57-67
F6	Flowering	73-87	64-76
F7	Soft dough	85-101	76-90
F8	Hard dough	95-113	98-112
F9	Physiological maturity	119-127	125-132

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Based on the growth phase of the sorghum genotypes Watar Hammu Manippa Tadda and Watar Hammu Mitting Nggangga, the recommended planting in Indonesia is at the end of the rainy season in March. So that the generative phase of sorghum occurs in the dry season, namely May to June. Thus the use of water for sorghum plants is more effective and the sorghum seeds produced can be of high quality.

CONCLUSION

Based on the research conducted, it can be concluded that the phenotype characteristics of the local sorghum genotypes from East Sumba, *Watar Hammu Manippa Tadda* and *Watar Hammu Mitting Nggangga*, are similar in terms of leaf, stem, and root traits, while their seed characteristics and panicle shapes are differ. Based on the growth phase, differences between the two genotypes were seen in the generative phase. The development of these two sorghum genotypes can be utilized both as a source of food (seeds) and as feed, by utilizing their biomass.

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