SELECTED ARTICLES

A STUDY ON COCONUT SEED SELECTION FOR GERMINATION*†

THE germination referred to in this paper means the resumption of growth by the embryo in a seed nut from the time of planting to the time it becomes visible outside the covering husk. Poor growth or death of the shoot after its emergence from the husk is not considered a failure to germinate.

Blackman (1918) states that the food stored in the seed is mainly responsible for the size and weight of seedling and that the annual growth of a plant, at least in its early stage, follows approximately the Compound Interest Law.

In regard to size and shape of coconuts as indicators of their meat content, Lacson‡ and Novero§ found that the orbicular, ellipsoid, obovoid, and oblong nuts have less meat than the round ones. These authors further reported that other types than the round nut possess relatively thick husks.

Munro and Brown (1920) state that seed should be taken from trees bearing well at the time of collection or from those showing by records that they have given good average yearly crops for a considerable length of time. Preference should be given to fair-sized, round nuts.

Maceda (1933) found that with equal volume, round nuts germinated earlier than oblong ones. He also found that the seedlings of round nuts were heavier and had more leaves and roots than those of oblong.

Patel (1938) reported that :

(*a*) Progenies of high setting mother trees were distinctly superior in early germination to those of mother trees which yield heavily, produce many female flowers, and have large nuts with thick meat.

(*b*) The percentage of germination of nuts from heavy bunches with a minimum of twelve nuts was higher than that of nuts from light bunches with a maximum of six.

(*c*) With the same average ratio of diameter to length, the heavy nuts weighing above one and one half pounds or 0·68 kilogram gave a higher percentage of germination than the light ones weighing below one and one-half pounds.

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* Experiment Station contribution No. 1,372. Prepared in the Department of Agronomy under the direction of Assistant Professor Pedro A. David.

† By Dioscorro L. Umali, in *The Philippine Agriculturist*, Volume XXIX, September 1940, Part 4.

‡ Lacson, P. 1921. Size and shape of coconut as indicators of its meat content. (Unpublished.)

§ Novero, T. F. 1922. Volume and shape of coconut as indicators of the meat content. (Unpublished.)

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(*d*) The thin-husked nuts (0·55 to 0·84 in. thick) were superior to any thin-husked (below 0·55 in. thick) and thick-husked (above 0·85 in. thick) ones in both percentage of germination and early germination.

(*e*) Though the progress of germination did not differ much in the nuts from the top, bottom, or middle of the bunch, the percentage of germination was poor in the top and bottom nuts. The dorsal and ventral nuts did not show any difference in germination.

In order to determine the relation of the thickness of the husks, the percentage of setting of the bunches, the size of the bunches, the percentage of female flower-bearing rachillæ, the weight of the nuts, and the position of the nuts in the bunch to the germination of the nuts and growth of the seedlings, this study was made in the Department of Agronomy, College of Agriculture, Los Banos, Laguna, from July, 1938, to February, 1939.

Materials and Methods.

The Laguna type of coconuts borne in 301 bunches from seventeen-year old trees of the College of Agriculture Experiment Station was used in this experiment. These nuts were almost of the same maturity because the Department of Agronomy harvests them regularly every two months.

The nuts were harvested two weeks before planting. Each mature bunch was lowered to the ground with a rope. Those which accidentally fell and those which did not contain water were discarded.

Each bunch was marked heavy or light, and correspondingly numbered. The nuts that developed, the buttons, the female flower-bearing rachillæ, and the total rachillæ in each bunch were recorded. The percentage of setting for each bunch was determined by dividing the number of nuts that developed by the total number of nuts and buttons in the inflorescence and multiplying by one hundred. The term *buttons* refers to the female flowers that were shed. The percentage of the female flower-bearing rachillæ in the inflorescence was determined, the nuts in each bunch were marked, and the following data were taken :—

(1) Position in the bunch—
   - (*a*) Top—nuts on spikes away from the crown.
   - (*b*) Bottom—nuts on the basal spikes in the bunch nearest the crown.
   - (*c*) Middle—nuts between the top and bottom nuts in the bunch.
   - (*d*) Dorsal—nuts facing away from the tree and exposed to the sun.
   - (*e*) Ventral—nuts facing the tree.

(2) Percentage of setting and female flower-bearing rachillæ.

(3) Number of nuts in the bunch.

(4) Weight of each nut in kilograms.

(5) The thickness of the husks. The thickness was determined by piercing the three protruding sides of the nut with a sharp pointed blade till it touched the shell. The average of the measurements of the three insertions was considered the thickness.

(6) The ratio of the diameter to the length to determine whether the nut was oblong or spherical. The diameter is the distance across the nut, and the length is the distance between the two polar ends. When the ratio was above 0·80, the nut was considered spherical and when less than 0·80, oblong.

The nuts for each treatment were selected within the limits of the different ranges given in table 1, for each definite character. In every two treatments the character of the nuts, whose effects were to be compared, had a very marked difference in range, whereas the range of the other characters was practically the same.

Eight beds 8m. × 1m. and 1·5 m. apart were prepared. Two treatments in single rows 50 cm. apart were planted in each bed. The nuts were buried to about two-thirds of their volume with the germinating eye up and were distanced 10 cm. in the row. The different lots were given the same care.

EXPERIMENTS AND RESULTS

Fifty nuts were used in each experiment and observed daily at the same hour. The following data were noted :—

(1) The exact number of days from planting to the emergence of the horny apex of the shoot from the husk.
(2) The daily percentage of germination.

After 211 days from the date of planting, the following was determined from each seedling :—

(1) The average height of the leaves.
(2) The number of leaves developed.
(3) The weight of the seedlings.
(4) The number of roots.
(5) The average length of the roots.

These results and observations are given in tables 1 to 7.

DISCUSSION OF RESULTS

Relation of the Thickness of Husk to Germination and Growth of Seedlings

Table 1 shows that the mean differences of the different characters of the seed nuts used, such as the number of nuts in the bunch, shape (diameter divided by length), weight, percentage of setting of the bunch, and percentage of female flower-bearing rachillæ in the inflorescence, were insignificant with the exception of the thickness of husk, which showed a significant difference of $1 \cdot 6360 \pm 0 \cdot 0657$ c.m. between the means of the two treatments.

Seed nuts with husks 2·88 cm. thick and less were considered thin-husked and those with 3·98 cm. and more, thick-husked.

The mean difference between the thin- and thick-husked nuts in number of days required for germination and percentage of germination was significant in favour of the thin-husked nuts. The husk of these perhaps offered less resistance to the emerging shoot. None of the shoots were deformed among the thin-husked nuts, whereas six shoots of the thick-husked nuts emerged with difficulty and became distorted.

In general the seedlings of the thin-husked nuts grew better than the thick-husked ; the mean differences of the average length and number of roots and number of leaves were statistically significant (table 2). The superior growth of the seedlings of the thin-husked nuts may have been influenced by the greater content of meat. These results are in conformity with those of Maceda (1933), who found that because of the greater amount of meat in the round nuts, the seedlings from them grew better than those from the oblong.

The average height of leaves of the seedlings from the thin- and thick-husked nuts was nearly the same, the difference being insignificant. The lateral growth of the seedlings of thin-husked nuts, as shown by the diameter of shoot and breadth of leaves, was better than that of the thick-husked nuts.

The weights of the seedlings in the two lots were nearly the same. This was contrary to expectation. Because of the superior growth of the seedlings of the thin-husked nuts, this lot should naturally have weighed much more than the thick-husked. The discrepancy, however, might have been caused by the frequent heavy rains that fell two days before the seedlings were dug up. The thick-husked nuts must have absorbed more water than the thin-husked and consequently weighed more.

Relation of Percentage of Setting of Bunches to Germination and Growth of Seedlings.

In this experiment (table 3) all characters studied that might have influenced the nature of the nut were the same except the percentages of setting, in which a very decided mean difference of $26 \cdot 3600 \pm 0 \cdot 2107$ per cent. occurred.

The lowest and the highest setting percentage of the bunches studied was taken to form a basis for classification. Nuts borne on bunches with a percentage of setting of $18 \cdot 50$ and below were considered low ; and those with $35 \cdot 50$ and above, high.

The mean difference between the low and high percentages of setting in earliness and percentage of germination, average height and number of leaves, and number and average length of roots of the seedlings was statistically significant in favour of the high percentage of setting in the bunch. The difference, however, in the weight of the seedlings in the two lots was not significant. Although the other characters showed significant increases in favour of the seedlings of nuts of the high percentage of setting, the average weights of the seedlings of nuts of the high and low percentages of setting did not show any significant difference. Examination of the nuts which germinated in both lots showed that the meat, a factor responsible for the weight of the seedlings, was almost used up in all the nuts from the bunches of high setting percentage. On the other hand only a small amount of the meat of nuts from the bunches of low setting percentage was consumed. Sampson (1923) reported that the length of time the seedling will absorb the endosperm (meat) depends upon its rate of development. Consequently the greater development of the roots and shoots of the nuts from the high percentage of setting resulted in the rapid consumption of the endosperm. Therefore the average weight of the seedlings in the two lots did not differ very much after 211 days.

Relation of the Size of Bunches to Germination and Growth of Seedlings

The size of bunches referred to in this paper is the number of nuts borne by the spadix. A bunch with a minimum of ten nuts was considered heavy and that with a maximum of five nuts, light.

Table 4 shows that the means of the two plots varied decidedly only in the number of nuts in the bunch. The difference was $8 \cdot 3200 \pm 0 \cdot 0663$. The results of the experiment showed that, as a general rule, nuts from heavy bunches germinated earlier than those from light. The mean difference, however, in the daily percentage of germination was not very marked.

The mean differences of the average height and number of leaves, weight of seedlings, and number of roots per seedling were statistically significant in favour of nuts from heavy bunches. The average length of the roots did not show any significant difference. The seedlings grown from seed nuts of heavy bunches grew better than those from nuts of light bunches.

Relation of the Percentage of Female Flower-bearing Rachillae to Germination and Growth of Seedlings

A spadix with $30 \cdot 5$ per cent. female flower-bearing rachillæ and below was considered low ; and that with $50 \cdot 5$ per cent. and above, high. The seed nuts planted for this experiment were middle nuts taken from the dorsal side of the bunch. All characters considered in this experiment were the same except the percentage of female flower-bearing rachillæ. The mean difference between the low and high percentages of female flower-bearing rachillæ was $33 \cdot 00 \pm 1 \cdot 05$ per cent. No significant differences in the means of the percentage of germination of the nuts, average height of leaves, weight of seedlings, and average length of roots in the two groups were found. The nuts in the high percentage of female flower-bearing rachillæ germinated earlier than those in the low, with a mean difference of $2 \cdot 600 \pm 0 \cdot 715$ days. The seedlings grown from seed nuts of the low percentage, however, produced more leaves and roots than those from the high.

The results seem to show that except for the earlier germination of the nuts in the high percentage of female flower-bearing rachillæ and the production of more leaves and roots of the seedlings in the low, the percentage of female flower-bearing rachillæ did not influence the other characters under study.

Relation of the Weight of Nuts to Germination and Growth of Seedlings

Nuts weighing $1 \cdot 35$ kgm. and below were classed as light and those, $1 \cdot 85$ kgm. and above, as heavy.

In this experiment the mean difference of the weights of nuts between the two treatments was significant ($0 \cdot 8060 \pm 0 \cdot 0092$). The differences of the other characters considered were significant.

Table 6 shows that the heavy nuts germinated earlier and had a higher percentage of germination than the light. The average height, number of leaves, and number of roots of the seedlings of the heavy nuts were significantly greater than those of the light. The difference, however, in the length of roots was not significant.

The mean difference of the weight of seedlings was not taken into account because before planting a very marked difference existed in the weights of the nuts in the two plots. The difference, however, in the increase of weight of the seedling from a nut was statistically insignificant. Examination of the meat content showed that the meat consumed by the seedlings of light nuts after 211 days was much less than that consumed by those of heavy nuts.

The roots of light nuts were much fewer than those of heavy nuts, the difference being highly significant.

The results showed that in germination of the nuts and subsequent development of the seedlings, heavy nuts were much better than light. The difference in growth of the seedlings in the two lots was very apparent.

Relation of the Position of Nuts in the Bunch to Germination and Growth of Seedlings

The seed nuts used in these experiments differed only in their respective position in the bunch. In one experiment top nuts from the dorsal and ventral sides of the bunch only were used, and the germination of the nuts and the growth of seedlings were compared. In another experiment top, middle, and bottom nuts, dorsally located on the bunch, were used. The germination of the nuts and growth of the seedlings were similarly compared.

Table 7 shows no significant difference exists in the means of the number of days, percentage of germination of the nuts, and the average height of leaves of the seedlings between the top nuts taken from the dorsal side and those from the ventral side of the bunch. The average number of leaves and the weight of the seedlings were slightly greater in the dorsal than in the ventral nuts. The number of roots per seedling from the dorsal nuts, however, was less than that from the ventral.

Based on the results obtained, the dorsal and ventral positions of the nuts did not seem to have any influence on the germination of the nuts and on the subsequent growth of the seedlings.

Table 8 shows that in the top and bottom nuts, no significant difference existed between the means with respect to earliness and percentage of germination, height and weight of the seedlings, and average length of the roots. More leaves, however, were produced by the seedlings grown from the top nuts.

The middle nuts germinated earlier but showed a lower percentage of germination than the top and bottom nuts. No significant difference was found between the means of the two treatments in weight of seedlings and average length of roots. The seedlings of the top and bottom nuts were slender but slightly taller than those of the middle.

The mean differences in the number of days from planting to germination and the percentage of germination of the middle and bottom nuts were significantly in favour of the middle nuts. The bottom nuts, however, produced taller but slightly more slender seedlings than the middle nuts. No significant difference was observed in weight of seedlings and average length of roots per seedling.

The middle nuts germinated earlier than the top; the latter, however, had a higher percentage of germination and taller seedlings with more leaves.

The results obtained in these experiments showed only one point in favour of the middle nuts ; they germinated earlier than either the bottom or the top. The seedlings of the bottom and top nuts were taller.

SUMMARY AND CONCLUSIONS

1. Thin-husked nuts with an average of 2·9 cm. (thickness of husk) and below germinated earlier and produced more seedlings with more leaves and roots than thick-husked nuts of 3·0 cm. (thickness of husk) and above.

2. Seedlings grown from nuts with a setting percentage of 35·5 per bunch and above germinated earlier and gave a higher percentage of germination. The seedlings produced had more leaves and longer roots than those from nuts obtained from bunches of a low percentage of setting, 18·5 and below.

3. Nuts gathered from heavy bunches of ten or more likewise germinated earlier and produced seedlings which were taller, heavier and with a much better root system than those from light bunches.

4. The nuts from bunches with a high percentage of female flower-bearing rachillæ (50·5 or more) required less time to germinate and produced slightly taller seedlings than those from bunches with a low percentage. Although the lengths of the roots in the two treatments were practically the same, the seedlings in the latter produced less roots and leaves than those in the former.

5. Light nuts weighing 0·95 to 1·35 kilograms germinated much later than heavy nuts (1·85 to 2·45 kilograms) and produced shorter seedlings with less roots and leaves.

6. The position of the nuts on the bunch, such as on the ventral and dorsal sides, had no influence on the time and percentage of germination. The seedlings of nuts from the dorsal side produced more leaves and were heavier than those from the ventral. The seedlings from the ventral side, however, were taller and developed more roots than those from the other lot.

7. The seedlings from the top nuts produced more leaves and roots than those from the bottom. The middle nuts required less days to germinate but gave a much lower percentage of germination than either the top or the bottom.

TABLE 1

Basis of Selection of Nuts for the Different Plantings*

Lot Number and Treatments	Ranges						
	Percentage of Setting	Diameter divided by Length	Thickness of Husk	Weight of Nuts	Percentage of Female Flower-bearing Rachillæ	Number nf Nuts in the Bunch	Position in the Bunch
	Per cent.		cm.	kgm.	Per cent.		
1. Low percentage of setting ..	**6·50–18·50**	0·77–0·94	2·28–3·48	1·35–1·85	2·85–56·50	5·00–10·00	Dorsal top
2. High percentage of setting ..	**35·50–55·50**	0·77–0·94	2·28–3·48	1·35–1·85	2·85–56·50	5·00–10·00	Dorsal top
3. Thin-husked nuts ..	18·50–36·50	0·81–0·96	**2·08–2·88**	1·35–1·85	38·50–60·50	5·00–10·00	Ventral middle
4. Thick-husked nuts ..	18·50–36·50	0·81–0·96	**3·98–4·78**	1·35–1·85	38·50–60·50	**5·00–10·00**	Ventral middle
5. Nuts from heavy bunches ..	16·50–30·50	0·75–0·90	2·88–3·88	1·35–2·05	38·50–60·50	**10·00–16·00**	Ventral bottom
6. Nuts from light bunches ..	16·50–30·50	0·75–0·90	2·88–3·88	1·35–2·05	38·50–60·50	1·00– 5·00	Ventral bottom
7. High percentage of female flower-bearing rachillæ ..	10·50–24·50	0·75–0·90	2·88–3·88	1·35–2·05	**50·50–80·50**	5·00–10·00	Dorsal middle
8. Low percentage of female flower-bearing rachillæ ..	10·50–38·50	0·75–0·90	2·88–3·88	1·35–2·05	**18·50–30·50**	5·00–10·00	Dorsal middle
9. Dorsal nuts	22·50–38·50	0·75–0·90	2·68–3·85	0·95–1·45	26·50–40·50	10·00–16·00	**Dorsal top**
10. Ventral nuts	22·50–38·50	0·75–0·90	2·68–3·85	0·95–1·45	34·50–60·50	10·00–16·00	**Ventral top**
11. Light nuts	16·50–32·50	0·81–1·02	2·48–3·48	**0·95–1·35**	26·50–50·50	1·00– 5·00	Dorsal bottom
12. Heavy nuts	16·50–40·50	0·81–1·02	2·48–3·48	**1·85–2·45**	26·50–50·50	1·00– 5·00	Dorsal bottom
13. Top nuts	26·50–40·50	0·73–0·94	2·28–3·48	1·65–2·35	32·50–60·50	1·00– 5·00	**Dorsal top**
14. Bottom nuts	26·50–40·50	0·73–0·94	2·28–3·48	1·65–2·35	32·50–60·50	1·00– 5·00	Dorsal bottom
15. Middle nuts	26·50–40·50	0·73–0·94	2·28–3·48	1·65–2·35	32·50–60·50	1·00– 5·00	**Dorsal middle**

* The two ranges in heavy type in each column are those of a certain character of the nut whose effects shall be compared,

TABLE 2

Comparison of the Means of Thin-and Thick-husked Nuts.

Characters	Thin-husked	Thick-husked	Difference	Significance
Number of nuts used	50	50		
Number of nuts in the bunch	6·82 ± 0·0193	6·82 ± 0·2030	0·00 ± 0·0280	Very insignificant
Diameter of nut over its length	0·89 ± 0·0018	0·86 ± 0·0016	0·02 ± 0·0023	Not significant
Thickness of husk in cm.	2·54 ± 0·0059	4·18 ± 0·0648	1·64 ± 0·0657	Very significant
Weight of nut in kgm.	1·55 ± 0·0068	1·55 ± 0·0216	0·00 ± 0·0215	Not significant
Percentage of setting	28·86 ± 0·1247	28·78 ± 0·3332	0·08 ± 0·3550	Not significant
Percentage of female flower-bearing rachillæ ..	47·14 ± 0·1573	48·02 ± 0·1289	0·88 ± 0·2337	Not very significant
Number of days from planting to germination ..	51·90 ± 0·4585	64·50 ± 0·2520	12·60 ± 0·5540	Very significant
Percentage of germination	51·90 ± 2·9116	65·72 ± 0·1950	13·82 ± 2·9180	Significant
Average height of leaves in cm.	61·90 ± 0·5940	60·36 ± 0·5140	1·54 ± 0·7110	Not significant
Number of leaves	4·78 ± 0·0108	4·52 ± 0·0467	0·26 ± 0·0427	Significant
Weight of seedling in kgm.	1·70 ± 0·0074	1·69 ± 0·0024	0·00 ± 0·0081	Not significant
Number of roots per seedling	6·92 ± 0·0151	6·73 ± 0·0636	0·19 ± 0·0657	Significant
Average length of roots in cm.	35·70 ± 0·3042	29·09 ± 0·7404	6·61 ± 0·8080	Significant

TABLE 3

Comparison of the Means of Nuts from Bunches of High and Low Setting Percentage

Characters	Low Setting Percentage	High setting Percentage	Difference	Significance
Number of nuts used	50	50		
Number of nuts in the bunch	6·80 ± 0·0031	6·30 ± 0·0880	0·50 ± 0·0881	Not very significant
Diameter of nut over its length	0·86 ± 0·0029	0·86 ± 0·0020	0·00 ± 0·0113	Not significant
Thickness of husk in cm.	3·00 ± 0·0194	3·00 ± 0·0186	0·00 ± 0·0268	Very insignificant
Weight of nut in kgm.	1·61 ± 0·0262	1·61 ± 0·0078	0·00 ± 0·0099	Not significant
Percentage of setting	14·94 ± 0·1533	41·30 ± 0·1448	26·36 ± 0·2107	Very significant
Percentage of female flower-bearing rachillæ ..	40·50 ± 0·6744	40·54 ± 0·6717	0·04 ± 0·9440	Not significant
Number of days from planting to germination ..	61·80 ± 0·6088	57·90 ± 0·4398	3·90 ± 0·7510	Significant
Percentage of germination	67·22 ± 0·4624	71·10 ± 0·4620	3·88 ± 0·6533	Significant
Average height of leaves in cm.	64·72 ± 0·0042	74·94 ± 0·0361	10·22 ± 0·0363	Significant
Number of leaves	4·16 ± 0·0813	4·54 ± 0·0392	0·38 ± 0·0417	Significant
Weight of seedling in kgm.	1·71 ± 0·0074	1·72 ± 0·0051	0·01 ± 0·0173	Not significant
Number of roots per seedling	6·50 ± 0·0298	6·73 ± 0·0341	0·23 ± 0·0427	Significant
Average length of roots in cm.	32·05 ± 0·0904	34·00 ± 0·0294	1·95 ± 0·0948	Significant

TABLE 4

Comparison of the Means of Nuts from Heavy and Light Bunches

Characters	Light	Heavy	Difference	Significance
Number of nuts used	50	50		
Number of nuts in the bunch	3·52 ± 0·0020	11·82 ± 0·0329	8·32 ± 0·0663	Very significant
Diameter of nut over its length	0·82 ± 0·0560	0·82 ± 0·0012	0·00 ± 0·0026	Not significant
Thickness of husk in cm.	3·30 ± 0·0029	3·33 ± 0·0247	0·03 ± 0·0262	Not significant
Weight of nut in kgm.	1·63 ± 0·0042	1·62 ± 0·0051	0·01 ± 0·0065	Not significant
Percentage of setting	27·10 ± 0·3010	27·02 ± 0·2474	0·08 ± 0·3888	Not significant
Percentage of female flower-bearing rachillæ ..	47·70 ± 0·3440	46·78 ± 0·3479	0·92 ± 0·4880	Not significant
Number of days from planting to germination ..	67·20 ± 0·5833	64·29 ± 0·4314	2·91 ± 0·7240	Significant
Percentage of germination	67·22 ± 2·4668	64·70 ± 0·0289	2·52 ± 2·4460	Not significant
Average height of leaves in cm.	64·73 ± 0·0245	74·71 ± 0·0094	9·98 ± 0·0262	Significant
Number of leaves	3·62 ± 0·0323	4·18 ± 0·0616	0·56 ± 0·0697	Significant
Weight of seedling in kgm.	1·73 ± 0·0046	1·77 ± 0·0052	0·04 ± 0·0069	Significant
Number of roots per seedling	5·52 ± 0·0112	7·21 ± 0·0357	1·69 ± 0·0375	Significant
Average length of roots in cm.	31·48 ± 0·0631	31·84 ± 1·1998	0·36 ± 1·1830	Not significant

TABLE 5

Comparison of the Means of Nuts from Bunches of High and Low Percentage of Female Flower-bearing Rachillae

Characters	Low Percentage	High Percentage	Difference	Significance
Number of nuts used	50	50		
Number of nuts in the bunch	7·36 ± 0·0346	7·54 ± 0·0612	0·18 ± 0·0703	Not significant
Diameter of nut over its length	0·83 ± 0·0020	0·83 ± 0·0028	0·00 ± 0·0021	Not significant
Thickness of husk in cm.	3·27 ± 0·0171	3·27 ± 0·0017	0·00 ± 0·0173	Very insignificant
Weight of nut in kgm.	1·54 ± 0·0012	1·55 ± 0·0003	0·01 ± 0·0012	Not significant
Percentage of setting	18·98 ± 0·2102	18·86 ± 0·1678	0·12 ± 0·2680	Not significant
Percentage of female flower-bearing rachillæ ..	59·58 ± 1·0520	26·58 ± 0·0116	33·00 ± 1·0500	Very significant
Number of days from planting to germination ..	68·70 ± 0·9620	66·10 ± 0·3222	2·60 ± 0·7150	Significant
Percentage of germination	66·60 ± 0·2480	66·12 ± 0·2682	0·48 ± 0·3604	Not significant
Average height of leaves in cm.	70·50 ± 0·1703	71·47 ± 0·0413	0·97 ± 0·4470	Not significant
Number of leaves	4·68 ± 0·0259	4·23 ± 0·0209	0·45 ± 0·0333	Significant
Weight of seedling in kgm.	1·65 ± 0·1039	1·67 ± 0·0194	0·02 ± 0·1014	Not significant
Number of roots per seedling	7·78 ± 0·0503	6·68 ± 0·0542	1·10 ± 0·0736	Significant
Average length of roots in cm.	29·30 ± 0·7955	29·36 ± 0·8179	0·06 ± 1·1803	Not significant

TABLE 6

Comparison of the Means of Heavy and Light Nuts.

Characters	Light	Heavy	Difference	Significance
Number of nuts used	50	50		
Number of nuts in the bunch	3·68 ± 0·0889	3·64 ± 0·8450	0·04 ± 0·8496	Not significant
Diameter of nut over its length	0·95 ± 0·0041	0·92 ± 0·6514	0·03 ± 0·0950	Not significant
Thickness of husk in cm.	3·19 ± 0·0140	3·13 ± 0·0066	0·06 ± 0·0154	Not significant
Weight of nut in kgm.	1·26 ± 0·0013	2·07 ± 0·0091	0·81 ± 0·0092	Very significant
Percentage of setting	23·04 ± 0·4580	23·58 ± 0·4468	0·54 ± 0·6392	Not significant
Percentage of female flower-bearing rachillæ ..	37·42 ± 0·3071	37·86 ± 0·4510	0·44 ± 0·5450	Not significant
Number of days from planting to germination ..	64·75 ± 0·0531	56·50 ± 0·3816	8·25 ± 0·3830	Significant
Percentage of germination	75·10 ± 1·9600	56·50 ± 0·2724	18·60 ± 2·1400	Significant
Average height of leaves in cm.	70·66 ± 0·1270	74·10 ± 0·0283	3·44 ± 0·1301	Significant
Number of leaves	3·85 ± 0·0129	4·64 ± 0·0322	0·79 ± 0·0349	Significant
Weight of seedling in kgm.	1·28 ± 0·0026	2·21 ± 0·0634	0·93 ± 0·0630	Very significant
Number of roots per seedling	5·60 ± 0·0672	7·76 ± 0·0415	2·16 ± 0·0785	Significant
Average length of roots in cm.	35·00 ± 0·7517	33·90 ± 0·3091	1·10 ± 0·8112	Not significant

TABLE 7

Comparison of the Means of Dorsal and Ventral Nuts in the Bunch.

Characters	Dorsal	Ventral	Difference	Significance
Number of nuts used	50	50		
Number of nuts in the bunch	13·10 ± 0·0202	12·58 ± 0·0644	0·52 ± 0·0675	Not very significant
Diameter of nut over its length	0·82 ± 0·0154	0·82 ± 0·0095	0·00 ± 0·0060	Not significant
Thickness of husk in cm.	3·16 ± 0·0211	3·14 ± 0·0230	0·02 ± 0·0312	Not significant
Weight of nut in kgm.	1·25 ± 0·0021	1·24 ± 0·0014	0·01 ± 0·0010	Not significant
Percentage of setting	31·10 ± 0·5220	31·10 ± 0·2333	0·00 ± 0·5715	Very insignificant
Percentage of female flower-bearing rachillæ ..	44·02 ± 0·1613	44·30 ± 0·2111	0·28 ± 0·2650	Not significant
Number of days from planting to germination ..	64·16 ± 0·0724	64·07 ± 0·0250	0·09 ± 0·0765	Not significant
Percentage of germination	61·03 ± 0·9800	59·63 ± 0·8397	1·40 ± 1·2810	Not significant
Average height of leaves in cm.	83·07 ± 0·0114	84·29 ± 0·0140	1·22 ± 1·2400	Not significant
Number of leaves	4·51 ± 0·0495	4·41 ± 0·0350	0·10 ± 0·0193	Significant
Weight of seedling in kgm.	1·44 ± 0·0288	1·40 ± 0·0106	0·04 ± 0·0113	Significant
Number of roots per seedling	7·22 ± 0·0136	7·57 ± 0·0809	0·35 ± 0·0822	Significant
Average length of roots in cm.	31·17 ± 0·7651	31·75 ± 0·0351	0·58 ± 0·7707	Not significant

TABLE 8

Comparison of the Means of Top, Bottom, and Middle Nuts in the Bunch

Characters	Top	Middle	Bottom	Difference of Top and Bottom	Significance	Difference of Middle and Bottom	Significance	Difference of Middle and Top	Significance
Number of nuts used ..	50	50	50						
Number of nuts in the bunch .	3·62 ± 0.0761	3·26 ± 0·0357	3·58 ± 0·0770	0·04 ± 0·0591	Not significant	0·32 ± 0·0846	Not very significant	0·36 ± 0·0981	Not very significant
Diameter of nut over its length	0·84 ± 0·0019	0·84 ± 0·0012	0·84 ± 0·0045	0·00 ± 0·0132	Not significant	0·00 ± 0·0096	Not significant	0·00 ± 0·0091	Not significant
Thickness of husk in cm. ..	3·01 ± 0·0220	3·00 ± 0·0186	3·00 ± 0·0205	0·01 ± 0·0306	Not significant	0·01 ± 0·0245	Not significant	0·02 ± 0·0288	Not significant
Weight of nut in kgm. ..	1·86 ± 0·0037	1·88 ± 0·0048	1·87 ± 0·0021	0·01 ± 0·0042	Not significant	0·01 ± 0·0052	Not significant	0·02 ± 0·0060	Not significant
Percentage of setting ..	31·22 ± 0·2703	31·23 ± 0·2688	31·18 ± 0·2417	0·04 ± 0·0363	Not significant	0·05 ± 0·3618	Not significant	0·01 ± 0·3818	Not significant
Percentage of female flower-bearing rachillæ ..	42·58 ± 0·0252	43·30 ± 0·2994	42·34 ± 0·7511	0·24 ± 0·0911	Not significant	0·96 ± 0·8000	Not significant	0·72 ± 0·3810	Not significant
Number of days from planting to germination ..	66·90 ± 0·5410	60·80 ± 0·8350	67·00 ± 0·5430	0·10 ± 0·7660	Not significant	6·20 ± 1·0570	Significant	6·10 ± 1·0560	Significant
Percentage of germination ..	66·94 ± 0·3973	58·50 ± 0·5807	67·00 ± 0·4307	0·06 ± 0·5860	Not significant	8·50 ± 0·7310	Significant	8·44 ± 0·7050	Significant
Average height of leaves in cm.	74·91 ± 0·0312	69·10 ± 0·4100	73·59 ± 0·0914	1·32 ± 0·0965	Not significant	4·49 ± 0·4195	Significant	5·80 ± 0·4101	Significant
Number of leaves ..	4·49 ± 0·0141	4·32 ± 0·0266	3·93 ± 0·0171	0·56 ± 0·0499	Significant	0·39 ± 0·0318	Significant	0·17 ± 0·0536	Significant
Weight of seedling in kgm. ..	2·01 ± 0·0316	2·07 ± 0·0150	2·02 ± 0·0280	0·01 ± 0·0424	Not significant	0·05 ± 0·0316	Not significant	0·06 ± 0·0352	Not significant
Number of roots per seedling ..	6·37 ± 0·0689	6·48 ± 0·0738	5·34 ± 0·0531	1·03 ± 0·0895	Significant	1·14 ± 0·0932	Significant	0·11 ± 0·1031	Not significant
Average length of roots in cm.	33·13 ± 1·0281	32·50 ± 0·9343	30·80 ± 0·3869	2·33 ± 1·1661	Not significant	1·70 ± 1·0049	Not significant	0·63 ± 1·4380	Not significant