Identification Of Sorgum Distribution And Soil Nutrient Status In Local Sorgum Genotype Growing Locations In North Sumatera

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Abstract.

Sorghum, a drought-resistant cereal crop, has great potential to support food security in North Sumatra. To optimize its utilization, identification and characterization of local sorghum varieties are needed. ***Identification of local sorghum plants*** *is an important step in efforts to optimize the utilization of plants that are useful for helping to document and preserve biodiversity, can help reveal hidden potential, so that superior varieties can be developed. Farmers can choose the varieties that best suit their agronomic conditions and needs so that they can help open up new opportunities for product development and downstreaming of sorghum, thereby increasing its economic value. By developing and utilizing local sorghum varieties, Indonesia can reduce dependence on food imports and strengthen its food sovereignty Data collection was carried out from August to December 2022 in several regencies/cities in North Sumatra based on information sources from the agricultural service, farmer groups and communities who know about sorghum cultivation. This study aims to collect soil samples in sorghum plantations in various regions in North Sumatra. The soil nutrients in local sorghum growing locations vary, in terms of soil pH content, almost all locations fall into the acid criteria, the soil N content falls into the low criteria, and the soil P content is very low.*

Keywords: *Identification; Soil nutrients; distribution of growth and environmental characteristics of sorghum growth.*

I. INTRODUCTION

North Sumatra, a province located at the northwestern tip of Sumatra Island, has great potential for sorghum development. This is supported by two main factors, namely a suitable climate and extensive land. North Sumatra has an area of 72,781 km² (BPS, 2021), with most of its area being dry land and underutilized swamps. The ideal type of soil is sandy clay which has a higher water retention capacity, so that the ideal soil moisture for sorghum is compared to sandy soil. These lands have the potential to be developed as sorghum planting areas, so that they can increase food production and food security in this region (BPPTP, 2013). Sorghum, a cereal crop known for its drought resistance, has great potential to become a promising food and industrial alternative. Its ability to adapt to various land conditions makes it an attractive choice for farmers. In dry lands, such as lowlands and hillsides with low rainfall (BALITKABI, 2015). Its drought-resistant nature allows sorghum to grow optimally in conditions of minimal water, making it the right solution for areas with limited irrigation (BPTP, 2017).Sorghum demonstrates its flexibility with its ability to be grown on a wide range of land types. From dry and marginal land to tidal and rice-harvested land, sorghum offers an adaptive and resilient cultivation solution. By selecting the right land and implementing optimal cultivation practices, sorghum can be a profitable and sustainable agricultural commodity.Good land management to increase sorghum yields includes water management, increasing soil fertility through soil improvement, pest and disease prevention, crop rotation, management of soil organic matter and fertilization according to soil characteristics and plant needs (Maftucha, *et, al*. 2021).

Soil survey is a scientific process conducted to study, map, and evaluate the physical, chemical, and biological properties of soil in an area (Risnawati, et al, 2019). The main purpose of soil survey is to classify soil into different soil map units based on their characteristics, and produce informative soil maps. Information obtained from soil nutrient status maps can be used as a basis for determining appropriate fertilizer recommendations for cultivated plants (Suarni, 2017).Knowing soil fertility is very important to support optimal plant cultivation. By using physical soil observations, soil chemical testing, plant growth observations and the use of soil testing tools, using these methods can determine the level of soil fertility and take appropriate steps to increase its fertility (Efendi and Fatmawati, 2013). Fertile soil will produce healthy plants and abundant harvests, thus supporting food security and the welfare of farmers. The criteria for whether a soil has low, medium, or high nutrient value depends on the results of soil analysis compared to plant nutrient requirements (Firmasnyah, *et*, *al*, 2013). The purpose of this study was to determine the variables of soil fertility that are obstacles in sorghum cultivation in North Sumatra.

II. MATERIALS AND METHODS

This research was conducted in the province of North Sumatra using a survey method. The tools used in this study were GPS (Global Position System) to determine the location of the research location, a soil drill to take soil samples, label paper to mark soil samples, plastic bags as a place for soil samples, rubber bands to tie the bags, burlap sacks as a place for all soil samples, markers and cameras.Field surveys were conducted to obtain information data on local sorghum genotypes obtained from the Department of Agriculture, farmer groups, agricultural activists and farmers who still plant sorghum either in large or small quantities as intercrops or insert crops on managed land. Sorghum plant tracking was carried out for four months (August to December 2020). Soil sampling was conducted in four districts, namely Langkat, Deli Serdang, Serdang Bedagai, and Karo. Soil samples for this study were taken from 9 locations with each plant with a minimum sampling of 5% of the total area of the plant.

Soil types Inceptisol and Ultisol Soil sampling was carried out once, using the *purposive random sampling method*, namely by determining from each land. Approximately 2 kg of soil samples were taken around the plants using a soil drill at a depth of 0-20 cm from a minimum of 5 (five) observation points that represent land conditions. The soil samples were composited until representative soil samples were obtained for a unit of land area. Next, the samples were sent to the Socfin Indonesia laboratory for pH analysis (H2O 1:5 Electrometry method), Mg (Ammonium acetate method at pH 7 with AAS), K (Ammonium acetate method at pH 7 with AAS) , C-organic soil (Walley & Black method with Spectrophotometer) , Na (Ammonium acetate method at pH 7 with AAS), N-total (Kjeldahl method with Spectrophotometer, P-Bray II (Bray II Extract with Spectrophotometer), cation exchange capacity (CEC) (distillation method, Ammonium acetate at pH 7 with Spectrophotometer) and Ca (distillation method, Ammonium acetate at pH 7 with AAS).

Data analysis

The results of the soil analysis that has been analyzed in the Laboratory will be subjected to a T-test to statistically confirm whether there are significant differences in nutrient content between local sorghum growing locations.

III. RESULTS AND DISCUSSION

From the survey results, 9 sorghum planting locations were found spread across five districts in North Sumatra.

Table 1. Results of analysis of pH, N, P and K of soil at the growing location of local sorghum genotypes

Regency	Coordinates	Soil Nutrients				Weight of 1000 seeds (g)
		pH	N	P (mg/kg)	K	
Langkat	3° 52' 28" N (k)98°34' 31" E	4.96 Sour	0.13 Low	1194 Very Low	1.84 Very high	30.20
	3° 50' 27" N (s)98°32'10" E	4.90 Sour	0.28 Low	1028 Very Low	0.49 moderate	31.00
	3° 43' 10" N (p)98°23'45" E	4.81 Sour	0.14 Low	1325 Very Low	0.80 moderate	31.50
Karo	3° 7' 4.53" N (t)98° 25' 1.2" E	4.95 Sour	0.44 Low	960 Very Low	0.58 moderate	26.00

	3° 7' 32.15" N (a)98° 32' 14" E	5.01 Sour	0.32 Low	967 Very Low	0.55 is moderate	24.50
Serdang Bedagai	3°28' 50.98" N (w)98° 58' 24" E	4.86 Sour	0.21 Low	1062 Very Low	1.28 Very high	31.80
	3°27' 18.93" N (pen)99° 9' 0.22" E	5.04 Sour	0.24 Low	1017 Very Low	0.59 moderate	30.00
Deli Serdang	3° 36' 6" N (e)98° 54' 6.01" E	4.93 Sour	0.20 Low	885 Very Low	0.44 moderate	33.00
	3° 36' 9" N (N)98° 49' 0.1" E	4.98 Sour	0.22 Low	865 Very Low	0.50 medium	31.00

Table 1 shows that the soil pH (H2O) value of the research location in rice fields varies from pH 5.47 to 6.82 or varies from acidic to neutral. Judging from soil health, there are several locations of rice fields that show that the soil is unhealthy because the pH value (H2O) <5.5 (Winarso, 2005). This is in accordance with the opinion of Lantoi et al. (2016) which explains that soil with a pH value of 4.5 to 6.5 is unhealthy soil. The highest pH value is in Cot Preh Village at 6.82 and the lowest pH value is in Ujong Blang Village at 5.47. This means that the rice field soil in Ujong Blang Village has problems with acidity so it needs to be managed properly.Soil pH value can be used as a benchmark to assess the quality or health of the soil to meet the needs of the growing environment. Lantoi et al. (2016) stated that soil reaction (pH) not only indicates acidity or alkalinity, but can also indicate the physical, chemical, and biological properties of the soil.

Low pH indicates that soil colloids are dominated by hydrogen ions (H +). This cation can come from the arrangement of organic matter from rice plant residues or can also come from subsoil layers containing Al and Fe. This is in accordance with the statement of Maryati et al. (2014) that Al and Fe release H ions into the dye solution as a result of hydrolysis. The more these elements in the soil, the more H is released into the soil solution, so that the soil becomes more acidic. Organic matter that continues to decompose usually causes a decrease in soil pH, because the decomposition process releases organic acids that cause a decrease in soil pH (Nazir et al., 2017). However, the problem of soil acidity in the rice fields of Kuta Baro District, Aceh Besar is not a major problem except for the land in Ujong Blang village, because if this rice field is managed in a flooded state, the pH will increase.

Table 2. Results of analysis of C-Organic, Ca, Mg and CEC of soil at the growing location of local sorghum genotypes North Sumatra

Regency	Coordinates	Soil nutrients				Weight of 100 seeds (g)
		C-organic	Ca (%)	Mg (%)	CEC (cmol/kg)	
Langkat	3° 52' 28" N (k) 98° 34' 31" E	0.78 low	2.47 moderate	1.74 very high	27.05 in progress	30.20
	3° 50' 27" N (s) 98° 32' 10" E	1.34 moderate	3.01 high	2.33 very high	41.19 high	31.00
	3° 43' 10" N (p) 98° 23' 45" E	0.82 low	2.21 high	0.76 high	24.13 in progress	31.50
Karo	3° 7' 4.53" N (t) 98° 25' 1.2" E	3.32 high	2.67 high	1.05 is very high	58.09 very high	26.00
	3° 7' 32.15" N (a) 98° 32' 14" E	2.12 moderate	3.47 very high	1.57 very high	42.54 high	24.50
Serdang Bedagai	3° 28' 50.98" N (p) 98° 58' 24" E	1.18 low	2.91 high	0.86 high	34.66 is moderate	31.80
	3° 27' 18.93" N (pen) 99° 9' 0.22" E	1.03 low	4.00 very high	2.40 very high	38.63 high	30.00
Deli Serdang	3° 36' 6" N (e) 98° 54' 6.01" E	3.19 high	5.37 very high	0.29 moderate	43.48 high	33.00
	3° 36' 9" N (N) 98° 49' 0.1" E	3.23 high	5.30 very high	0.28 moderate	43.41 high	31.00

Calcium (Ca) is one of the important macronutrients for plants. Ca plays a role in various physiological processes of plants, such as cell wall formation, enzyme activation, water and nutrient absorption, and resistance to pests and diseases. From the research results, the effect of Ca can vary depending on the type of plant, soil conditions and fertilization practices. Ca deficiency can have a negative impact on plants, with consequences of decreased yields, low seed quality, and instability of harvest results.

Excess Ca can interfere with the absorption of other nutrients that are important for plants, such as potassium (K), magnesium (Mg), and phosphorus (P) (Asiono, *et al*. 2023). This can inhibit plant growth and development. Ca can cause poisoning in plants. Symptoms of Ca poisoning can be chlorosis (yellowing leaves), necrosis (dead tissue).

Cation Exchange Capacity (CEC) is one of the important indicators of soil fertility. CEC indicates the ability of the soil to bind and exchange cations (positively charged ions) such as calcium (Ca), magnesium (Mg), potassium (K), and sodium (Na). These cations play an important role in various physiological processes of plants, such as water and nutrient absorption, photosynthesis, and enzyme activation. Low soil CEC can have negative impacts on plants, such as decreased nutrient availability, damage to soil structure, decreased plant resistance to pests and diseases, and decreased crop yields (Hardjowigeno, 2016). Maintaining and increasing soil CEC can be done in various ways, such as adding organic matter, good soil management, and selecting plants that are tolerant to CEC deficiencies. With high soil CEC, plants can grow well and produce abundant and quality harvests.

IV. CONCLUSION

Soil pH at local sorghum growing sites in North Sumatra is mostly acidic, which can limit the availability of essential nutrients such as nitrogen, phosphorus, and potassium. Nitrogen content at almost all sites is low, while phosphorus content is very low, indicating the need to increase the supply of this nutrient through appropriate fertilization. Potassium content varies, with some sites having very high levels that can support plant growth without additional potassium fertilizer. Populations of soil bacteria and fungi show significant variation between sites, influenced by environmental factors such as moisture and organic matter content. Phosphate-solubilizing bacteria and fungi are found in varying numbers, with some sites showing high potential for providing natural phosphorus to plants. By implementing appropriate soil management strategies, sorghum cultivation in North Sumatra has the potential to increase production yields and food security in the region.

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