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Original Research Paper

The Relationship between Seed Weight, Nutrient Composition and Germinating Seeds of Five Tree Species of the Lake Chad Basin Area of Nigeria

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The relationship between seed weight, nutrient contents of seeds and germinating seeds of *Acacia senegal (L.) Willd*., *Albizzia lebbeck (L.) Benth., Faidherbia albida (Del.) A. Chev., Piliostigma reticulatum (DC.) Hochst.* and *Prosopis juliflora (SW.) DC*. was studied. Weighing of the seeds was carried out in the Department of Biological Sciences Laboratory for light, slightly heavy and heavy sized seeds, while nutrient composition of seeds and germlings were tested in the Animal Science Laboratory, Faculty of Agriculture and germination of seeds was conducted in the Laboratory of the Department of Biological Sciences. Completely Randomized Design (CRD) was employed. Proximate composition of seeds (ungerminated) and germlings (germinated) showed significant variation among the five species. Carbohydrate was the main food reserve in all the five seed species, followed by fibre, protein, lipid and then ash. Seeds of *P. juliflora* had the highest protein content (20.7%). *A. lebbeck* had the highest fibre content (26.3%). The seed with the highest lipid content was *A. senegal* (3.3%). Ash content was highest in seeds of *A. senegal* and *F. albida* (2.6%) and *P. reticulatum* had the highest carbohydrate content of (61.0%). Proximate composition of germlings showed depletion of carbohydrate and lipid contents while protein, fibre and ash increased in all the five tree species. Seed weight within and between species on nutrient composition was not significant at 5% probability except in fibre content. Seed weight within and between species on rate of germination was significant at 5% probability level but not significant on percentage germination. Seed weight between species indicated *P. juliflora* as the fastest 1-6days and highest percentage germination (98.75%) while *P. reticulatum* was the slowest 5-11 days and lowest (43.33%). In conclusion, among the species, germination was not influenced by seed weight and nutrient composition of the seeds but within species significantly influenced germinating seeds.

Keywords: Seed weight, Nutrient composition, Lake chad basin area.

INTRODUCTION

Seed weight is generally assumed to be an ecologically important life history trait in plants because it influences both dispersal ability and seedling establishment. The life cycle of a plant begins with the germination of a seed. The product of the fertilized ovule, it is a unit that contains embryo and endosperm or food reserve (Dutta, 1995). The endosperm is rich in carbohydrate, fat, protein and growth hormones. It is the food that is being absorbed by the embryo in the process of germination and further growth of a plant. The seed is also a vehicle of genetic transfer of physiological traits from parent to offspring and the maintenance of generation of the species.

Seed characteristics affect germination, seedling growth and canopy development. Seeds of higher plants have various sizes and this is attributable to the size of the endosperm within the seed and it has been found to influence germination and consequently productivity of species (Dutta, 1995) Thus, according to Houssard and Escarre (1991), early germination means early opportunity for growth. The present study is determined to investigate the influence of seed weight and nutrient composition on the germination of seeds of *A. senegal*, *A. lebbeck*, *F. albida*, *P. reticulatum* and *P. juliflora* which are multipurpose tree species that meet the requirements of the community.

MATERIALS AND METHODS

Pods of the five leguminous species were collected from matured plants in the plantation of the Borno State Afforestation Programme, Maiduguri, Nigeria (Lat. 11° 50'N; Long. 13° 11°E) between the months of January and February.

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Table 1. Nutrient composition of the seeds of five tree species as affected by seed weight

Tree species	Protein (%)	Fibre (%)	Lipid (%)	Ash (%)	Carbohydrate (%)
Acacia senegal	20.6	22.7	3.3	2.6	51.7
Albizzia lebbeck	17.4	26.3	2.5	2.3	51.6
Faidherbia albida	16.4	20.4	1.9	2.6	58.8
Piliostigma reticulatum	18.9	16.8	1.8	2.0	61.0
Prosopis juliflora	20.7	20.2	1.7	1.8	55.6
Mean	18.8	21.2	2.2	2.3	55.7
$LSD_{0.01}$	3.4197	3.2980	0.7048	Ns	7.1831
Seed weight					
Light	17.8	25.7	2.2	2.1	52.6
Slightly heavy	19.1	19.6	2.3	2.4	56.8
Heavy	19.6	18.3	2.3	2.2	57.8
Mean	18.8	21.2	2.2	2.3	55.7
$LSD_{0.05}$	Ns	2.1282	Ns	Ns	3.5355
Interaction					
species x seed weight	Ns	**	Ns	Ns	Ns

** = Significant at 1% probability level; Ns = Not significant at 5% probability level

Seeds were handpicked from pods and kept in separate enclosed glass bottles for subsequent use. Seeds of the five tree species were weighed individually using a sensitive weighing balance (Sartorius LC 12015) in grams, in the Department of Biological Sciences Laboratory of the University of Maiduguri.

The proximate analysis of the weighed seeds was determined according to Association of Official Analytical Chemists (AOAC) (1980) in the Faculty of Agriculture, Animal Science Department, University of Maiduguri for percentage protein, fibre, lipid, ash and carbohydrate.

Germination of the weighed seeds was conducted in the Biological Sciences Department. The seeds were placed in 10cm diameter Petri Dishes lined with filter papers and moistened with distilled water. 100 seeds (4 replicates of 25 seeds) were used for each of the tree species. Watering was done every other day and when necessary as done by Mukhtar and Alhassan (2006).

A seed was considered to have germinated when the radicle protruded to about 1.5mm from seed coat. Germination was observed and recorded every day, rate of germination (number of days needed for the commencement of germination to the number of days taken for completion of germination) and percentage germination (number of seeds that germinated over the total number of seeds that were sown and multiplied by 100) were calculated. Data collected from proximate analysis and seed germination were subjected to Analysis of Variance (ANOVA). Treatment means were compared by Least Significant Difference.

RESULTS AND DISCUSSION

Result on nutrient composition of the seeds indicated significant ($P < 0.01$) variation among the five species except for ash (Table 1). Carbohydrate was the main food reserve in the five tree species followed by fibre, protein, lipid and then ash. Protein content was highest in *P. juliflora* (20.7%) and the least from *F. albida* (16.4%). *A. lebbeck* had the highest fibre content (26.3%) while *P. reticulatum* had the lowest (16.8%) fibre content. *A.senegal* had the highest lipid content (3.3%) and *P. juliflora* had the least (1.7%) lipid content. *A. senegal* and *F. albida* had the highest (2.6%) ash content while *P. juliflora* had the least (1.8%) ash content. *P. reticulatum* had the highest (61.0%) carbohydrate content and *A. lebbeck* had the lowest (51.6%) carbohydrate content.

Comparing seed weight between species revealed that *A. lebbeck* with the highest seed weight gave the highest fibre content while *P. juliflora* had the least seed weight but did not give the least fibre content, indicating that the weight of a seed had no significant influence on the nutrient contents of the seeds. This conforms with the work of Mukhtar and Alhassan (2006) who reported that there were variations with regards to the biochemical and moisture composition of the different cowpea varieties they worked on and that seed weight and/or hardness did not appear to control them.

Seed sizes within species showed that In the work of Seibert and Pearce (1993), within species showed that the direct relationship shown between seed weight and size suggest higher food reserves in larger, heavier seeds and that the ability of a plant to secure nutrient resources is directly affected by the size of the seedling shoot and root systems and therefore has been shown to enhance seedling competitive ability.

Proximate composition of germinated seeds

Table 2 shows the proximate composition of germinated seeds (germlings). Comparing the nutrient contents of the seeds and those of the germlings revealed the extent of nutrient exploitation after germination of the seeds. Carbohydrate and lipid contents were found to decrease while protein, fibre and ash contents increased in germinating seeds. The decrease in carbohydrate and ash might be because of the hydrolysis of these substances to provide energy and materials for the formation of new protoplasmic materials while the increase in protein, fibre and ash might be because of the formation of new cells as the seedlings grow.

The result of this study agrees with the work of Mukhtar and Alhassan (2006) who reported that carbohydrate and lipid contents decreased with increase in hours of imbibition from 0-42hrs while protein, fibre, ash and moisture contents increased in germinating cowpea seeds. The result of this study however, disagrees with Agboola (1995) that protein decreased from 22%-2% in germinating seeds of *Prosopis africana*.

Table 2. Nutrient composition of the germlings of five tree species as affected by seed weight

Tree species	Protein (%)	Fibre (%)	Lipid (%)	Ash (%)	Carbohydrate (%)
Acacia senegal	30.0	25.1	2.2	3.8	38.9
Albizzia lebbeck	28.8	30.3	1.5	3.4	36.0
Faidherbia albida	25.5	25.2	1.2	3.9	44.1
Piliostigma reticulatum	30.9	19.5	1.0	3.3	45.2
Prosopis juliflora	24.9	26.6	1.0	3.3	44.3
Mean	28.0	25.3	1.4	3.5	41.7
$LSD_{0.01}$	2.8460	1.2487	0.7914	Ns	2.5399
Seed weight					
Light	23.9	25.9	1.5	3.7	45.1
Slightly heavy	30.7	23.6	1.5	3.4	40.9
Heavy	29.5	26.5	1.3	3.6	39.2
Mean	28.0	25.3	1.4	3.5	41.7
$LSD_{0.01}$	2.9217	1.0904	Ns	Ns	2.5147
Interaction					
species x seed weight	Ns	**	Ns	Ns	Ns

** = Significant at 1% probability level; Ns = Not significant at 5% probability level

Table 3: Influence of species and seed weight on rate of germination (days)

Tree species	No. of days needed for Commencement of germination	No. of days taken for Completion of germination
Acacia senegal	1.00	8.33
Albizzia lebbeck	1.00	9.00
Faidherbia albida	1.00	9.67
Piliostigma reticulatum	5.00	11.00
Prosopis juliflora	1.00	6.00
Mean	1.8	8.8
LSD $_{0.05}$	0.60	2.53
Seed weight		
Light	1.6	8.2
Slightly heavy	1.8	8.4
Heavy	2.0	9.6
Mean	1.8	8.7
LSD $_{0.05}$	0.44	0.83
Interaction		
species x seed weight	*	*

* = Significant at 5% probability level

Table 4. Mean percentage germination for the five tree species and seed size

	% germination													
Tree species	**1DAP**	**2 DAP**	**3 DAP**	**4 DAP**	**5 DAP**	**6 DAP**	**7 DAP**	**8 DAP**	**9 DAP**	**10 DAP**	**11 DAP**	**12 DAP**	**13 DAP**	**14 DAP**
Acacia Senegal	21.25	32.91	43.33	51.25	57.50	63.75	68.75	72.08	74.58	75.41	75.41	75.41	75.41	75.41
Albizzia lebbeck	28.33	36.25	40.83	45.00	52.08	56.25	64.16	67.50	67.50	70.41	70.41	70.41	70.41	70.41
Faidherbia albida	17.08	34.17	39.58	46.66	52.08	55.83	64.58	67.91	72.91	75.83	75.83	75.83	75.83	75.83
Piliostigma reticulatum	0.00	0.00	0.00	7.50	10.41	17.08	23.33	29.60	32.91	38.75	41.67	41.67	43.33	43.33
Prosopis juliflora	28.33	78.75	89.58	92.91	95.41	98.75	98.75	98.75	98.75	98.75	98.75	98.75	98.75	98.75
Mean	19.00	36.4	42.66	48.66	53.50	40.33	64.58	66.50	69.08	71.83	72.41	72.41	73.15	72.65
$LSD_{0.05}$	7.08	8.11	7.85	9.41	9.95	6.43	7.13	7.35	6.94	7.66	8.45	8.20	9.27	8.95
Seed weight														
Light	16.50	32.75	40.50	44.00	51.00	56.50	62.75	62.00	62.50	64.00	64.50	65.25	66.25	65.25
Slightly heavy	20.25	38.00	40.70	46.75	50.25	54.50	60.50	62.50	68.00	71.50	72.50	71.25	72.50	72.75
Heavy	20.50	38.75	47.50	55.25	58.75	63.25	69.75	74.25	76.75	78.50	79.75	79.75	80.50	80.00
Mean	19.08	36.5	42.91	48.66	53.50	58.08	64.33	66.25	69.08	71.33	72.25	72.25	73.08	72.66
$LSD_{0.05}$	9.93	11.37	11.01	8.04	13.98	9.02	10.01	8.58	9.20	8.98	9.01	9.23	8.90	8.48
Interaction														
species x seed weight	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns

Ns = Not significant at 5% probability level

Seed weight and germination of studied seeds

Table 3 shows the weights of seeds and germination of the studied seeds. *A. lebbeck* had the highest seed weight but rated third in rate of germination and rated fourth in percentage germination. *P. juliflora* with the least seed weight gave the fastest rate of germination and highest percentage germination, indicating that seed weight had no significant effect on rate of germination and percentage germination. This finding agrees with the work of Molken *et al*. (2005) that seed size was more influential than seed weight in improving grain yield when they tested seed weight of spring barley.

CONCLUSION

It can be concluded from this study that seed weight within species was positively and significantly associated with species. The heavier the seeds, the faster the rate of germination and the higher the percentage germination and also the higher the nutrient content of the seeds. Between species showed that seed weight had no significant effect on the nutrient composition of seeds, rate of germination and percentage germination of the studied seeds.

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