Sorghum genotype screening for increased productivity on marginal land through the ratoon cropping system

Faesal\textsuperscript{1}, Syuryawati\textsuperscript{1} and Suarni\textsuperscript{1}
\textsuperscript{1}The researchers of Indonesian Cereals Research Institute (ICERI), Maros 90514, South Sulawesi, Indonesia

Abstract. Sorghum as a drought tolerant crop, its planting is directed to marginal dry land type agro-climate which is relatively hotter for the supply of alternative food for rice substitution. The food sorghum genotype was selected from a multilocation test of 15 accessions plus Numbu variety, local Lombok and local Flores, so that there were 18 accessions arranged according to the randomized block design with three replications as the main crop. Spacing of 75 cm x 20 cm (66,666 plants per ha), fertilized with 135 kg N, 45 kg P\textsubscript{2}O\textsubscript{5} and 60 kg K\textsubscript{2}O per ha on the main crop. After the main crop has been harvested, relatively homogeneous shoots are kept as ratoon plants until harvest and are fertilized 1 time as much as 50\% of the main crop fertilizing dose after the shoots begin to grow. The results showed that five sorghum genotypes in the ratoon cultivation system produced higher seeds than superior varieties of Numbu and were significantly higher than those of Flores and local Lombok. Sorghum genotypes that provide high profits from two seed harvests (main crop yields > 6 t / ha and sorghum rations > 5 t / ha) compared to three comparative varieties, especially Numbu, are genotypes No. 58-1 (Rp. 14,922,700); 86-1 (Rp. 13,954,200); 11-5 (Rp. 13,936,000); 113-1 (Rp. 13,905,000); and No. 103-1 (Rp. 13,006,800) while Numbu benefits Rp. 12,178,500 / ha. This is supported by higher genotype farming efficiency values, ranging from R/C of 2.36 - 2.53 and B/C of 1.36 - 1.53 and lower cost per kg ratio of Rp 790 - 846 / kg of temporary seeds Numbu value of R/C 2.26; B/C 1.26 and the cost/kg ratio of seeds is Rp 884.

1. Introduction
Sorghum is known as a drought-resistant crop, so that its planting is directed to dry land and marginal with a relatively hot type of agro-climate. In some areas such as East Java sorghum is planted in arid climates, the rainy season is short and the soil is less fertile. Global climate change between regions and between time causes losses that must be borne by farmers [4]. Sorghum has several benefits, both staple food and substitute rice or flour, the nutrient content of sorghum seeds is quite competitive with other foodstuffs such as rice or corn. To get sufficient food in marginal sorghum land, one of the plants that can adapt in marginal land is better than other cereals such as rice and corn.

Sorghum plants are very responsive to N fertilization depending on the level of soil fertility and varieties used. This is the case with P, K and S fertilizers needed to maintain nutrient balance in the soil. Potassium is also needed to encourage the production of carbohydrates, in addition potassium is needed to help the absorption of water by the roots and prevent the evaporation of water out of the leaves so potassium plays a role in reducing the sensitivity of sorghum plants to drought [7]. Marginal dry land generally has a number of rainy days and low rainfall with a short duration, so sorghum
technology is more appropriate to be developed in this region, because to plant with seeds from the beginning of growth in these conditions becomes a problem due to drought. Sorghum genotypes significantly affected the performance of main and ratoon crop production ranging from 48.90-65.73% to the main crop production [11]. Cultivation of the sorghum ratoon system saves the use of seeds, reduces production costs by up to 20% and can control erosion [17]. Sorghum with a cropping system harvests 20-30 days earlier than planting seeds [8]. Sorghum ratoon planting system appeals to farmers who only have seeds with low growing capacity, because planting such seeds will fail [14]. It was further reported by [5] that sorghum in the ratoon crop system was superior to seed planting in terms of suppressing weed populations.

In Indonesia sorghum does not have to be a staple food, but rather a rice supplement. Rice with a mixture of 20-25% sorghum and 75-80% rice is not expected to change the texture and aroma, even in a crisis situation the mixture of 50% sorghum and 50% rice is still suitable for consumption [18]. Fertilization of plants in sorghum depends on soil fertility, farmers in many places use urea ranging from 45-224 kg N / ha in sorghum cultivation. Fertilization of 200 kg N / ha gives the highest biomass of 64.80 t / ha, protein 8%, and the lowest dissolved carbohydrate is 12.80%, and fiber content is 31.90% [1]. The optimal N and P needs for sweet sorghum for the long term based on total production and fertilizer application are around 90-110 kg N / ha and 15-20 kg / ha P2O5 [3]. Seed yields can be improved through practical management manipulations such as genotype selection, fertilization and use of insecticides [12].

Gluten-free sorghum seeds have the potential to be used as an alternative to flour. There are thousands of sorghum that have been characterized for seeds, flour or the quality of the final product such as making good quality egg noodles in China [9]. Furthermore it is said that seed size and weight are key factors for differences in seed quality, flour and end use, and have been considered in the selection of hybrid sorghum.

2. Materials and Methods
The material in the form of yield lines or being multi-location test is chosen that is good and adapted to some sorghum requirements for food. Some sorghum requirements for food begin with the choice of sorghum based on color. Sorghum breeders in Africa state that determining the quality of sorghum for food is associated with clean, white, beige, clear yellow, shiny yellow with thin pericarp [2]. The sorghum strains selected from the 15 multilocation test activities (prospective varieties) were added with 1 variety (Numbu), and two local varieties namely 1 local Lombok and 1 local Flores, so there were 18 accessions, then arranged according to group design with three replications as main plant. The plot size of the experiment is 5 m x 3 m with a spacing of 75 cm x 20 cm, 2 seeds are planted per hole, then sparse into 1 plant per hole. Fertilization is given 135 kg N, 45 kg P2O5 and 45 kg K2O per ha. The first fertilization is carried out at 10 days after planting (dap) with 50% dose of N plus all the doses of P and K. The 50% supplementary urea fertilizer is given as a second fertilizer at 30 days after the plant is blown 5-10 cm beside the plant. Plant maintenance includes weeding, growing, watering and controlling pests and diseases optimally until the main crop is harvested.

Genotypes and cultivars in main plants with good appearance especially those that stay green in the field after harvesting panicles/seeds, maintained with a ratoon system begins by cutting the main plant stems, leaving the base of the stems about 7 cm above the soil surface. Next, choose plants that are sturdy, have good roots, grow from below the surface of the soil, are healthy, free from pests and diseases. Give enough water to stimulate the emergence of a number of shoots and immediately do fertilized only once after cutting the main plant stems with 150 kg urea, 25 kg P2O5, 30 kg K2O per ha. Ratoon thinning is carried out at the age of 15-20 days, leaving 1 sapling in one family. Plant maintenance is carried out as well as in the main crop until the ratoon are harvested by panicles and seeds.

Observation:1. Analysis of soil samples before research,2. Plant height at harvest,3. Wet and dry weights of plant stover,4. Plant stem cycle, 5. Dried weights (seeds, 1000 seeds),6. Age of crop harvest,7. Yield decline to main plants, 8. Economic evaluation of main and ratoon plants.
3. Results and Discussion

3.1. Land Research Location
Soil analysis from the study site shows that the physical properties of the soil are quite good with dusty clay texture, but from the chemical aspect of soil fertility there is no nutrient balance where N is low (0.14%) while K is high (49 ppm) and P is very high (81 ppm). Likewise cations can exchange such as very high Ca (27.6 me / 100 g), high Mg (0.78 me / 100 g), while K is low (0.07 me 100 g). To get optimal sorghum crop yields on this land additional fertilizer is needed, especially N and K which are sufficient to allow nutrient balance to occur in the soil and available to plants.

3.2. Main Crop Growth
The height of the main plant at harvest showed that sorghum plants at Bonto Ramba Jeneponto did not show any significant difference from all genotypes and cultivars tested. The height of the genotype test plants was generally classified as ideal, this is in accordance with the statement of [19] that the height of sorghum plants should ideally not exceed 210 cm. For Lombok local sorghum stem circumference, it gives the highest stem circumference that is significantly different from other genotypes, the name is not significantly different from KT 247-1-1 and No. 11-5.

Table 1. Major plant growth components of sorghum genotypes, Bonto Ramba Jeneponto Regency South Sulawesi 2018

| Genotype/ cultivar | Plant height (cm) | Stem diameter (cm) | Number of fresh leaf | Stalk dry weight (t/ha) |
|--------------------|------------------|--------------------|----------------------|------------------------|
| No. 11-2           | 209.7 tn         | 1.70 bc            | 6.60 abc             | 6.21 ab                |
| No. 11-3           | 225.7            | 1.82 bc            | 7.30 ab              | 6.46 ab                |
| No. 11-5           | 223.4            | 1.89 ab            | 7.93 a               | 6.63 ab                |
| No. 5-2            | 218.3            | 1.81 bc            | 7.50 ab              | 5.54 ab                |
| No. 36-1           | 208.3            | 1.85 b             | 7.33 ab              | 5.62 ab                |
| No. 58-1           | 213.8            | 1.83 b             | 8.01 a               | 6.82 a                 |
| No. 86-1           | 201.9            | 1.86 b             | 8.13 a               | 6.56 ab                |
| KT 247-1-1         | 155.5            | 1.97 ab            | 5.83 bc              | 4.85 bc                |
| No. 76-1           | 202.2            | 1.63 bc            | 6.63 abc             | 5.10 abc               |
| No. 34-1           | 204.5            | 1.73 bc            | 6.70 abc             | 5.23 abc               |
| No. 50-1           | 208.6            | 1.67 bc            | 7.13 abc             | 5.18 abc               |
| No. 96-1           | 192.4            | 1.76 bc            | 6.03 bc              | 6.41 ab                |
| No. 103-1          | 136.9            | 1.83 b             | 5.50 c               | 6.58 ab                |
| No. 113-1          | 211.9            | 1.86 bc            | 7.13 abc             | 6.91 a                 |
| No. 93-1           | 198.5            | 1.71 bc            | 6.80 abc             | 5.56 ab                |
| Numbu              | 195.3            | 1.78 bc            | 6.47 abc             | 4.86 bc                |
| Local Lombok       | 236.7            | 2.26 a             | 8.12 a               | 6.30 ab                |
| Local Flores       | 191.8            | 1.43 c             | 6.29 abc             | 3.97 c                 |
| CC                 | 18.4             | 7.0                | 12.6                 | 11.0                   |

The numbers that follow the same letter do not differ significantly from the 5% DMRT.

While for the number of fresh leaves at the local Lombok sorghum harvest, the highest number of leaves was not significantly different from other genotypes, but significantly different from genotype No. 96-1, No. 103-1, and KT 247-1-1. Whereas the highest stover dry weight was obtained in genotype No. 113.1 which is significantly different from other genotypes except for Numbu, local Flores and No. genotype. 86-1 (Table 1). Genotype significantly affect to primary and ratoon of sorghum performance [11].
3.3. Growth of Ratoon Crops

Growth of the sorghum genotype ratoon tested showed that the general appearance of the plants grew well, this was shown by the number of shoot after cutting the stems, plant height, non-senescentous leaf and stems dry weight. The similar was stated by [17] that important factors that need to be considered in sorghum ratoon are drought-tolerant plants, strong stems, leaves do not dry out quickly, and the ability to produce shoot. The number of tillers, number of fresh leaves and dry weight of stalk did not show any significant difference between the genotypes tested. Whereas the plant height indicates that Lombok’s local cultivars produced plant height that were significantly different from whole genotype except No. 5-2, and No. 58-1, and 76-1 (Table 2).

Table 2. Components of growth of sorghum genotype ratoon plants, Bonto Ramba, Jeneponto Regency, South Sulawesi, 2018

| Genotype and cultivar | Number of shoot | Plant Height (cm) | Fresh leaf number | Stem waste dry weight(t/ha) |
|-----------------------|----------------|------------------|------------------|---------------------------|
| No. 11-2              | 3.07 Tn        | 176.1 b          | 5.60 tn          | 5.01 tn                    |
| No. 11-3              | 3.06           | 191.1 b          | 5.13             | 5.19                       |
| No. 11-5              | 3.13           | 191.2 b          | 5.61             | 5.47                       |
| No. 5-2               | 3.40           | 196.3 ab         | 5.61             | 4.84                       |
| No. 36-1              | 3.03           | 191.0 b          | 4.80             | 4.91                       |
| No. 58-1              | 3.67           | 196.5 ab         | 5.67             | 6.14                       |
| No. 86-1              | 3.43           | 177.3 b          | 5.66             | 6.09                       |
| KT 247-1-1            | 3.33           | 135.7 c          | 6.27             | 4.86                       |
| No. 76-1              | 3.53           | 193.5 ab         | 5.40             | 4.82                       |
| No. 34-1              | 3.63           | 190.0 b          | 5.33             | 4.47                       |
| No. 50-1              | 2.97           | 188.9 b          | 5.70             | 4.58                       |
| No. 96-1              | 3.10           | 180.6 b          | 5.30             | 5.44                       |
| No. 103-1             | 3.47           | 130.7 c          | 5.20             | 4.97                       |
| No. 113-1             | 3.06           | 179.3 b          | 5.47             | 5.53                       |
| No. 93-1              | 3.17           | 179.1 b          | 5.13             | 3.98                       |
| Numbu                 | 3.26           | 180.0 b          | 5.06             | 4.61                       |
| Local Lombok          | 2.77           | 225.9 a          | 6.30             | 6.57                       |
| Local Flores          | 2.92           | 178.1 b          | 6.80             | 3.85                       |
| CC                    | 14.6           | 6.2              | 16.0             | 17.1                       |

The numbers that follow the same letter do not differ significantly from the 5% DMRT

3.4. Primary and ratoon grain yield

In the main plant the highest panicle length was No. genotype. 103-1 which is not significantly different from KT 247-1-1 and local Lombok but significantly different from other genotypes including Numbu, and local Flores. While the highest panicle ratoon plants on KT 247-1-1 were significantly different from other genotypes, but no different from No. 103-1 and local Lombok. The decrease in panicle length ranged from 0.0% in genotype No.11-5 to the highest 2.6% in genotype No. 103-1. For the weight of 1000 dried seeds at 11% moisture content the main plants showed that No. 11-3 highest is not significantly different from other genotypes, but different from No. 36-1, No. 76-1, No. 93-1 and local Flores. Whereas for ratoon plants the highest weight of 1000 seeds was no. 11.5 is significantly different from other genotypes, but is no different from No. 11-2, No. 11-2 No. 11-5, No. 36-1, No. 58-1,96-1 and No.113-1. The highest weight loss of 1000 ratoon seeds to the main crop was in Numbu (38.25%) and the lowest in No. 58-1 namely + 9.58% (Table 3). The yield of sorghum genotype seeds was significantly affected by the weight of 1000 seeds and flowering age [15]. Cropping system, variety and reduction of shoot significantly increase grain yield of sorghum ratoon [13].
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Table 3. Panicle length and weight of 1000 main plant seeds and ratoon sorghum genotype, Bonto Ramba, Jeneponto Regency, South Sulawesi, 2018

| Genotype/cultivar         | Primary crop (cm) | Ratoon crop (cm) | Reduction (%) | Primary crop (cm) | Ratoon crop (cm) | Reduction (%) |
|---------------------------|------------------|-----------------|---------------|------------------|-----------------|---------------|
| No. 11-2                  | 19.9 b           | 20.9 b          | +1.0          | 41.3 abc         | 41.6 ab         | +0.72         |
| No. 11-3                  | 19.0 b           | 19.8 b          | +0.8          | 42.7 a           | 41.7 ab         | +1.20         |
| No. 11-5                  | 19.9 b           | 19.9 b          | 0.0           | 40.6 abcd        | 42.66 a         | +4.69         |
| N0. 5-2                   | 21.3 b           | 20.2 b          | 1.1           | 36.7 abcd        | 36.0 bcd        | 1.94          |
| No. 36-1                  | 20.7 b           | 21.2 b          | +0.5          | 34.6 d           | 33.6 abc        | 2.98          |
| No. 58-1                  | 20.6 b           | 21.3 b          | +0.7          | 40.7 abcd        | 44.6 a          | +9.58         |
| No. 86-1                  | 21.0 b           | 20.2 b          | 0.8           | 41.3 abc         | 43.0 a          | +4.12         |
| KT 247-1-1                | 34.3 ab          | 33.1 a          | 1.2           | 38.0 abcd        | 25.7 e          | 32.37         |
| No. 76-1                  | 20.1 b           | 19.8 b          | 0.3           | 35.0 bcd         | 33.0 d          | 2.85          |
| No. 86-1                  | 19.9 b           | 19.7 b          | 0.2           | 36.0 bcd         | 35.0 d          | 1.00          |
| No. 50-1                  | 20.0 b           | 20.8 b          | +0.8          | 35.3 cd          | 34.6 d          | 1.98          |
| No. 96-1                  | 21.3 b           | 20.6 b          | 0.7           | 40.7 abcd        | 43.3 a          | +6.39         |
| No. 103-1                 | 35.1 a           | 32.5 a          | 2.6           | 40.0 abcd        | 26.0 e          | 35.00         |
| No. 113-1                 | 21. b            | 21.5 b          | +0.5          | 40.6 abcd        | 41.7 ab         | +2.71         |
| No. 93-1                  | 20.0 b           | 19.7 b          | 0.3           | 36.0 bcd         | 35.3 cd         | 1.94          |
| Numbu variety             | 20.6 b           | 20.5 b          | 0.1           | 40.0 abcd        | 24.7 d          | 38.25         |
| Local Lombok              | 32.3 ab          | 31.7 a          | 0.6           | 42.0 ab          | 35.3 cd         | 15.95         |
| Local Flores              | 22.9 b           | 20.9 b          | 2.0           | 35.3 cd          | 34.7 d          | 1.70          |

The numbers that follow the same letter do not differ significantly from the 5% DMRT.

The highest yield of dried ratoon in no. 58-1 which is significantly different from No. 34-1, local Lombok and local Flores, but not significantly different from other genotypes. There are 5 (five) genotypes giving higher yields compared to Numbu variety although not statistically different, the genotype is No. 58-1, No. 86-1, No. 11-5, No. 113-1 and No. 103-1. The highest total yield of main and ratoon plants was 12.333 t/ha in No. 58-1, while the lowest is Lombok local area of 6.937 kg/ha. For the decline of seed crop ratoon against prime plants ranged from 3.1% KT 247-1-1 to 21.4% of No. 5-2 (Table 4). Reported that ratoon sorghum produce grain yield vary of 0.65-73% toward primary crops [11]. Some sorghum genotypes for food which in this study produce higher seed weights and have larger seed sizes, this is as reported by [10] that productive sorghum is sorghum that has large seed size characteristics and a high harvest index.

3.5. Economic Evaluation of Seed Results

Sorghum planting with two harvests of its production greatly helps farm income. In this regard, sorghum genotypes that provide high profits from twice the production of seeds (main crop seed yields> 6 t/ha and ratoon sorghum> 5 t/ha) compared to the three comparative varieties, especially the superior varieties of sorghum. No. 58-1 (IDR 14,922,700); No. 86-1 (IDR 13,954,200); No.11-5 (IDR 13,936,000); No.113-1 (IDR 13,905,000); and No. 103-1 (IDR 13,006,800) while Numbu benefits IDR 12,178,500/ha. This is supported by the higher efficiency of farming genotypes, ranging from R/C value of 2.36 - 2.53 and B/C value of 1.36 - 1.53 and lower cost per kg ratio of IDR. 790 - 846/ kg of seeds, while Numbu value of R/C is 2.26; B/C 1.26 and seed/kg cost ratio of IDR. 884. If value of R/C ratio >1, its means sorghum farming was efficient (6). Thus the five genotypes are feasible to be proposed as new improved varieties of sorghum because seed yields are higher, more efficient and profitable compared to Numbu variety, local Flores and local Lombok.

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### Table 4. Primary and ratoon crop yields of the sorghum genotype, Bonto Ramba Jeneponto Regency, South Sulawesi 2018

| Genotype/ cultivar | Grain Yields (t/ha) | Total Seeds (t/ha) | Yield Reduction (%) |
|--------------------|---------------------|--------------------|---------------------|
| No. 11-2           | 5.920 ab            | 4.860 abc          | 10.780              | 17.9 |
| No. 11-3           | 6.329 a             | 4.976 abc          | 11.305              | 21.4 |
| No. 11-5           | 6.450 a             | 5.390 ab           | 11.840              | 16.4 |
| No. 5-2            | 5.369 abc           | 4.193 abc          | 9.562               | 21.9 |
| No. 36-1           | 5.311 abc           | 4.410 abc          | 9.721               | 16.9 |
| No. 58-1           | 6.503 a             | 5.830 a            | 12.333              | 10.3 |
| No. 86-1           | 6.151 ab            | 5.567 ab           | 11.718              | 9.5  |
| KT 247-1-1         | 4.484 bc            | 4.453 abc          | 8.937               | 3.1  |
| No. 76-1           | 4.922 abc           | 4.260 abc          | 9.182               | 13.4 |
| No. 34-1           | 4.990 abc           | 3.993 bc           | 8.983               | 20.0 |
| No. 50-1           | 4.956 abc           | 4.330 abc          | 9.286               | 12.6 |
| No. 96-1           | 6.190 ab            | 4.993 abc          | 11.183              | 19.3 |
| No. 103-1          | 6.102 ab            | 5.170 ab           | 11.272              | 15.2 |
| No. 113-1          | 6.570 a             | 5.280 ab           | 11.850              | 19.6 |
| No. 93-1           | 5.413 ab            | 4.157 abc          | 9.570               | 23.3 |
| Numbu              | 6.062 ab            | 4.853 abc          | 10.915              | 19.9 |
| Local Lombok       | 3.627 c             | 3.310 c            | 6.937               | 8.7  |
| Local Flores       | 4.551 bc            | 3.893 bc           | 8.444               | 14.5 |

The numbers that follow the same letter do not differ significantly from the 5% DMRT
| Galur/Varietas | Total seeds of primary and ratoon (t/ha) | Total receipt (IDR/ha) | Total cost production (IDR/ha,.) | Total benefit (IDR/ha) | R/C ratio | B/C ratio | Ratio cost/kg seeds (IDR/kg) |
|---------------|--------------------------------------|-----------------------|-------------------------------|---------------------|----------|----------|-----------------------------|
| No. 11-2      | 10.780                               | 21,560.000            | 9,588,000                     | 11,972,000          | 2.25     | 1.25     | 889                         |
| No. 11-3      | 11.305                               | 22,610.000            | 9,790,500                     | 12,819,500          | 2.31     | 1.31     | 866                         |
| No. 11-5      | 11.840                               | 23,680.000            | 9,744,000                     | 13,936,000          | 2.43     | 1.43     | 823                         |
| No. 5-2       | 9.562                                | 19,124.000            | 9,166,200                     | 9,957,800           | 2.09     | 1.09     | 959                         |
| No. 36-1      | 9.721                                | 19,442.000            | 9,232,100                     | 10,209,900          | 2.11     | 1.11     | 950                         |
| No. 58-1      | 12.333                               | 24,666.000            | 9,743,300                     | 14,922,700          | 2.53     | 1.53     | 790                         |
| No. 86-1      | 11.718                               | 23,436.000            | 9,481,800                     | 13,954,200          | 2.47     | 1.47     | 809                         |
| KT247-1-1     | 8.937                                | 17,874.000            | 9,253,700                     | 8,620,300           | 1.93     | 0.93     | 1,035                       |
| No. 76-1      | 9.182                                | 18,364.000            | 9,178,200                     | 9,185,800           | 2.00     | 1.00     | 1,000                       |
| No. 34-1      | 8.983                                | 17,966.000            | 9,158,300                     | 8,807,700           | 1.96     | 0.96     | 1,020                       |
| No. 50-1      | 9.286                                | 18,572.000            | 9,288,600                     | 9,283,400           | 2.00     | 1.00     | 1,000                       |
| No. 96-1      | 11.183                               | 22,366.000            | 9,678,300                     | 12,687,700          | 2.31     | 1.31     | 865                         |
| No. 103-1     | 11.272                               | 22,544.000            | 9,537,200                     | 13,006,800          | 2.36     | 1.36     | 846                         |
| No. 113-1     | 11.850                               | 23,700.000            | 9,795,000                     | 13,905,000          | 2.42     | 1.42     | 827                         |
| No. 93-1      | 9.570                                | 19,140.000            | 9,367,000                     | 9,773,000           | 2.04     | 1.04     | 979                         |
| Numbu         | 10.915                               | 21,830.000            | 9,651,500                     | 12,178,500          | 2.26     | 1.26     | 884                         |
| L. Lombok     | 6.937                                | 13,874.000            | 8,853,700                     | 5,020,300           | 1.57     | 0.57     | 1,276                       |
| L. Flores     | 8.444                                | 16,888.000            | 9,254,400                     | 7,633,600           | 1.82     | 0.82     | 1,096                       |

4. Conclusion
The screening of sorghum genotypes obtained by 5 sorghum food cultivated with a ratoon system gives higher seed yields from Numbu and local Flores and Lombok. The sorghum genotype is No.58.1, No. 86.1, No. 11.5, No. 113.1 and No. 103.1 with the dry seed yield of each is 5.83; 5.57; 5.39; 5.28 and 5.17 t/ha with decreases in yield to main crops ranging from 9.5 to 19.6%. Farming efficiency of these genotype is higher, ranging from R/C value of 2.36 - 2.53 and B/C value of 1.36 - 1.53 and lower cost per kg ratio of IDR 790 - 846 / kg seeds while Numbu value of R/C is 2.26; B/C 1.26 and the cost/kg ratio of seeds is IDR 884.

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