Characteristics of land for development of sorghum (sorghum bicholor L.) As a supplement due to outbreak of Covid-19 on sub optimal land in Padang Laweh West Sumatera, Indonesia

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Abstract. Sorghum is a dry land food crop that has great potential developed in Indonesia. The results proved that sorghum is the most appropriate crop of choice in an effort to increase the productivity of dry land that is acid, empty land or other non-productive land such as mining land that has been done by PT. Semen Tonasa in 2012. While Juniarti in 2009-2011 has been planting sorghum on the soil of Andisol, Entisol and Regosol in two seasons; winter and summer at Shobara, Hiroshima Prefecture Japan. The planted sorghum can produce biomass that can be utilized as an energy source used for the cultivation of strawberries in greenhouses and the utilization of energy in the household scope of Shobara-Hiroshima. The development of sorghum, the land productivity will be increased and support the development of sustainable agriculture and the increased of Indonesian food production. Through the research collaboration that has been done with PT. Agro Indah Permata 21 since 2015 has been planting sorghum in Padang Laweh, Koto VII District Sijunjung Regency, West Sumatera Indonesia with planting area of proximate 8 T/Ha and has produced production of 10 T/Ha of wheat seeds. The results of planting sorghum that has been done to produce sorghum seed products that have been processed into flour and sugar products from the stem of sorghum as a supplement due to outbreak of COVID-19. By evaluating land characteristics appropriate for the development of sorghum plants, in Padang Laweh, West Sumatra Indonesia.

1. Introduction
The potential of dry land in West Sumatra for the development of food crops is quite wide, about 590,450 hectares. Dry land with slope of <8% is feasible for the development of sorghum cultivation [1]. Sorghum has long been cultivated and known to Indonesian farmers especially in Java, NTB and NTT, commonly
planted by farmers as inter-cropping with other food crops. The problem is, some of this dry land is dominated by acid soils. In addition, the cultivation, research, and development of sorghum in West Sumatra is still very limited, due to lack of information about (superior seed, sorghum utilization and cultivation and how to grow good and true sorghum).

Previous research has been carried out by the Cereal Maros and the Isotope and Radiation Technology Application Center (PATIR), the National Nuclear Energy Agency (BATAN), specifically the sorghum, the study was focused on improving the available germplasm using Cobalt-60 gamma-sourced irradiation aimed at superior crops according to the criteria desired.

Agronomic ally, there was ten of hope have been produced, such as: high production, drought resistant, and clear white seed. Several mutant sorghum mutant lines of the PATIR-BATAN collection have been tested for resistance to acid soils. The study was conducted at Lampung, Indonesia in areas with soil pH conditions ranged from 4.2 to 4.7 with an Al saturation level of 30-39%. The results showed that several sorghum strains were highly resistant (highly tolerant) and partly moderately tolerant to acid soils. The acid-resistant sorghum strains are now in the process of purification and seed propagation.

The purpose of this study was to produce of sorghum that are resistant to pests and diseases on sub optimal land. The goal is expected to be obtained after three years.

2. Materials and method

2.1. Evaluation of Land characteristics for sorghum development on sub optimal land

This research was used survey method with intentional sampling (Purposive Random Sampling). The first survey by collecting data containing about the existence of the population of sorghum plant located in West Sumatera obtained from the owners of sorghum plantation, residents, and local community leaders as well as direct search in

2.2. Field

The study was conducted on the land planted with sorghum. Composite soil sampling was done at a depth of 0-20 cm.

3. Results and discussion

Sub optimal land in Padang Laweh District, Sijunjung Regency, West Sumatra is on the back of Bukit Barisan. This area has a variable height that starts from 118 meters to 1,335 meters above sea level with hilly and wavy topography.

Climatic conditions of Sijunjung Regency were included in the tropics with an average temperature of 21 °C -33 °C with an average rainfall of 2,451 mm / year. The condition of this climate according to Oldeman (Climatology Map of West Sumatra) is including type B2, with dry months 3-4 months. This condition makes it difficult for farmers to cultivate paddy rice fields twice a year (IP 200%) in rained lowland areas. Meanwhile, the hydrological conditions at Sijunjung Regency vary greatly from place to place. Some of the causes were climate differences, topography, and geological structure.

Based on the results of the analysis of soil samples on sorghum planted land in Padang Laweh District, Sijunjung Regency, West Sumatra was shown on Table 1. Based on the observations of land characteristics shown on Table 2 and the analysis of soil samples shows that Padang Laweh District, Sijunjung Regency, West Sumatra has the potential for the development of sorghum plants with average land temperature characteristics 25-27 ° C, rainfall <200 mm, air humidity <75%, good drainage, soil depth> 60 cm, pH 4.4-6.1 but availability of N, P and K were low (Table 1).
### Table 1. Characteristic of land at Padang Laweh, Sijunjung District, West Sumatera.

| Requirements of land use/Land Characteristics | Land Characteristics | Classification of Land Suitability |
|---------------------------------------------|----------------------|-----------------------------------|
| Temperature (t)                              |                      | S1  | S2  | S3  | N    |
| - Temperature Average (°C)                  | 21-33 25-27          | 18-25/27-30 | 15-18/30-35 | <15/>35 |
| Water availability (w)                      |                      |     |     |     |      |
| - Dry season (month)                        | 3-4  8-4             | 2.5-4/8-8.5 | 1.5-2.5/8.5-9.5 | <1.5/>9.5 |
| - Rainfall (mm)                             | 2451 <200 200-1200   | 1200-2000 | >2000 |      |
| Air humidity (%)                            | 60-80 <75 75-80      | >85 | td  |
| Oxygen availability (o)                     |                      |     |     |     |      |
| - Drainage                                  | b  b, at  s          | t  | st, sc |
| Rooting medium (r)                          |                     |     |     |     |      |
| - Texture                                  | loam-clay            | h, s| ah | ak | k |
| - Coarse material (%)                       | <15  <15            | 15-35 | 35-55 | >55 |
| - Depth of soil (cm)                        | >60  >60            | 40-80 | 25-40 | <25 |
| Nutrient retention (n)                      |                     |     |     |     |      |
| - CEC (cmol)                                | 9.5-36.2 >16  ≤16     | td  | td  |
| - Base saturation (%)                       | >50  35-50          | <35  | td  |
| - pH H2O                                    | 4.4-6.1 5.5 – 8.5    | 5.3-5.5 / 8.2-8.3 | <5.3 / > 8.3 | td |
| - Total N                                   | 0.06-0.66 t,s,r,sr  | st, t, s | r  | sr |
| - K2O                                       | 3.1-18.9 st          | t, s | r  | sr |
| - P2O5                                      | 2.6-3.0 s            | >0.4 | ≤0.4 | td |
| Toxicity (xc)                               |                     |     |     |     |      |
| - Salinity (dS/m)                           | <8   <8            | 8-12  | 12-16 | >16 |
| Sodositas (xn)                              |                     |     |     |     |      |
| - Alkalinity/ESP                            | <20  <20          | 20-28 | 28-35 | >35 |
| Erosion hazard (e)                          |                     |     |     |     |      |
| - Slope (%)                                 | 8->40 <8            | 8-16  | 16-30/16-50 | >30/>50 |
| - Erosion hazard                            | b  sr  r,s         | b  | sb  |
| Flood (f)                                   |                     |     |     |     |      |
| - Flood                                     | f2   f0            | f1  | f2  | >f3 |
| Land preparation (lp)                       |                     |     |     |     |      |
| - Rocks at the surface (%)                  | <5   <5            | 5-15  | 15-40 | >40 |
| - Rock outcrop (%)                          | <5   <5            | 5-15  | 15-25 | >25 |

Notes: st = very high, t = high, s = medium, r = low, sr = very low, td = no data, k = rought, ak = little rough, ah = little smooth, h = smooth.
**Table 2.** Characteristic of Land use requirements / Land suitability classes for sorghum [2].

| Requirements of land use/Land Characteristics | Classification of Land Suitability |
|-----------------------------------------------|-----------------------------------|
| Temperature (t)                               | S1 | S2 | S3 | N |
| - Temperature Average (ºC)                    | 25-27 | 18 – 25 / 27 - 30 | 15-18 / 30-35 | <15 / >35 |
| Water availability (w)                        | 8-4 | 2.5-4/8-8.5 | 1.5-2.5/8.5-9.5 | <1.5/9.5 |
| - Dry season (month)                          | <200 | 200-1200 | 1200-2000 | >2000 |
| - Rainfall (mm)                               | <75 | 75-80 | >85 | td |
| Air humidity (%)                              | <75 | 75-80 | >85 | td |
| Oxygen availability (o)                       | b, at | s | t | st, sc |
| Rooting medium (r)                            | h, s | ah | ak | k |
| - Texture                                     | <15 | 15 - 35 | 35-55 | >55 |
| - Coarse material (%)                         | >60 | 40 - 80 | 25 - 40 | <25 |
| Nutrient retention (n)                        | 5.5 – 8.5 | 5.3-5.5 / 8.2-8.3 | < 5.3 / > 8.3 | td |
| - CEC (cmol)                                  | >16 | ≤16 | td | td |
| - Base saturation (%)                         | >50 | 35-50 | < 35 | td |
| - pH H2O                                      | 5.5-8.5 | 5.3-5.5 / 8.2-8.3 | < 5.3 / > 8.3 | td |
| - Total N                                     | st, t, s | r | sr | td |
| - K2O                                         | st, t, s | r | sr | td |
| - P2O5                                        | st | t, s | r | sr |
| - C-organic                                   | > 0,4 | ≤0,4 | td |
| Toxicity (xc)                                 | < 8 | 8 - 12 | 12 -16 | >16 |
| - Salinity (dS/m)                             | < 20 | 20-28 | 28-35 | >35 |
| Sodositas (xn)                                | < 8 | 8 - 16 | 16-30/16-50 | >30/50 |
| Erosion hazard (e)                            | < 8 | 8 - 16 | 16-30/16-50 | >30/50 |
| - Slope (%)                                   | sr | r, s | b | sb |
| Flood (f)                                     | f0 | f1 | f2 | f3 |
| - Flood                                      | < 5 | 5 - 15 | 15 - 40 | >40 |
| - Rocks at the surface (%)                    | < 5 | 5 - 15 | 15 - 25 | >25 |
| - Rock outcrop (%)                            | < 5 | 5 - 15 | 15 - 25 | >25 |

Notes: st = very high, t = high, s = medium, r = low, sr = very low, td = no data, k = rought, ak = little rough, ah = little smooth, h = smooth.

Based on Table 2. above shows that the characteristics of agricultural land at Padang Laweh District, Sijunjung Regency, West Sumatera has potential for the development of sorghum, by applying proper soil technique because the land was dominated by Inceptisol and Ultisol. Furthermore, the type of land management with the addition of organic materials has the potential to develop sorghum with a yield of 10 Ton / Ha, but if kept in continuously without the addition of organic materials will be able to reduce the quality of the land. For that addition of input in the form of organic fertilizer was needed [3]. While Juniarti in 2009-2011 has been planting sorghum on the soil of Andisol, Entisol and Regosol in two
seasons; winter and summer at Shobara, Hiroshima Prefecture Japan. The planted sorghum can produce biomass that can be utilized as an energy source used for the cultivation of strawberries in greenhouses and the utilization of energy in the household scope of Shobara-Hiroshima [4].

4. Conclusion
The results showed that land in Padang Laweh District, Sijunjung Regency West Sumatera has potential for the development of sorghum plants with average temperature characteristics 25-27 °C, rainfall <200 mm, air humidity <75%, good drainage, soil depth> 60 cm, pH 4.4 - 6.1 but low N, P and K nutrient availability.

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