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The Effect of Number of Shoots of Sorghum in First and Second Ratoon System

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ABSTRACT

The ratoon cultivation system for sorghum offers various advantages, such as a short life span, minimal production costs, and the ability of the plant to grow again without the need to plant new seeds. The first objective of this research is to determine the effect of variety and number of shoots in ratoon 1 and ratoon 2, while the second objective is to determine the interaction between variety and number of shoots in the ratoon system. This research was conducted between March - August 2022 in Cabeyan, Sukoharjo, Central Java, Indonesia. Varieties used include Numbu, Super 1, Suri 3, Kawali, and Keller. The number of shoots used is up to four. The analysis of research on the 1st and 2nd ratoon was conducted as independent research with a Completely Randomized Block Design with 3 replicates. Comparison of the analysis of the 1st and 2nd ratoon. Two factors (Numbu, Super 1, Suri 3, and Keller) and the number of shoots (1, 2, 3, and 4) were used. The research results indicate that all parameters affect the variety and number of shoots in the 1st and 2nd ratoon. There was no interaction between varieties and number of shoots. All the variables were better in the 1st ratoon than in the 2nd ratoon. The first ratoon developed and performed better in terms of growth and yield than the second ratoon.

Keywords: Ratoon, shoots, sorghum, stem, yield

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INTRODUCTION

Sorghum is a versatile plant that can serve as both a food and an energy source across its various types and applications (Mehla et al., 2025; Stoicea et al., 2025). Sorghum stalks are often left neglected at harvest, even though they have the potential to produce ratoon shoots. The ratoon system is

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established by planting the remaining parts of the harvest. The benefits of ratoon cultivation over seed-based cultivation include: a shorter life cycle, lower water use, less labour, and lower production costs. Production costs are low because it does not involve tilling or buying seeds.

Most studies on sorghum focus solely on seed production and planting material. The advantage of sorghum is that this plant can be ratooned, and the yield of ratoon one does not decrease significantly compared with yields on unratooned sorghum. Meanwhile, the yield of animal feed using ratooned sorghum was higher than that of sorghum ratooned previously. The production potential, in terms of both time and duration, can be up to 49 - 66 percent of the original performance or the initial crop (Hamaker et al., 2025). The rest of the sorghum stems are squeezed, and the 2 low outbreaks are left to produce new outbreaks. The performance of the culture at that time was also significantly and positively correlated with the main crop yield (Yali, 2026).

To achieve high yields, the number of shoots per clump in sorghum ratoon plants should be increased by using adult plants from the first ratoon. Sorghum is more drought-resistant than other cereals and is also more drought-resistant than corn. The research on the first and second ratoons was conducted separately, using the same treatments (five varieties and four types of shoots). Overall, there is no more than one ratoon in the existing research. Clarify the specific research gap and moderate the claim that no previous study has compared these ratoon cycles. Research on ratoon crops typically focuses on cultivation starting from seed and proceeding to the first ratoon.

This study addresses a research gap by examining the transition from the first to the second ratoon, as the second ratoon of sorghum has rarely been studied. This experiment will compare the growth and yield of sorghum in the first and second ratoons. The first objective of this research is to determine the effect of variety and shoot number in ratoon 1 and ratoon 2, while the second objective is to determine the interaction between variety and shoot number in the ratoon system.

LITERATURE REVIEW

Ratoon cultivation is a crop-growing technique that exploits a plant's ability to regrow after harvest, with shoots emerging from the base of the stem or other surviving parts of the plant (Wu et al., 2026). Several crops can be cultivated using the ratoon system, including rice, sorghum, sugarcane, bananas, and certain forage grasses (Cheyed et al., 2026). In the case of rice (*Oryza sativa* L.), this is known as "ratoon rice", the regrowth of shoots from the remaining stubble after harvest. This system allows farmers to obtain an additional yield within a relatively short period, as the crops do not require the stages of seedling preparation and replanting. The productivity of ratoon rice is influenced by the variety, the height at which the stalks are cut, the condition of the stubble, water availability, and fertilisation (Abirami et al., 2026).

The success of ratoon cultivation depends on a plant's tillering capacity, root system health, the availability of water and nutrients, and the variety's genetic characteristics. After the first harvest, emerging tillers must compete for light, water, growing space, and nutrients. Consequently, managing tiller numbers is critical to plant growth and productivity in a ratoon system. Regulating tiller numbers aims to balance the number of productive stalks with the resources available to each tiller (Luo et al., 2025). An excessive number of tillers intensifies competition, which can negatively affect stalk growth, panicle formation, grain filling, and biomass accumulation in individual stalks. Conversely, too few tillers may reduce the number of productive stalks per clump, thereby limiting total yield potential. Therefore, the optimal number of tillers must be determined based on production objectives and the specific characteristics of the variety being cultivated (Deng et al., 2025).

In ratoon sorghum, the response to tiller management may also differ between the first and second ratoon crops. These differences are linked to the plant's physiological state, photosynthate reserves, root development, and its capacity to regenerate after the previous harvest (Paesal et al., 2021). For this reason, research into tiller management is essential to identify a combination of tiller density and ratoon system that enhances cultivation efficiency and achieves optimal productivity. Second-ratoon cultivation in sorghum (*Sorghum bicolor* L.) is a production system that utilises the regrowth of shoots following the harvest of the main crop and the first ratoon (Zhou, 2024).

METHODS

The research was conducted from March to August 2022. The research location was in Cabeyan, Sukoharjo, Central Java, Indonesia. Materials used included herbicides, Urea fertiliser, and sorghum seeds: Numbu, Super 1, Suri 3, Kawali, and Keller. Measurement instruments included a metre, a hoe, a caliper, a hose, scales, and stationery. Each treatment combination measured 3 m in length, 1 m in width, and 30 cm in height. Planting spacing was 60 x 20 cm, with 1 m between ridges. Each ridge contained two planting rows, and each treatment plot held 20 plants (totaling 1200 plants). The planting area covered 400 m². Elevation was 104 m above sea level, and the soil type was Vertisol. Rainfall during the study period fell within the dry season, and water management relied on a rain-fed system.

This research was carried out in two ratoons, using the same experimental design in both. The two studies were conducted using a Completely Randomised Block Design with a factorial structure and 3 replicates. Analysis of Variance (ANOVA) was performed at the 5% level, after which the Duncan Multiple Range Test was used to analyse the observational data. Data analysis was conducted twice: once for the first ratoon and once for the second ratoon. The outcomes for ratoon 1 and ratoon 2 were compared for the variables. This research consisted of two factors. Factor I comprised sorghum varieties Numbu, Super 1, Suri 3, Keller and Kawali. Factor II was the occurrence of 1, 2, 3 and 4 shoots.

The experimental designs for ratoon 1 and ratoon 2 were identical, with the same treatments. The measured variables included plant height, stem diameter, weight of a bunch of seeds, number of seeds per clump, weight of 1000 seeds and seed yield per plot.

Cutting the sorghum stalks for ratoon cultivation is carried out concurrently with the harvest of the seed-grown crop. The stalks are cut at the second node above the ground. Regrowth begins seven days after cutting. By day 21, the shoots have fully emerged, allowing selection of the desired number of shoots. The same technique is used to prepare for the second ratoon crop. The sorghum is harvested 100 days after shoot selection.

RESULTS AND DISCUSSION

Plant Height

For the first ratoon, ANOVA results indicate that the variety and shoot number treatments influenced plant height; however, there was no interaction between the variety and shoot number treatments. Sorghum varieties can be useful to farmers, especially in situations where they are well-adapted to low soil fertility (Muui, 2026). According to Singh and Maiti (2026), sorghum variety diversity, the quantity, and the size of rod segments determine the height of the plants. The Numbu plant had two shoots in its normal form and four in the Kawali treatment. The Numbu cultivar was more than 2 metres in height. Sorghum variety Numbu thrived excellently in original soil at every time (Farooq et al., 2026).

Table 1
Plant height in all five varieties and in first-ratoon sorghum

Treatment	1st	2nd	3rd	4th	Average
Numbu	239.56	239.89	231.30	235.83	236.64c
Super 1	183.56	187.06	225.74	192.14	197.12b
Suri 3	195.11	213.83	195.57	190.36	198.72b
Keller	204.22	219.43	227.59	183.39	208.66b
Kawali	142.89	167.94	142.44	133.19	146.62a
Average	193.07ab	205.63c	204.53bc	186.98a	

Note. The same letter shows the absence of a significant difference at 5%
Source: Primary Data (2025)

The lowest average plant height was observed in the four-shoot group. The two-shoot treatment was more effective than either the single-shoot or four-shoot treatment. Shoot numbers are often high, causing intense competition that affects plant height. Varieties also affected plant height in ratoon 2. Numbu was the tallest, averaging 169.34 cm, followed by Keller, Super 1, Kawali, and Suri 3. The greatest shoot growth under the one-shoot treatment was 154.18 cm (Table 1). The next-highest value for shoot height was 130.75 cm under the four-shoot treatment, followed by the three- and two-shoot treatments (Table 2).

Table 2
Plant height in all five varieties and in second-ratoon sorghum

Treatment	1st	2nd	3rd	4th	Average
Numbu	206.44	152.67	163.33	154.92	169.34d
Super 1	151.33	134.33	117.85	136.91	135.11bc
Suri 3	123.11	95.22	81.91	105.16	101.35a
Keller	168.56	124.28	143.80	132.64	142.32cd
Kawali	121.44	67.56	133.02	124.11	111.53ab
Average	154.18c	114.81a	127.98a	130.75bc	

Note. The same letter shows the absence of a significant difference at 5%
Source: Primary Data (2025)

For the second ratoon, ANOVA results indicate that the variety and shoot number treatments influenced plant height; however, there was no interaction between the variety and shoot number treatments. There was a reduction in the average plant height of ratoon 2 compared with ratoon 1. This did not cause an excessive reduction in plant height. The decrease in height varied by variety. Ratoon 1-2 varieties of Numbu and Keller were high-morph. Plant height was associated with genetic characteristics. The population was negligible, which gave the best results. Examples include plant height and stem diameter. A higher population concentration tended to prevent plant growth. Leaf shading within the population caused this reduction, so only the leaves at the top received sunlight. The result was optimal photosynthetic activity in the population, thus affecting the metabolic processes of plants (Zou, 2026). An experiment using sugar cane and a raccoon system suggested that there was no significant difference between organic and inorganic fertilisers in terms of plant height (Yu et al., 2026). The same fertiliser as in ratoon 1 was used to fertilise ratoon 2. The yield in ratoon 2 was on the decline, although it was treated in the same way as ratoon 1. Vegetative character and ratoon plant production were largely related to the characteristics of ratoon plants, such as plant height, number of leaves, and stem diameter.

Stem Diameter

On the first ratoon, ANOVA results indicate that the variety and number of shoots treatments influenced stem diameter; however, there was no interaction between the variety and number of shoots treatments. The highest stem diameter was observed in the Kawali variety, with an average of 2.40 cm for 1 shoot (Table 3). The Keller variety with 4 shoots had the lowest stem diameter of 1 cm. The internode diameter character was used to show differences among varieties. The middle of the sorghum stem was usually straight and long compared with the lower and upper parts of the plant. The final segment (the end of the plant) was the longest and took the form of a panicle stalk. The internodes of sorghum were waxy, except at the ends of the stems, which were of sugar-cane type. The upper

surface wax screened the central rib of the leaves to a large extent, minimising water loss through the leaf surface and enhancing sorghum's ability to withstand drought (Santos et al., 2025). Super 1, Numbu, Suri 3, Kawali and Keller were the largest and smallest stem diameters, respectively. The species varied in their use of water, light and nutrients, which affected plant growth and development. The average stem diameter was highest with 1 shoot in ratoon 1. The lower the number of shoots, the better the growth, as there was no competition. This also had a significant influence on stem diameter, as nutrients could be taken up maximally.

Table 3
Stem diameter in all five varieties and in first-ratoon sorghum

Treatment	1st	2nd	3rd	4th	Average
Numbu	1.35	1.11	1.50	1.33	1.32a
Super 1	1.44	1.23	1.50	2.14	1.58bc
Suri 3	1.81	2.00	2.00	1.42	1.81c
Keller	1.81	2.00	1.43	1.00	1.56ab
Kawali	2.40	1.64	1.60	1.47	1.78bc
Average	1.76b	1.60a	1.61a	1.47a	

Note. The same letter shows the absence of a significant difference at 5%
Source: Primary Data (2025)

Ratoon 2 showed no variation in stem diameter across the varieties and the number of shoots. The largest stem diameter in ratoon 2 for the Kawali variety was 1.26 cm, with Super 1, Keller, Numbu and Suri 3 recording the lowest stem diameter of 0.79 cm (Table 4). The number of shoots with the largest diameter was treated as the number of shoots 1, and the lowest was treated as the number of shoots 2. Across all varieties, the average stem diameter in ratoon 2 decreased. The diameter of the rods in ratoon 2 decreased compared to ratoon 1.

Table 4
Stem diameter in all five varieties and in second-ratoon sorghum

Treatment	1st	2nd	3rd	4th	Average
Numbu	0.90	0.69	0.77	0.94	0.83a
Super 1	0.97	0.91	0.99	0.94	0.95a
Suri 3	0.98	0.74	0.57	0.88	0.79a
Keller	1.08	0.68	1.01	0.86	0.91a
Kawali	1.57	1.33	1.07	1.05	1.26a
Average	1.10c	0.87a	0.88ab	0.93ab	

Note. The same letter shows the absence of a significant difference at 5%
Source: Primary Data (2025)

There was a 50% reduction in the diameter of ratoon 2. The variety had varying growth in diameter when planted in ratoon 2. For the second ratoon, ANOVA results indicate that the variety and shoot number treatments influenced stem diameter; however, there was no interaction between them. In cases where diameter is small, yielding a smaller scale, the stems extract sap with the help of sorghum. Plant cane sugarcane farming technical efficiency averages were higher than those of ratoon cane sugarcane farming technical efficiency (Liu et al., 2025).

Seed Weight Per Clump

Seed weight per clump was influenced by treatment type and shoots number. Keller had the highest average seed weight per clump: 113.30 grams with 3 shoots. Suri 3 had the lowest, at 11.10 grams (Table 5). Variety and shoot number were interdependent (Ngidi et al., 2024). For the first ratoon, ANOVA results showed that variety and shoot number treatments influenced seed weight per clump, but there was no interaction between them. A variety is a group of plants with certain properties (morphology, physiology, cytology, chemistry, etc.) of interest to agriculture that will vary and be reproduced. The varieties had different genetic capabilities, and each sorghum type responded differently to the environment in which it was cultivated (Fadeyi et al., 2025).

Table 5
Seed weight per clump in all five varieties and in first-ratoon sorghum

Treatment	1st	2nd	3rd	4th	Average
Numbu	23.52	20.17	12.04	22.32	19.51a
Super 1	33.15	41.76	28.13	84.60	46.91b
Suri 3	26.98	26.07	11.10	70.99	33.78b
Keller	30.07	14.79	113.30	65.32	55.87c
Kawali	18.76	35.98	15.60	28.77	24.78ab
Average	26.50a	27.76a	36.03a	54.40b	

Note. The same letter shows the absence of a significant difference at 5%
Source: Primary Data (2025)

Not all cases were like those in Ratoon 2, where the quantity and varieties of shoots were not affected. In Table 6, the highest seed weight per clump in Ratoon 2 was 8.24 grams, recorded by Kawali, and the lowest seed weight per clump in Ratoon was 2.57 grams, recorded by Numbu, Suri 3, and Keller. The highest yield for two shoots was 6.47 grams, whereas the lowest for four shoots was 4.34 grams. Although they were planted in the same soil, the growth of many plant species varied. Keller Super 1, Suri 3, and Kawali seeds had the highest, middle, and lowest clump weights, respectively.

Table 6
Seed weight per clump in all five varieties and in second-ratoon sorghum

Treatment	1st	2nd	3rd	4th	Average
Numbu	7.45	6.11	9.07	5.88	7.13bc
Super 1	4.89	2.53	5.76	8.34	5.38abc
Suri 3	4.95	4.75	3.43	4.53	4.42ab
Keller	2.56	1.74	3.47	2.51	2.57a
Kawali	7.85	6,.8	7.43	11.11	8.24c
Average	5.54a	4.34a	5.83a	6.47a	

Note. The same letter shows the absence of a significant difference at 5%
Source: Primary Data (2025)

In the second ratoon, the ANOVA results indicate that variety and shoot number treatments affected seed weight per clump, but there was no interaction between them. Sorghum plants with a single stem generally produced one panicle clump. The study by Karunadhipathi et al. (2024) found that genotype had a substantial effect on all reproductive parameters, including flowering age, harvest age, panicle weight, seed weight per panicle, 1,000-seed weight, and harvest index. These parameters varied depending on the plant genotype. Genotype also influences variation in vegetative and reproductive traits, meaning that differences in the observed trait values result from genetic variation.

Number of Seeds Per Clump

The first ratoon ANOVA results indicate that the variety and shoot number treatments influenced the number of seeds per clump (Table 7). There was no interaction between the treatments. The number of seeds per clump in Kawali was 3,508.06, and in Numbu it was 2. The variety also produced different numbers of seeds per clump, as the number of seeds per panicle and the size of the seeds varied. This was due to the plant's genetics. Endalamaw et al. (2025) found that genetics and climatic and environmental factors were determinants of sorghum performance.

Table 7
Number of seeds per clump in all five varieties and in first ratoons sorghum

Treatment	1st	2nd	3rd	4th	Average
Numbu	51.90	560.49	653.70	657.44	615.81a
Super 1	995.22	1,285.43	884.47	2,302.33	1,366.86c
Suri 3	921.21	788.35	700.42	1,132.68	885.66ab
Keller	1,049.90	698.07	987.26	980.00	927.81bc
Kawali	1,818.37	3,112.60	2,752.85	3,508.06	2,797.97c
Average	1,075.26a	1,288.19a	1,195.74a	1,716.10c	

Note. The same letter shows the absence of a significant difference at 5%
Source: Primary Data (2025)

The Kawali type had the highest average seed count for its seed size, with smaller seeds and the same panicle shape as the other varieties. Competition reduced the yield component per plant when three or four plants were grown in a single planting hole, but the yield component per unit area was greater than when one or two plants were planted per hole. Experiments with plant populations indicated that high densities per hectare led to lower growth and yield per individual, but yield per hectare was larger. Sorghum ratoons require more time to emerge than rice. The ratoon then continues to grow and produces tillers.

In the Kawali variety, 2,176.78 was the highest number of seeds in a clump in ratoon 2, followed by the varieties Numbu, Keller, Super 1 and Suri 3. In the treatment, the number of shoots had the highest number of seeds. In the number of shoots, 3 was 871.76, and the lowest number of shoots was in treatment 2, which was 670.03. The varietal treatment in ratoon 2 was significant, but the number of shoots was not significant. The number of shoots had no interaction with the varietal treatment. The maximum number of seeds was realised in the Kawali variety, as high as 2,176.78, and the lowest in Suri 3 at 296.97. Shoots 3 produced the largest amount of seeds, as high as 871.76, and 2 produced the least at 670.03 (Table 8).

Table 8
Number of seeds per clump in all five varieties and in second-ratoon sorghum

Treatment	1st	2nd	3rd	4th	Average
Numbu	670.33	551.11	680.00	671.11	643.14a
Super 1	260.22	446.11	323.00	524.44	388.44a
Suri 3	268.22	457.50	139.67	322.50	296.97a
Keller	333.67	376.00	634.78	422.89	441.84a
Kawali	2,645.78	1,519.44	2,581.33	1,960.56	2,176.78b
Average	835.64a	670.03a	871.76a	780.30a	

Note. The same letter shows the absence of a significant difference at 5%
Source: Primary Data (2025)

This increase in the average number of seeds was observed only in the Numbu variety, reaching 643.14, compared with 615.18 seeds in ratoon 1. In the second ratoon, ANOVA results indicate that the variety and shoot number treatments influenced the number of seeds per clump; however, there was no interaction between the variety and shoot number treatments. Numbu has a strong capacity for tiller regeneration, allowing it to continue forming panicles and maintaining grain yield per clump even in the second ratoon crop. In contrast, the decline observed in the Super 1, Suri 3, and Keller varieties may be linked to a reduction in the number of productive tillers or a diminished ability of these tillers to produce fertile panicles. Ratoon growth depends on the condition of the root system, the base of the stem, the viability of remaining tillers, and the availability of carbohydrate

reserves and nutrients following the previous harvest. Numbu is able to maintain root function and utilise available resources relatively efficiently during the second ratoon cycle.

When this capacity is preserved, panicle formation and grain filling can proceed without a significant reduction in grain yield. Conversely, plants that experience a decline in root vigour, damage to the stem base, or a depletion of assimilate reserves may show reduced reproductive growth in subsequent ratoon cycles. This was not a substantial increase in yield, in comparison with the reduction across all varieties. Ratoon crops are environmentally sensitive. On genotypes that are able to survive stressful environmental conditions, good and stable ratoons can be produced. The stability of the main/primary plant does not necessarily correspond to the stability of the ratoon plant. Variations may occur in varietal differentiation between the main crop and the time of the plants in various locations (Utomo et al., 2025). All the vegetative quality of the period plants had lost value as compared to the main crop. Plants had a shorter time, fewer leaves and a smaller stem diameter than the plants from the seeds, even though they were fertilised with the same amount of fertiliser. The harvest age of the time plants was earlier than the main crop (Mekonen et al., 2025).

Weight of 1000 Seeds

Ratoon 1 ANOVA results indicate that the variety and shoot number treatments influenced the weight of 1000 seeds; however, there was no interaction between the variety and shoot number treatments. The average weight of 1000 seeds was greatest in Numbu, followed by the number of 1st shoots 42.24 g, and least in Kawali, with the number of 4th shoots 2.55 g (Table 9). The varieties planted in the same location exhibited varying responses to the constituents of plant growth and performance (Tian et al., 2026). The panicle and seed size of Kawali were the smallest compared with the other varieties. The weight of 100 grains determines seed size, with seed weight increasing as the weight of 100 grains increases (Nasreen et al., 2025). Seed size can determine seed weight. Advanced maturation and ageing lead to the production of the smallest seeds.

Table 9
Weight of 1000 seeds in all five varieties and in first ratoons

Treatment	1st	2nd	3rd	4th	Average
Numbu	42.24	38.59	39.41	26.10	36.59a
Super 1	33.69	38.96	24.98	36.86	33.63a
Suri 3	30.56	21.43	10.97	21.65	21.15a
Keller	29.92	32.18	26.05	24.80	28.24a
Kawali	8.46	4.54	8.11	2.55	5.92a
Average	28.98a	27.14a	21.90a	22.39a	

Note. The same letter shows the absence of a significant difference at 5%
Source: Primary Data (2025)

The seed number of the Kawali variety was the lowest among the other four varieties. When compared with the other varieties, the same amount was obtained at a lower weight. The quality of the seeds produced by the plant is related to their weight on 1000 seeds. The amount of nutrients available and the ability of plants to uptake nutrients like phosphorus during seed filling will influence the weight of 1000 seeds (Tóth et al., 2026). In ratoon 2, the various treatments and the number of shoots had no effect on the weight of 1000 seeds. The Numbu variety had the highest average yield of 30.28 grams, and Kawali had the lowest average yield of 4.25 grams (Table 10), respectively, in eight of 1000 ratoon 2 seeds. Kawali variety had the lowest average weight of 1000 seeds. Numbu is capable of maintaining effective grain filling under specific growing conditions, resulting in relatively heavy grains. The number of tillers can influence competition for light, water, nutrients, and photosynthetic products—or assimilates. If productive tillers have access to sufficient resources and the number of grains formed is relatively lower, the amount of assimilates available for each individual grain can increase, potentially leading to a higher grain weight. This result was the same as in ratoon 1. The average weight of 1000 seeds of ratoon 2 was reduced in comparison to ratoon 1. The weight loss of the 1000 ratoon seeds was also influenced by plant growth, such as reduced height and stem diameter. Genotype had a great impact on all vegetative characters of ratoon plants. The genotype of the ratoon plants influenced plant height, the number of leaves, and stem diameter.

Table 10
Weight of 1000 seeds in all five varieties and in second ratoons

Treatment	1st	2nd	3rd	4th	Average
Numbu	34.87	11.77	8.28	66.20	30.28b
Super 1	9.75	5.80	11.58	11.49	9.66ab
Suri 3	9.68	5.23	20.02	6.59	10.38ab
Keller	4.53	4.47	22.08	3.84	8.73ab
Kawali	3.58	3.08	4.71	5.61	4.25a
Average	12.48a	6.07a	13.33a	18.75a	

Note. The same letter shows the absence of a significant difference at 5%
Source: Primary Data (2025)

In the second ratoon, ANOVA results indicate that variety and shoot number treatments influenced the weight of 1000 seeds, but there was no interaction between these treatments. Ratoon growth and development are influenced by the growth of the main plant; a low generative phase is associated with low vegetative growth. The Numbu variety had the highest average 1,000-seed weight in Ratoon 2, at 30.28 grams, while Kawali had the lowest, at 4.25 grams. Among the shoot number treatments, four shoots produced the highest 1,000-seed weight at 18.75 grams, followed by three, one, and two shoots, which

had a weight of 6.07 grams. In Ratoon 2, a decrease in 1,000-seed weight was observed in all results. The plant's vegetative traits were associated with its reproductive traits, ratoon vegetative traits, and ratoon capacity. The ratoon's reproductive traits were correlated with its vegetative traits.

Seed Yield Per Plot

Seed yield per plot was the total weight of all seed of a given type in each treatment plot. Each treatment combination plot measured 3 m in length and 1 m in width, with a planting spacing of 60 x 20 cm. Consequently, a plot area of 3 m² accommodated a population of 20 plants. All plants in each plot were harvested, and the total seed weight per plot was then determined. The effect of the variety treatment was on seed yield per plot. The number of shoots had no effect on seed yield per plot within the treatment. The varietal treatment and the number of shoots did not interact. Super 1 had the highest yield of 604.33 grams, and Suri 3 had the lowest yield of 75.33 grams, with a number of shoots of 4 (Table 11). For the first ratoon, ANOVA results indicated that the variety and number of shoots treatments influenced seed yield per plot; however, there was no interaction between the variety and number of shoots treatments. The morphological and agronomic features of sorghum were highly variable, and sorghum weight varied with qualitative features of other species, such as panicle length and panicle type, the number of panicle branches, seed shape, and the number of seeds, which varied by species and by variety.

Table 11
Seed yield per plot in all five varieties and in the first ratoons

Treatment	1st	2nd	3rd	4th	Average
Numbu	262.67	130.00	146.67	182.67	180.50a
Super 1	259.33	315.00	406.33	604.33	396.25b
Suri 3	214.33	114.67	129.00	75.33	133.33a
Keller	290.67	521.33	307.67	394.33	378.50b
Kawali	147.00	119.00	100.33	146.33	128.17a
Average	234.80a	240.00a	218.00a	280.60a	

Note. The same letter shows the absence of a significant difference at 5%
Source: Primary Data (2025)

The highest yield was produced by four shoots. More shoots produce more panicles, and a greater number of panicles and sorghum grains leads to higher crop yields per plot. In Ratoon 2, average seed yield per plot did not differ significantly by variety treatment or number of shoots, and there was no interaction between these factors. The Kawali variety had the highest average yield in Ratoon 2, at 20.40 grams, while Keller had the lowest, at 4.56 grams. The highest yield among shoot-number treatments was 16.36 grams with four

shoots, while the lowest was 9.45 grams with two shoots. The best treatment was Kawali with four shoots, yielding 34.09 grams or 0.18 ton/ha. The poorest treatment was Keller with two shoots, yielding 2.54 grams or 0.13 ton/ha (Table 12).

Table 12
Seed yield per plot in all five varieties and in second ratoons

Treatment	1st	2nd	3rd	4th	Average
Numbu	8.93	17.95	27.80	16.41	17.77bc
Super 1	12.14	7.80	13.47	19.69	13.28
Suri 3	15.27	8.90	4.50	6.88	8.89ababc
Keller	2.54	1.97	9.01	4.73	4.56a
Kawali	16.89	10.64	19.99	34.09	20.40c
Average	11.15a	9.45a	14.95a	16.36a	

Note. The same letter shows the absence of a significant difference at 5%
Source: Primary Data (2025)

For the second ratoon, ANOVA results indicate that the variety and shoot number treatments influenced seed yield per plot; however, there was no interaction between the variety and shoot number treatments. These findings indicate that sorghum grain yields in the second ratoon crop declined significantly across all tested varieties. The largest decline was observed in the Keller variety (98.80%), followed by Super 1 (96.65%), Suri 3 (93.33%), Numbu (90.15%), and Kawali (84.09%). Kawali exhibited the smallest percentage decline and maintained the highest grain yield in the second ratoon crop, at 20.40 per plot. This suggests that Kawali performs relatively better in sustaining production during the second ratoon cycle compared with the other varieties. Numbu also maintained a relatively better yield than Super 1, Suri 3, and Keller, even though its percentage decline reached 90.15%. Such declines may be linked to reduced plant vigour, diminished shoot regeneration capacity, root system condition, and shifts in assimilate allocation during subsequent ratoon cycles. However, these factors remain potential explanations and require further substantiation through data on plant growth and yield components. Super-1 evolved from the selection of pure lines of local water varieties of Water Hammu White of Sumba, East Nusa Tenggara, Indonesia. Matured ICRAI (International Institute of International Plant Research) lines matured as Super-2 were a better kind of sweet sorghum, which had a potential high yield. The highest seed production was 6 ton/ ha, with a potential sap content of above 17% Brix scale.

CONCLUSION

The research results indicate that all parameters affect the variety and number of shoots in the 1st and 2nd ratoons. In the 1st ratoon, the Numbu variety had the greatest plant height,

while the Kawali variety had the largest stem diameter. Four shoots had a higher seed yield per clump and a lower plant height. There was no interaction between the characters and the varietal treatment for the number of shoots. In the 2nd ratoon, the Numbu variety was the heaviest, and Kawali had the largest stem diameter, which was the same as in ratoon 1. Super1 and Keller produced more seed per plot, but Kawali produced the best seed per clump. There was no effect of the varietal treatment on any traits in terms of shoot quantity. Ratoon 2 decreased all observational variables compared to Ratoon 1. The greatest reductions were observed in plant height and stem circumference. The counts of seeds, seed mass, weight of 1000 seeds, and seed yield per plot varied the most, with yield in Ratoon 1 decreasing by less than 10%.

IMPLICATION OF THE STUDY

This study shows that sorghum plants can be obtained from post-harvest residues by maintaining some branches. Sorghum branches only grow in ratoon systems; no branches appear in seed-grown plants. The study used five different sorghum varieties that produced varying growth and yields.

LIMITATION AND RECOMMENDATION FOR FUTURE RESEARCH

Fertiliser dosages were not compared experimentally. The use of higher fertiliser dosages is intended as a subject for future research, rather than as an established recommendation.

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