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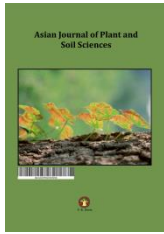
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Soybean Intercrop Enhances the Yield and Flavor Profile of Sweetcorn Grown in Alkaline Soil under Drought Condition

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

Declining corn yield in monoculture systems, along with soil analyses indicates increased alkalinity caused by excessive use of chemical fertilizers, which undermines the value of intercropping. A field experiment was conducted at Cebu Technological University-Barili Campus from on the driest months of the year (March to May), to evaluate the effects of different legume intercrop on the growth and development of sweetcorn (*Zea mays* L. Var. Macho-F1) grown in alkaline soil (pH 7.5). The experiment utilized a Randomized Complete Block Design (RCBD) with five treatments corresponding to different legume intercrop: T0 = Sweetcorn alone, T1 = Sweetcorn + Soybean

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(*Glycine max*), T2 = Sweetcorn + Rice bean (*Vigna umbellata*), T3 = Sweetcorn + Lima bean (*Phaseolus lunatus*), and T4 = Sweetcorn + String bean (*Phaseolus vulgaris*). The data gathered were plant height (cm) at 30 and 60 days after planting (DAP), ear height at 60 DAP (cm), ear length (cm), ear diameter (cm), weight with husk (g/ear), weight without husk (g/ear) and total soluble solids ($^{\circ}$ Brix). Results showed no significant differences in plant height at 30 and 60 days DAP or ear height at 60 DAP. Sweetcorn intercropped with soybean produced taller corn plants (138.90 ± 6.20 cm and 156.33 ± 15.84 cm at 30 and 60 DAP, respectively) and highest ear height (49.23 ± 5.72 cm at 60 DAP). No significant differences were found in ear length, ear diameter, or weight with husk. However, results demonstrated that sweetcorn intercropped with soybean consistently outperformed those intercropped with other legumes and sweetcorn monoculture. Intercropping sweetcorn with soybean resulted in the highest Total Soluble Solids value of 8.80 ± 0.20 SE ($^{\circ}$ Brix), ear weight (126.73 ± 28.57 SE grams/ear), and computed yield (11.40 ± 2.57 t/ha). Therefore, intercropping sweetcorn with soybean will increase its yield and improve its flavor profile, notwithstanding the supposed added income from the soybean intercrop.

Keywords: Sweetcorn; alkaline soil; intercropping; legumes; total soluble solids; agronomic performance.

1. INTRODUCTION

Corn (*Zea mays* L.) is a vital annual crop, originally domesticated in America. As a cereal belonging to the Family Poaceae, it serves as a significant source of carbohydrates for both humans, particularly in developing countries, and as animal feed worldwide due to its high nutritional value (Undie, et al., 2012). Globally, corn ranks third in cereal production, following wheat and rice.

In Central Visayas, Philippines, farmers have been cultivating sweetcorn in a monoculture system for several years. Recently, a decline in yield performance has been observed. The farmers are exploring intercropping corn with different legumes, such as mung beans and soybeans, which are known for improving soil fertility and providing sustainable nitrogen sources. However, potential growth and yield performance for sweetcorn when intercropped with these legumes in alkaline soil is not widely reported.

Intercropping legumes in maize-based systems can enhance nitrogen availability, increase sweetcorn yield, and offer higher productivity and economic returns compared to monoculture (Thayamini & Brintha, 2010). Legumes contribute to nitrogen fixation, reducing environmental impact and providing ground cover that optimizes nutrient use from various soil depths (Steiner, 1991; Jensen, 1996). Numerous studies have shown that rhizobia on legume crops converts atmospheric nitrogen into ammonia, benefiting both the legumes and accompanying plants (Li et al., 2020). While intercropping sweetcorn and

soybean has been successful in North America since the early 1900s (Prithiviraj et al., 2000), and soybean is often used to enhance the protein content of sweetcorn silage (Geren et al., 2008), there is a lack of research on the effects of different legume species on sweetcorn growth and flavor profile in alkaline soil. Some intercropping combinations may lead to increased competition among crops, making certain species unsuitable for intercropping (Dasbak and Asiegbu, 2009, <https://cebudailynews.inquirer.net/571007/cebu-virtually-had-no-rains-in-april>).

Therefore, the current study was conducted to examine the effect of intercropping different legume species on the yield, and flavor profile of sweetcorn on alkaline soil.

2. MATERIALS AND METHODS

2.1 Preparation of Experimental Area

The research was conducted at the experimental and production farm of Cebu Technological University - Barili Campus ($10^{\circ}7'53''$ N, $123^{\circ}32'45''$ E), covering a study area of 379.75 square meters. In terms of chemical characteristics, the soils have alkaline pH > 7.5 (Enojada, et al., 2015). The experimental area was plowed twice to improve soil aeration and drainage. The study utilized five treatments, each replicated three times, for a total of 15 experimental blocks. Furrows were established 75 cm apart across the plots. Each treatment plot measured 5 meters in length and 3.75 meters in width, with a one-meter space allocated between plots and replications to facilitate data collection and regular inspection.

2.2 Climatic Conditions

The study was conducted from March to May 2024, during a period characterized by warm and humid conditions in Cebu, Philippines. Temperatures ranged from 25°C to 31°C in March, accompanied by moderate rainfall of approximately 103 mm over 8 days. In April, temperatures increased slightly, peaking at 32°C, with reduced rainfall of around 81 mm over 7 days. May recorded the highest temperatures, reaching up to 33°C, with increased rainfall between 127-147 mm over 8-9 days (World Weather & Climate Information). Despite the rainfall in May, the study coincided with a dry spell caused by the El Niño phenomenon (PAGASA, 2024), leading to below-average rainfall, particularly in April, which resulted in drought conditions (Cebu Daily News, 2024).

2.3 Field Planting

Planting was carried out immediately following land preparation, with two seeds sown per hill. Both sweetcorn and legumes were planted simultaneously. The planting arrangement varied across treatments: T0 (sweetcorn alone) consisted of four rows of sweetcorn, while T1 (sweetcorn + soybean), T2 (sweetcorn + rice bean), T3 (sweetcorn + lima bean), and T4 (sweetcorn + string bean) involved intercropping sweetcorn with respective legumes. The spacing between rows was 75 cm for all treatments. For sweetcorn, the spacing between hills was 25 cm, while soybeans were spaced 50 cm apart, rice beans 25 cm, lima beans 60 cm, and string beans 50 cm. This planting arrangement ensured proper spacing for each crop, allowing for accurate comparison across treatments.

2.4 Fertilization

At the time of planting, four bags of organic fertilizer (Microbial Compost) were applied as a basal nutrient source for both sweetcorn and beans equivalent to 10 tons/ha fertilization rate. Additionally, a split application of nitrogen fertilizer, specifically Ammonium Sulfate (21-0-0), was employed. The first application was administered 30 days after planting, followed by a second application at 45 days after planting. This fertilization regimen ensured a consistent supply of nitrogen during the critical early stages of crop development, promoting optimal growth and productivity (<https://weather.com/weather/tenday//25414ec6b3178100e232564a4347cadead55c8e0758dce9d74ea69f0b1228ba>).

2.5 Thinning and Weeding

Thinning to one seedling per hill was done 10 days after planting for sweetcorn. Missing hills were promptly replenished using thinned seedlings to maintain uniform plant density. Uniform hand weeding was performed across all treatment plots to manage weed pressure. Additionally, hilling up was carried out 30 days after crop emergence to further suppress weed growth and improve soil aeration for sweetcorn monocrop. These management practices enhanced root development and overall plant health, contributing to better crop performance.

2.6 Experimental Design and Treatments

The experimental plots were arranged in a Randomized Complete Block Design (RCBD), with five treatments replicated three times.

The following were the treatments:

- T0 = Sweetcorn Alone
- T1 = Intercropping of Sweetcorn + Soybean
- T2 = Intercropping of Sweetcorn + Rice bean
- T3 = Intercropping of Sweetcorn + Lima bean
- T4 = Intercropping of Sweetcorn + String bean

2.7 Data Gathered

Agronomic characteristics of Sweetcorn Variety Macho Dos F1:

- Plant height (cm) was determined by measuring from the base of the plant to the base of the tassel using a measuring tape.
- Ear height (cm) was measured from the base of the plant to the base of the first sweetcorn ear closest to the ground, also using a measuring tape.
- Ear Length (cm) and Ear Diameter (cm), ten ears without husks were randomly selected from ten sample plants, and their lengths and diameters were measured using a plastic caliper.
- Weight ears (g), both with and without husks, was recorded for ten randomly selected ears from the same sample plants using a digital weighing scale.
- Grain weight (g) was determined by shelling and weighing the grains from ten randomly selected ears, using a digital weighing scale.
- Total Soluble Solids (TSS, Brix %), Kernels from ten randomly selected ears were crushed, and two drops of filtered juice

were added to a digital refractometer (Hanna brand, HI 96801, USA), Brix values range from 0 to 85%, with an accuracy of 0.1 Brix. TSS content was expressed in percentages (Arenas-ochoa, et al., 2022)

Agronomic characteristics – Different leguminous crops as an intercrop:

- Number of pods per plant was determined by counting all brown, dried pods on each sample plant at the time of harvest
- Average pod length (cm) was calculated by randomly selecting ten pods at harvest and measuring their lengths with a measuring tape
- Average pod diameter (cm) was measured using a plastic caliper on ten randomly selected pods.
- Average number of seeds per pod was calculated by counting the seeds in ten randomly selected pods and determining the average
- Grain weight per plant (g) was obtained by measuring the total grain weight from each plant using a digital weighing scale.

2.8 Data Analysis

Data were compared using Analysis of Variance (ANOVA) for Randomized Complete Block Design (RCBD). Further tests were done through the Least Significant Difference (LSD) Test (Debela et al., 2018).

3. RESULTS AND DISCUSSION

Table 1 shows no statistically significant differences in plant height at 30 and 60 days after planting (DAP), nor in ear height at 60 DAP among the different intercropping treatments. Specifically, T1 = Sweetcorn + Soybean exhibited the tallest plants, with an average

height of 138.90 ± 6.20 cm at 30 DAP, 156.33 ± 15.84 cm at 60 DAP, and an Ear height of 49.23 ± 5.72 cm at 60 DAP. However, these variations were not statistically significant. The growth patterns observed in sweetcorn plants were primarily attributed to the genetic characteristics of the Macho Dos F1 variety, rather than the type of legume used in the intercropping system.

Quality seeds are critical to the success of plant cultivation (Oelviani & Sodik, 2018), and the production potential of a sweetcorn variety is revealed through high physiological quality in seeds, which respond effectively to fertilization (Saenong, 2018). This responsiveness in seeds with high physiological attributes aligns with improved growth patterns, including the ear and flowering age components, which are influenced by genetic factors (Mrema et al., 2018). Genetic and environmental factors contribute to genotypic and phenotypic diversity in plant growth phases; in this case, genetic factors appeared more dominant in influencing plant height and ear height in sweetcorn. Field observations showed a consistent pattern in which male parent plants (NEI 9008) exhibited lower, more uniform plant heights than female parent plants (Bima 4), underscoring genetic influence over environmental factors in shaping parent seed growth (Mrema et al., 2018; Xu et al., 2020). Additionally, plant genotype plays a critical role in plant growth, with each parent exhibiting a distinct response to the growing environment (Xu et al., 2020).

Hybrid corn varieties take advantage of the phenomenon of heterosis, also known as hybrid vigor. F1 hybrids are created by crossing genetically distinct parental lines that have been inbred over many generations and harvesting the “first filial” or F1 seeds that result from this cross.

Table 1. Plant Height on 30DAP, 60DAP, and Ear Height 60DAP as affected by different legume intercrops

Treatment	Plant Height 30DAP (cm)	Plant Height 60DAP (cm)	Ear Height 60DAP (cm)
T0=Corn alone	112.70	113.10	40.80
T1=Corn+Soybean	138.90	156.33	49.23
T2=Corn+Rice bean	128.33	134.73	48.40
T3=Corn+Lima Bean	133.80	129.70	46.23
T4=Corn+String bean	128.67	130.37	47.00
CV%	7.22	10.87	12.02
P-value	0.0677	0.0637	0.4363

The F1 seeds in turn produce plants that may perform significantly better in the field than the lines from which either of their parents were derived. For geneticist James Crow, as for many others, figuring out how to harness heterosis to create higher-yielding crop varieties was “surely one of genetics’ greatest triumphs (Crow, 1998, <https://www.pagasa.dost.gov.ph/weather/weather-outlook-selected-philippine-cities>).

Table 2 shows significant differences in weight per ear across treatments. The weight varied considerably depending on the specific treatment, with the highest recorded at T1=Sweetcorn + Soybean at 126.73 ± 28.57 SE grams/ear, and the lowest at T0=Sweetcorn Alone with 85.17 ± 3.07 SE grams/ear. This study highlights how removing the husk from sweetcorn provides a more accurate way to measure the actual grain yield. The husk adds weight, but it's not part of the edible portion, so focusing on the grain without the husk gives a clearer picture of how productive the sweetcorn is. The results showed that sweetcorn grown in intercropping systems with soybeans had heavier grains, indicating improved productivity. The increased productivity observed in sweetcorn intercropped with soybeans can be primarily attributed to the role of soybeans in improving soil fertility. Soybeans, a legume, enhance nitrogen levels in the soil through a process called nitrogen fixation, where they convert atmospheric nitrogen into a form usable by plants. This additional nitrogen boosts sweetcorn growth, leading to denser and heavier kernels (Xiang et al., 2018; Sousa et al., 2022). The facilitative interactions between the crops' root systems also contribute to improved nutrient sharing, which further enhances crop yield and nutrient uptake (Li et al., 2019; Liu et al., 2019; Nasar et al., 2021).

Intercropping soybeans with sweetcorn not only enhance nitrogen availability but also promotes better moisture retention, benefiting sweetcorn plants during periods of drought (Nyawade et al., 2019; Nasar et al., 2020a). Improved nitrogen assimilation due to enzymatic activities in the intercropping system also positively impacts plant nitrogen content and uptake (Nasar et al., 2022a). This system takes advantage of the complementary associations of cereal and legumes, especially in terms of nutrient cycling and biological nitrogen fixation, resulting in enhanced crop performance (Nasar et al., 2024). improved soil quality (Nasar et al., 2020) and controlling weeds (Carton et al., 2020; Cheriére

et al., 2020) Several studies demonstrate how legume-cereal intercropping systems increase plant nitrogen status by modifying the rhizosphere and facilitating nutrient transfer between crops (Sun et al., 2018; Nasar et al., 2020b; Raza et al., 2021).

Furthermore, intercropping enhances nutrient absorption, especially in alkaline soils, where some nutrients may be less available to sweetcorn. These combined benefits—higher nitrogen levels, better moisture management, and more efficient nutrient use—result in higher grain yields, even when accounting for husk removal (Bybee-Finley and Ryan, 2018; Zaeem et al., 2019). This study also revealed that sweetcorn-soybean intercropping increased nitrogen yield and nitrogen use efficiency, with additional benefits under optimal nitrogen treatments, likely due to complementary nutrient sharing and better utilization of available soil nitrogen (Gitari et al., 2018b; Li et al., 2020; Yong et al., 2018; Nyawade et al., 2020a).

Additionally, the highest TSS was obtained by treatment T1 = Sweetcorn + Soybean 8.80 ± 0.20 SE (°Brix), lowest TSS was obtained by T2 = Sweetcorn + Rice bean 6.00 ± 0.35 SE (°Brix). Moreover, No Significant differences in Ear height, Ear length, Ear diameter, and Weight with husk of sweetcorn. Legumes, including soybeans, also improve soil health through microbial interactions that promote nutrient cycling and organic matter breakdown, which further supports sweetcorn growth (Zaeem et al., 2019; Phiri et al., 2013). The soybean root system's capacity to fix atmospheric nitrogen into the soil minimizes competition for nitrogen resources, ensuring that both crops benefit from enhanced soil fertility without added fertilizers (Seran and Brintha, 2009; Thayamini and Brintha, 2010). Additionally, intercropping improves drought resistance, as soybean roots help retain moisture in the soil, which reduces stress on the sweetcorn during dry periods and enhances carbohydrate accumulation (Du et al., 2020; Raza et al., 2020; Nasar et al., 2022b).

Overall, the combination of nitrogen fixation, improved moisture retention, better nutrient absorption, and microbial support highlights the significant advantages of sweetcorn-soybean intercropping, leading to improved grain yields, increased total soluble solids (TSS) levels, and greater environmental sustainability (Habineza et al., 2018; Lulie, 2017).

Table 2. Yield components of sweetcorn as inter cropped with various legumes on alkaline soil

Treatment	Ear Length (cm)	Ear Diameter (cm)	Weight with Husk (g/per ear)	Weight without Husk (g/per ear)	TSS (°Brix)	Computed yield(t/ha)
T0=Sweetcorn alone	10.73	3.67	109.70	85.17 c	6.55 b	7.66c
T1=Sweetcorn+Soybean	12.50	3.97	163.10	126.73 a	8.80 a	11.40a
T2=Sweetcorn+Rice bean	11.80	3.70	137.23	107.33 b	6.00 b	9.65b
T3=Sweetcorn+Lima Bean	11.97	3.90	160.50	116.17 ab	6.92 b	10.45ab
T4=Sweetcorn+String bean	11.83	4.23	138.97	121.57 ab	6.88 b	10.45ab
CV%	11.60	13.51	20.84	7.00	8.54	7.00
P-value	0.6338	0.6932	0.2653	0.0014	0.0042	0.0014

On average, each Stringbean produced 2.86 pods, with pods measuring 50.65 cm in length, 0.97 cm in diameter, weighing 33.90 grams, and containing 11.88 seeds per pod (Table 3). All other legumes did not produce any yield. Although yields were modest for string beans, the plant was able to enhance soil fertility through nitrogen fixation, enriching the soil with the nitrogen needed for sweetcorn. Even with lower yields, their nitrogen-fixing ability supports their neighboring sweetcorn and boosts their productivity.

Worldwide nitrogen fixation is around 1.75×10^{11} kg, with legumes contributing about 8.0×10^{10} kg through symbiotic nitrogen fixation, averaging 20–200 kg N fixed per hectare per year. Another substantial portion of the nitrogen is industrially fixed to produce fertilizers (approximately 8.8×10^{10} kg) (Shah et al., 2021). Biological nitrogen fixation (BNF), especially in rhizobia-legume symbiosis, provides a sustainable approach by enabling rhizobia bacteria to fix atmospheric nitrogen, which benefits host legumes and other crops in the system (Stagnari et al., 2017). Yield increases with nitrogen-fixing legumes are linked to improved soil organism activity, altered soil properties, and reduced pest cycles (Wani et al., 1995). Integrating legumes into agricultural systems enhances soil nutrients and reduces the need for external inputs, supporting sustainable agriculture (Peoples et al., 1995; Postgate, 1998; Kebede, 2020a).

To maximize BNF's benefits, legumes can be incorporated into practices like crop rotation, intercropping, green manuring, and alley cropping (Ghosh et al., 2007; Meena et al., 2018; Nanganoa et al., 2019; Kebede, 2020a). Legumes in mixed systems release nitrogen that benefits cereal crops, either during their growth or as residual nitrogen for later crops. This nutrient transfer occurs through processes like root excretion, leaf fall, and the breakdown of root and nodule tissues, with legumes contributing up to 102 kg N per hectare annually through root and nodule decomposition (Thilakarathna et al., 2016).

Legumes also improve drought resilience by accessing deep soil moisture and enhancing nutrient availability in alkaline soils. Smallholder farmers value intercropping for its ability to reduce crop failure risk, diversify food sources, and increase income. Intercropping also makes efficient use of sunlight, water, and nutrients while helping control pests and weeds, maintain

soil fertility, and improve physical soil conditions, especially when cereals and legumes are combined (Liu, et al., 2018; Shao, et al., 2020; Zaeem, et al., 2019; Mohammad, et al., 2022; Ochieng'IO, et al., 2021).

In comparing the benefits of sweetcorn intercropped with soybean against string beans, it's essential to evaluate both the yield of the main crop and intercrop. The study shows that while sweetcorn/soybean intercropping with sufficient nitrogen fertilization significantly increases sweetcorn yield, biomass, and 1000-grain weight, the soybean did not produce any yield. Soybeans contribute to soil fertility through nitrogen fixation, enhancing nutrient availability over time, which indirectly benefits sweetcorn growth by allowing more nutrients and space for the sweetcorn (Raza, et al., 2022; Galanopoulou, et al., 2019).

Both sweetcorn and soybean utilize different soil depths due to their root structures—sweetcorn has a shallower system while soybean roots are deeper. This minimizes competition for resources, enabling both crops to access water and nutrients efficiently from different soil layers, improving overall soil nutrient availability. Such complementarity in root systems optimizes resource utilization, enhancing photosynthesis and improving yield potential (Blessing, et al., 2022; Ebbisa, et al., 2022).

Intercropping sweetcorn with string beans has clear benefits for soil fertility and yield for both crops, particularly under tough conditions like drought and alkaline soils. String beans are well-suited for drought-prone and alkaline soils, where they thrive while soybeans may struggle. Their deep roots access water from lower soil layers, maintaining moisture for nearby crops, and they improve nutrient availability in alkaline conditions (Louarn et al., 2015).

In intercropping systems with sweetcorn, string beans offer the advantage of providing a direct yield (pods) without competing for resources as soybeans might. This combination boosts productivity by enhancing nutrient cycling, resource use, and pest control (Ghosh et al., 2007; Meena et al., 2018).

String beans also contribute to nitrogen transfer through the decomposition of roots and nodules, supporting sweetcorn growth and improving soil fertility (Thilakarathna et al., 2016). Compared to soybeans, string beans offer immediate benefits

Table 3. The yield of legume intercrop

Legumes	No. of Pods per Plant	Pod Length (cm)	Pod Diameter (cm)	Number of Seeds/ Pods	Grain Weight (g/ per pod)	Computed yield(t/ha).
Stringbean	2.86	50.56	0.97	11.88	33.90	14.125
Soybean	No yield	No yield	No yield	No yield	No yield	No yield
Rice bean	No yield	No yield	No yield	No yield	No yield	No yield
Lima bean	No yield	No yield	No yield	No yield	No yield	No yield

by adding nitrogen-rich biomass to the system, directly supporting crop growth. Their ability to thrive in challenging soil conditions makes them a valuable choice for sustainable intercropping with sweetcorn.

4. CONCLUSION

Intercropping corn with soybeans improved the yield by (3.74 t/ha) and crop quality of sweetcorn 8.80 (°Brix) Soybeans can contribute to nitrogen fixation, enhancing soil fertility, which is particularly beneficial in alkaline soil conditions. Additionally, legumes influenced the flavor profile of sweetcorn by increasing Total Soluble Solids (TSS), potentially improving its sweetness. String beans can as well offer additional benefits, especially in drought and alkaline soils. Unlike soybeans, string beans provide a direct yield (14.125t/ha), increasing overall productivity

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

The Author hereby declares that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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APPENDIX

List 1. Plant height 30DAP

Source	DF	Sum of Square	Mean Square	F Value	Pr(> F)
Replication	2	312.0280	156.0140	1.81	0.2240
Treatment	4	1157.8307	289.4577	3.37	0.0677
Error	8	687.9453	85.9932		
Total	14	2157.8040			
CV (%)	7.22				

List 2. Plant height 60DAP

Source	DF	Sum of Square	Mean Square	F Value	Pr(> F)
Replication	2	693.0013	346.5007	1.66	0.2490
Treatment	4	2883.4973	720.8743	3.46	0.0637
Error	8	1667.0787	208.3848		
Total	14	5243.5773			
CV (%)	10.87				

List 3. Ear height 60DAP

Source	DF	Sum of Square	Mean Square	F Value	Pr(> F)
Replication	2	95.9413	47.9707	1.55	0.2705
Treatment	4	131.2600	32.8150	1.06	0.4363
Error	8	248.1920	31.0240		
Total	14	475.3933			
CV (%)	12.02				

List 4. Ear length

Source	DF	Sum of Square	Mean Square	F Value	Pr(> F)
Replication	2	7.1213	3.5607	1.91	0.2096
Treatment	4	4.9533	1.2383	0.66	0.6338
Error	8	14.8987	1.8623		
Total	14	26.9733			
CV (%)	11.60				

List 5. Ear diameter

Source	DF	Sum of Square	Mean Square	F Value	Pr(> F)
Replication	2	0.3053	0.1527	0.55	0.5965
Treatment	4	0.6293	0.1573	0.57	0.6932
Error	8	2.2147	0.2768		
Total	14	3.1493			
CV (%)	13.51				

List 6. Weight with husk

Source	DF	Sum of Square	Mean Square	F Value	Pr(> F)
Replication	2	5744.8360	2872.4180	3.28	0.0910
Treatment	4	5587.8667	1396.9667	1.60	0.2653
Error	8	6998.5373	874.8172		
Total	14	18331.2400			
CV (%)	20.84				

List 7. Weight without husk

Source	DF	Sum of Square	Mean Square	F Value	Pr(> F)
Replication	2	92.8213	46.4107	0.76	0.4973
Treatment	4	3197.7560	799.4390	13.15	0.0014
Error	8	486.4320	60.8040		
Total	14	3777.0093			
CV (%)	7.00				

List 8. TSS

Source	DF	Sum of Square	Mean Square	F Value	Pr(> F)
Replication	2	1.7640	0.8820	2.45	0.1482
Treatment	4	13.3757	3.3439	9.27	0.0042
Error	8	2.8843	0.3605		
Total	14	18.0240			
CV (%)	8.54				

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