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VARIATIONS IN FRUIT AND SEED CHARACTERISTICS AND GERMINATION OF *Tetrapleura tetraptera* (Schum & Thonn.) Taub. FROM DIFFERENT SOURCES IN SOUTH - WESTERN NIGERIA.

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ABSTRACT

An assessment was carried out of variability in fruit and seed characteristics and the effects of seed source and seed size on germination of *Tetrapleura tetraptera* from four sources in South-Western Nigeria. The sources were Emure-Ekiti (Lat. 7°26'N and Long. 5°30'E); Ikoyi-Ile (Lat. 8°15'N and Long. 4°49'E); Osogbo (Lat. 7° 46' and Long 4°35'E) and Sapele (Lat. 5°55'N and Long. 5°46'E). Fruit length and diameter were determined using a string and a metre-ruler, while fruit and seed weights were measured with an electronic balance and the number of seeds per pod was counted. Seeds were categorised into two, based on sources and size classes for germination studies. Seed dormancy was broken using concentrated Tetra-oxo-sulphate VI acid. The seeds were thoroughly washed in distilled water before sowing in germination boxes filled with top soil.Significant variations were observed both in fruit and seed characteristics and in germination. Mean pod length ranged from 21.60cm to 24.39cm with coefficient of variation of 5.90%. Pod diameter ranged from 3.95cm to 7.5cm with 6.9% coefficient of variation. Mean pod weight ranged from 34.94g to 57.46g with coefficient of variation of 11.11%. The number of seeds per pod varied between 10.46 and 14.04 with coefficient of variation of 14.92%. Seed length varied between 9.12 and 9.78mm with coefficient of variation of 2.58%, while seed diameter and seed weight ranged from 6.26mm to 7.00mm and 1.50g to 1.76g respectively. The coefficient of variation for seed diameter was 7.05% while that of seed weight was 6.91%. Germination pattern also varied according to seed size classes and sources. The largest size class (10.7mm+) gave the highest cummulative germination percentage of 88.2% and a germination rate of 12.52 seeds per day. The size class 6.0 - 7.5mm gave the lowest cummulative germination percentage of 57.5% and a germination rate of 8.19 seeds per day. Seeds from Ikoyi-Ile had a total germination percentage of 92.8% and a germination rate of 12 seeds per day. The lowest total germination of 56.6% was recorded for Osogbo. Interaction effects between mother trees and seed source were significant. There was, however, no significant interaction between seed size and seed source

Key Words:Tetrapleura tetraptera, fruit characteristics, seed source, variation, germination.

INTRODUCTION

Tetrapleura tetraptera (Schum and Thonn) Taub. is an important multipurpose tree in Nigeria. The species is widely spread in Tropical Africa (Keay, 1989) and grows wild in tropical West Africa (Adewumi, 1989). In Nigeria it is found mainly in the Southern parts of the country where it occurs in rainforest, secondary vegetation, forest fringes and derived savanna where the rainfall and relative humidity are generally high. The fruit is consumed in many parts of the country (Essien *et al.*, 1994) as a spice because of its strong aroma. It is also used by traditional medical practitioners as one of the ingredients for curing malaria. In eastern Nigeria, households use it to repel snakes from homesteads (Onyekwelu, 1990).

Furthermore, active chemicals of medicinal importance have been extracted from different parts of the tree (Oyedapo and Famurewa, 1989; Mailard *et al.*, 1991, 1992; Ngassapa *et al.*, 1993). Unfortunately not much work has been done on selection, breeding and improvement of the species. Most of the uses to which the species is being put are based either on the seeds or whole fruit. Presently, the species is propagated mainly by seeds, hence further pressure for domestic and commercial utilization of the species may constitute threat to it's germplasm. There is therefore, a need to research into the selection, breeding and improvement towards domestication of *T. tetraptera* to prevent the imminent loss of the germplams of the species.

This study is focused on the possible effect(s) of sources of parent plants on fruit and seed characteristics and also the effect(s) of sources of parent plants on fruit and seed characteristics and also the effect(s) of seed size and source on the germination pattern of the seeds. This is with the aim of providing the necessary baseline information for quality seed collection for improvement, multiplication and domestication of the species.

MATERIALS AND METHODS

The experimental design adopted is a factorial design layed out in complete Randomised Blocks with three replicates for fruit and seed characteristics assessment and four replicates for the germination experiment.

The study area falls between latitudes 5°55'N and 8°51'N; and longitudes 4°35'E and 5°46'E (Fig. 1). The topography is generally gently undulating with occasional elevations and depressions at various places. The altitudes range from 4.1m at Sapele through 310m at Emure-Ekiti to 380m at Ikoyi-Ile. The rainy season varies from 10 months at Sapele to 8 months at Ikoyi-Ile with a short dry spell lasting between two and four months. The mean annual rainfall is generally over 1,000mm with Sapele and Emure-Ekiti recording well over 2,000mm annually.

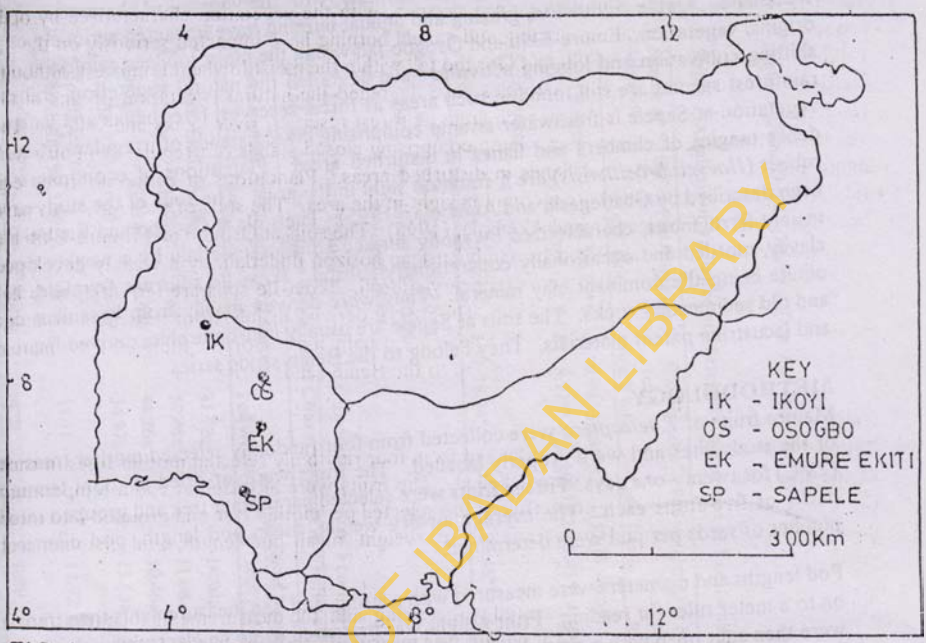

FIG. 1 MAP OF NIGERIA SHOWING THE STUDY SITES

Ikoyi-Ile falls within the Southern guinea savanna, with the vegetation characterised by open woodland. Arable cultivation, grazing and annual burning have impacted seriously on the original vegetation. Emure-Ekiti and Osogbo fall within the moist lowland rainforest, although shifting cultivation and logging activities have degraded the natural vegetation; relics of the rainforest species are still found in such areas as forest reserves, river banks and valleys. The vegetation at Sapele is freshwater swamp comprising closed stands of irregular structure with dense tangles of climbers and lianes in disturbed areas. Plantations of economic trees e.g. rubber (*Haevea braziliensis*) are a common sight in the area. The soils of the study area have been described by Gbadegesin and Akinbola, (1995). The soils at Osogbo and Emure-Ekiti are mainly ferruginous, characterized by sandy surface horizon underlain by a weakly developed clayey, mottled and occasionally concretionary subsoil. Ikoyi-Ile soils are ferralitic, with kaolinite being the dominant clay mineral. They were derived mainly from basement complex and old sedimentary rocks. The soils at Sapele are usually hydromorphic, derived from marine and lacustrine parent materials. They belong to the Benin sands series.

METHODOLOGY

Mature fruits of *T. tetraptera* were collected from four randomly selected mother trees in each of the study sites and were properly labelled. The fruits were air-dried at room temperature (28°C) for twenty-one days. Fifteen fruits were selected per mother tree and grouped into three packs of five fruits each. The average air-dry weight, mean pod length, pod diameter and number of seeds per pod were determined.

Pod lengths and diameters were measured with a string and the measurements then transferred on to a meter ruler for reading. Fruit weight was measured using an electronic balance. Fruits were then split open with a sharp knife and the number of seeds per pod counted.

In order to bring out the differences in fruit characteristics between the four study sites, all fruits from the same source were mixed thoroughly and another batch of 15 fruits selected per source. Each batch of 15 fruits was subdivided into three groups of 5 fruits each, and subjected to the same measurements as above.

Seed Characteristics

All seeds from the same source were mixed together and sorted into four size classes as follows: T_1(6.0 - 7.5mm); T_2(7.6 - 9.1mm); T_3(9.2 - 10.7mm) and T_4(10.7mm+). The seed sources were designated as S_1, S_2, S_3, and S_4 representing Emure-Ekiti, Ikoyi-Ile, Osogbo and Sapele respectively. Sixty seeds were selected for each size class per source giving a total of 960 seeds.

Seed dormancy was broken by soaking seeds in concentrated Tetra-oxo-sulphate (vi) acid for

Table 1 Analysis of Variance of Metrical Characters of Fruit and Seed of T. tetrapleura from South-Western Nigeria

Source of Variation	D.F	Pod lenght (cm)		Pod diameter (cm)		Pod weight (g)		No of Seed per pod (mm)		Seed length (mm)		Seed diameter		Seed weight (g)	
		m.s.	F. ratio	m.s.	F ratio	m.s.	F ratio	m.s.	F ratio	m.s.	F ratio	m.s.	F ratio	m.s.	F ratio
Seed Source	3	16.5	8.77**	6.99	38.64**	1132.78	46.59**	50.92	1.34n.s	1.70	28.41**	0.3	1.34n.s	0.35	30.10**
Trees	3	5.23	2.78*	1.81	9.97**	1007.82	41.45**	4.46	3.36*	0.76	12.62**	0.78	3.36**	0.12	9.86**
Seed Source X Trees	9	38.85	20.64**	3.30	18.24**	522.21	21.48**	22.43	2.37 n.s.	0.47	7.93**	0.55	2.37*	0.13	10.83**

** = Significant at $P \leq 0.01$
* = Significant at $P \leq 0.05$
n.s. = Not Significant

Table 2: Means Values of Metrical Characteristics of Fruit and Seed of T. tetraptera from South-Western Nigeria

Seed sources	Pod length (cm)	Pod diameter (cm)	Pod weight (g)	Number of seed per pod	Seed lenght (mm)	Seed diameter (mm)	Seed weight (g)
Emure -Ekiti	24.39a	3.95	41.72ab	14.04a	9.78	6.58a	1.58b
Ikoyi -Ile	23.49a	7.54	57.46	11.08a	8.00	7.00a	1.76a
Osogbo	23.21a	6.42a	44.26a	10.46a	8.75a	6.26a	1.59ab
Sapele	21.60	6.30a	34.97b	13.63a	9.12a	6.63a	1.50b
Coefficient of Variability (%)	5.90	6.59	11.11	14.92	2.58	7.05	6.91
Standard error (±)	0.58	+0.75	4.71	0.89	0.37	0.15	0.05
LSD	2.29	0.357	8.21	3.10	0.41	0.80	0.18

60 minutes and later thoroughly washing in several changes of distilled water. The seeds were then sown at 2.0cm depth in germination boxes filled with moist top soil. Watering was done once daily while the rate of germination and the cumulative germination were recorded daily for 16 days after which no further germination was observed.

RESULTS

Fruit Characteristics

The grand mean pod length for all the sources was 23.24cm. The highest mean value of 24.39cm was recorded for Emure-Ekiti; while the least value of 21.60cm was recorded for Sapele. Analysis of Variance indicates significant variations both within and between the sources ($P \leq 0.01$) although within source variation was only significant at 0.05 level of probability. There was also significant interaction between mother trees and seed sources (Table 1). However, Least Significant Difference (LSD) test indicates no significant difference between the Emure, Ikoyi-Ile and Osogbo sources. Only fruits from Sapele were significantly different from those of the other sources (Table 2).

The grand mean pod diameter was 6.45cm with the highest value of 7.54cm recorded for Ikoyi-Ile while the least value of 3.95cm was recorded for Emure-Ekiti. Analysis of Variance indicates significant variation within and between sources. There was also a significant interaction between the effects of mother trees and seed sources at $P < 0.01$. LSD test shows that fruits from Osogbo and Sapele were not significantly different from each other in pod diameter; they were, however, different significantly from Emure and Ikoyi-Ile fruits which were also significantly different from each other (Table 2).

The grand mean pod weight for all the sources was 44.39g. The heaviest mean podweight of 57.46g was recorded for Ikoyi-Ile while the least mean of 34.97g was observed for Sapele fruits. Analysis of Variance indicates significant differences in fruit weights both within and between the sources. Interaction effect of mother trees and seed sources was also significant at both 0.05 and 0.01 levels of probability. LSD test indicates that only the Ikoyi-Ile fruits were significantly different from those of the other three sources. There was also a significant difference between Osogbo and Sapele sources, while Sapele and Emure-Ekiti fruits were not significantly different (Table 2).

The highest mean number of seeds per pod of 14.04 was recorded from Emure-Ekiti while the fewest mean of 10.46 was recorded for Osogbo. Analysis of Variance indicates significant difference in number of seed per pod within source (between mother trees) at 0.05 level of probability although differences between the sources were not significant. Least significant difference (LSD) test confirms this observation.

Seed Characteristics

Seed length varied between 8.00mm at Ikoyi-Ile and 9.78mm at Emure-Ekiti. Osogbo and Sapele recorded mean seed lengths of 8.75mm and 9.12mm respectively. Analysis of Variance indicates significant variations in seed lengths both within and between the sources. The interaction effect of the mother trees and seed sources was also significant ($P < 0.01$). LSD test indicates no significant difference between Osogbo and Sapele sources although they were also different from each other (Table 2)collectively different from the Ikoyi-Ile and Emure-Ekiti fruits which were also different from each other.

Seed diameter varied from 6.26mm at Osogbo to 7.0mm at Ikoyi-Ile. Emure-Ekiti and Sapele seeds had average diameters of 6.58mm and 6.63mm respectively. Analysis of Variance shows significant variation in seed diameter only between the sources. The interaction effects of mother trees and seed sources were only significant at 0.05 level of probability. LSD test, however, indicates no significant difference between the sources (Table 2).

Seed weight varied between 1.50g at Sapele and 1.76g at Ikoyi-Ile. Emure-Ekiti and Osogbo seeds recorded average seed weights of 1.58g and 1.59g respectively. Analysis of Variance indicates significant variations both within and between the sources as well as interaction between the effects of mother trees and seed sources. Least significant difference test, however, indicates no significant difference in seed weights of seed from Sapele, Osogbo and Emure-Ekiti. Only the seeds from Ikoyi-Ile were shown to be significantly different from the_others (Table 2).

Germination

Seed source and size were found to be highly influential on the rate of seed germination and total germination percentage. Germination started on the 5th day for size class iv (10.7mm+) and was completed in 15 days, whereas germination in size class I (6.0 - 7.5mm) started on the 6th day and was completed in 16 days. Although germination started on the 5th day for size class II (7.6 - 9.1mm), it was not completed until the 16th day. Similarly, germination started on the 6th day for size Class III (9.2 - 10.7mm+) and was completed in 16 days. Cumulative germination percentage was highest (88.2%) for the largest-sized seeds and least (57.51%) for seeds of lowest size (Fig. 2) while size classes II and III had germination percentages of 75.5% and 78.5% respectively.

Rates of germination also varied directly with seed size. The largest size class recorded an average of 12.57 seeds germinating per day, while the lowest size class had an average daily germination of 8.19 seeds. Size classes II and III germinated at an average rate of 10.8 and 11.2 seeds per day respectively. Seed source also had significant effect on the germination pattern. Seeds from Ikoyi-Ile recorded the highest germination percentage of 92.88%, followed by seeds

from Emure-Ekiti with a total of 71.2%. The Osogbo seeds recorded a percentage germination of 67.0%, while the least percentage germination of 56.6% was recorded from Sapele (Fig. 3).

Analysis of variance indicates highly significant variability at ($P \leq 0.01$) in germination of seeds from the four sources and the four size classes. However, the interaction between the effects of seed size and seed source was not significant (Table 3).

DISCUSSION

Fruit and Seed Characteristics

The variations observed in fruit and seed characteristics of *T. tetrapleura* could be of use in the selection of superior trait for improvement and domestication of the species. Generally, variation is a natural phenomenon. No two individuals, are exactly alike in nature. Differences do occur in the genetic constitution of organisms during meiotic cell division. The laws of segregation and independent assortment offer some explanation for such changes in genetic composition. Mutation may also be responsible for such differences, as a result of sudden adverse environmental changes. Hence the observed variations may be attributed to both biotic and abiotic factors.

Environmental factors such as light intensity, irradiance and climatic factors such as rainfall and relative humidity affect fruit characteristics. Furthermore, age of parent plants and stage of maturity of fruits may also contribute to differences observed in these characters. Presence of pollirators at the appropriate time, success or failure of fertilization, and seed abortion may affect the number of seeds per pod. Bello (1990) and Adewusi (1991) reported variations in fruit length, diameter, weight and number of seeds per pod for *Acacia nilotica* and *Faidherbia albida* respectively in Nigeria. The variations observed in the seed length and seed weight may also be attributed to both genetic and environmental factors of different parent plants. Seed size may be affected by availability or otherwise of soil nutrients during seed development, or environmental factors such as humidity and sunlight. Normal seed development would be affected if plants suffer from nutrient element deficiency e.g. phosphorus or if there is water stress or inadequate photosynthesis by the parent plant. Variations in seed weight may be attributed to differences in grain filling.

Generally, however, genetic factors play significant role in the characteristics of both fruits and seeds. Since there are differences in these factors within and between sources and even within same plant; the variations observed in seed characteristics are justified.
The significant interaction effect of mother trees and seed sources observed in pod length, pod diameter, pod weight, seed length and seed diameter may mean that the combined effects of mother trees and seed sources are important in the differences observed in these characteristics.

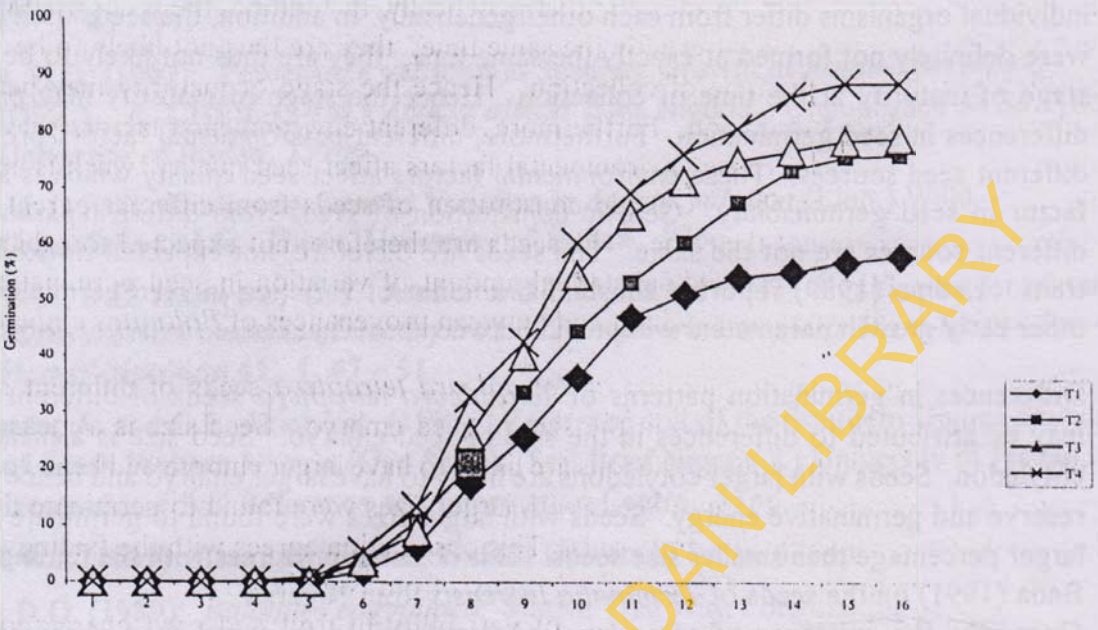

Figure 2: Effect of seed size on Germination of Tetrapleura tetraptera from four sources in South Western Nigeria

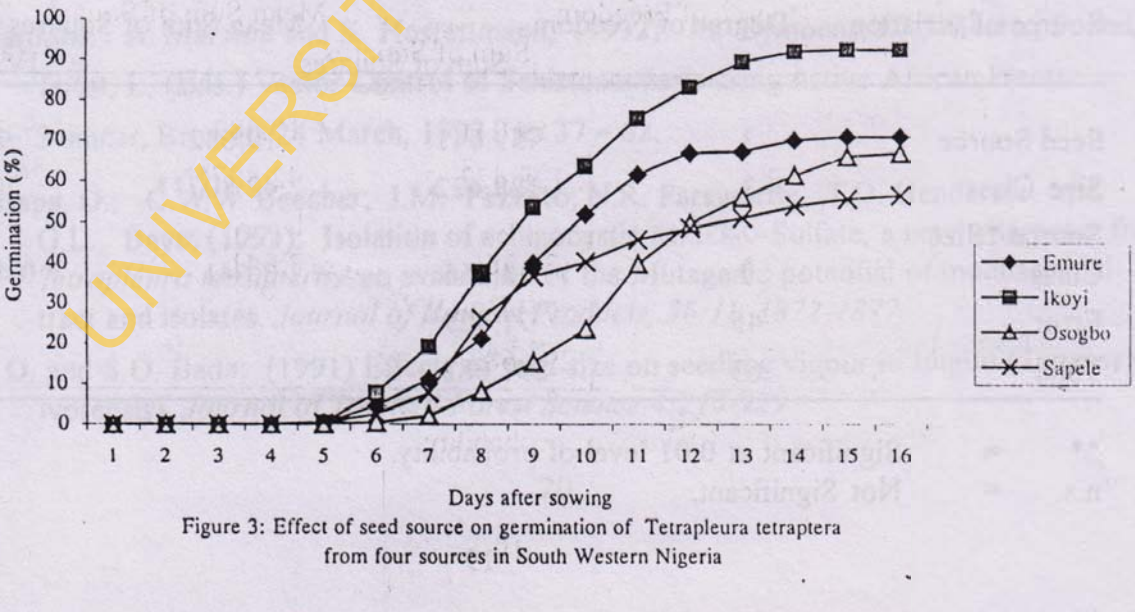

Figure 3: Effect of seed source on germination of Tetrapleura tetraptera from four sources in South Western Nigeria

Germination

Patterns of seed germination were affected by both seed sources and size. As stated earlier, individual organisms differ from each other genetically. In addition, the seeds used in this study were definitely not formed at exactly the same time; they are thus not likely to be at the same stage of maturity at the time of collection. Hence the stage of maturity may partly explain differences in seed germination. Furthermore, different environmental factors prevail at the different seed sources. These environmental factors affect seed quality which is an important factor in seed germinability. Genetic constitution of seeds from different parent plants and different sources are not the same. The seeds are therefore, not expected to exhibit the same traits. Ladipo (1989) reported substantial amount of variation in seed germination rate and other early growth parameters within and between provenances of *Balanites aegyptiaca*.

Differences in germination patterns of *Tetrapleura tetraptera* seeds of different size classes may be attributed to differences in the size of seed embryo. Seed size is a measure of seed cotyledon. Seeds with larger cotyledons are likely to have larger embryo and hence greater food reserve and germinative energy. Seeds with larger sizes were found to germinate faster and in larger percentage than smaller size seeds. This observation agrees with the findings of Oni and Bada (1991) on the seeds of *Terminalia ivorensis* from Nigeria.

Generally, the existence of some level of variability in fruit and seed characteristics of *T. tetrapleura* as observed in this study may be useful in selection and breeding programmes of the species. Also large seeds are likely to germinate faster and in larger quantity and should therefore be sought for during seed collection if the mother trees satisfy other selection criteria.

Table 3: Analysis of Variance showing the effects of Seed Source and Seed Size on germination of *T. tetraptera* from South Western Nigeria:

Source of variation	Degree of Freedom	Sum of Squares	Mean Sum of Squares	F- ratio
Seed Source	3	59.041	19.682	9.25**
Size Class	3	128.422	42.807**	20.13 **
Source *Size Class	9	32.766	3.641	0.44n.s.
Error	45	71.453		
Total	63	291.682		

** = Significant at 0.01 level of probability.
n.s. = Not Significant.

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