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Evaluation of Seed Grading Effect on Germination and Seedling Vigour of *Diploknema butyracea* (Butter Tree)

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ABSTRACT: *Diploknema butyracea* (Roxb.) H.J. Lam. is a fast growing, multipurpose tree species with several uses. Overviews of this species reveal that no work has been carried out on seed grading for production of quality seedling. Sowing of ungraded seed of a species gives rise to non-uniform planting material, which in turn gives rise to heterogeneity in the vigour and the size of the seedling produced. Hence, the present study was conducted with the objective to determine best dimension of seed for quality seedling production of butter tree.

Key words : Seed grading, Germination, Vigour, Butter tree

INTRODUCTION

Sowing of ungraded seed of a species gives rise to non - uniform planting material in a nursery bed, which in turn gives rise to heterogeneity in the vigour and the size of the seedling produced. Usually the quantity of seed to be sown per unit area or per nursery bed is fixed by weight. The number of seeds of a species in a given weight will vary according to the size of the seed used. If the smaller seed is used, the given weight of seed will have more number of seed, resulting in a high density of seedlings in the nursery bed. As against this, if an assortment of the large sized seed be used, the number of seeds in a given weight will be less, resulting in a low density of seedlings in the nursery bed. Seedlings are usually smaller at higher densities and their root/ shoot ratio is low and seedlings with low root/ shoot ratio have less survival potential on difficult sites.

Seed size has long been regarded as an important aspect of plant reproductive biology. Seed mass within a plant species is considered a remarkably constant characteristic [1]. However, other studies have demonstrated that seed mass within a species or even of an individual plant can vary greatly [2]. [3] recognized that although seed mass varied between species, seed size was correlated with habitat and tended to increase with successional maturity. Variation in seed mass within a species may affect seed germination [4]. Larger sized seeds frequently have greater germination per cent than smaller sized seeds [5]. Seed size also affects seedling biomass [6]. Some studies indicate that a higher growth of seedlings from smaller sized seeds exists only in the early stages of development [7]. Seed size is one of the more stable morphological characteristics in many plant species. However, various studies have demonstrated that seed size within a species can vary [8].

Diploknema butyracea (Roxb.) H.J. Lam. is a fast growing species and belongs to family Sapotaceae. It is a multipurpose tree species with several uses as source of oil, fodder, fuel wood, timber and medicine. It is commonly found in Himalayan ranges (600 - 1850m) and is native to Nepal. It is distributed across India,Nepal and Philippines. Within India, it is distributed from Garhwal Himalayas to Sikkim and extends up to

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Bhutan [9]. In Uttarakhand, it occurs abundantly in Pithoragarh and adjoining areas of Almora, Bageshwar, Champawat and Nainital Districts [10]. The fruit ripens in the month of June and July. The seeds yield edible oil which is used in chocolate, soap and candle manufacture. The oil from seed is also used as medicine (ointment) for rheumatism, paralysis and sprains [11].

Overviews of this species reveal that no work has been carried out on seed grading for production of quality seedling so far. Therefore, there is an urgent need to evaluate the seed grading. Thus, an attempt was undertaken with the objective to determine best dimension of seed for quality seedling production of butter tree and it is presented in this communication.

Matured fruits of *D. butyracea* were collected from Pithoragarh Forest Division, Uttarakhand State. Seeds were extracted by rubbing the fruits with a wire mesh inside water to remove the pulpy, mucilaginous protective coat. After extraction, seeds were cleaned and sorted out into three grade by seed grader based on their dimension. Experiment was conducted in Forest Tree Seed Laboratory, Silviculture Division, Forest Research Institute, Dehradun. For determination of seed weight, eight random samples of 100 seed were measured to nearest two decimal points with the help of Top Pan Balance and expressed as the 1000-seed weight. The germination test was conducted as per the procedure prescribed by International Seed Testing Association [12]. Mean germination time (MGT) was calculated using the equation: $\Sigma fx/\Sigma f$, where f is the number of germinated seeds at a particular count, and C is the time, in days, from sowing to the midpoint between the particular count and the preceding count, or, if there is no preceding count, the time of sowing. The germination value was calculated on the basis of formula described by [13] as shown below; GV = DGs/N x (GPx10), where, GV = Germination value, DGs = Daily germination speed i.e. total germination per cent/ Number of days since beginning of test, N= Number of days since beginning of germination, GP = Germination per cent and 10 = Constant. On 30st day of the experiment, seedlings were measured for root and shoot length. Seedling vigour index (SVI) on length basis was calculated based on formula by [14].

ANALYSIS OF VARIANCE (ANOVA)

The statistical analysis of each parameter was carried out on mean value and the analysis of variance was performed using SPSS package. The critical difference (CD) was calculated as CD = SEM × t at 0.01

$$CD = SEM \times t\ 0.01$$

Where, t is the tabulated value at 1 per cent level of significance and SEM is the standard error of mean calculated as,

$$SEM = \sqrt{2me/r}$$

Where me is the mean sum of square due to error and r is replicate.

Morphological studies of ungraded seed lot revealed that seed length was 21.63mm, seed width 10.77 mm, seed thickness 7.23 mm, However, in case of graded seed lot the maximum seed length 31.72 mm, seed width 10.57mm and seed thickness 8.66 mm was recorded in larger sized seed lot followed by medium sized seed lot and smaller sized seed lot (Table 1). In case of ungraded seed lot, the weight of 100 nos of seed was 121.00 g and number of seed per kg was recorded 876.However, in case of graded seed lot the weight of 100 nos. seeds 138.00 g and number of seed per kg 724.00 was recorded in larger sized seed lot followed by medium sized seed lot and smaller sized seed lot. The seed proportional was found maximum 50% in medium sized seed lot and minimum (20%) in the smaller sized seed lot (Table 2).

The seeds of *D. butyracea* were sown in sand medium to evaluate the best seed sized for germination studies. The present results revealed that the seed germination was found epigeal in nature (the cotyledons remain above the soil surface). The germination per cent was recorded 78.54, 81.87, 88.65 and 80.94 in smaller sized, medium sized, larger sized and ungraded seed lot, respectively. It is evident from the results that the seed germination studies was maximum in the larger sized seed lot followed by medium sized seed lot, ungraded seed lot and smaller

Table 1. Morphological traits of seed

Classes	Seed length(mm)	Seed breadth(mm)	Seed thickness(mm)
Smaller sized seed lot	20.29 ± 1.047	9.13 ± 0.502	6.98 ± 0.373
Medium sized seed lot	24.86 ± 0.750	11.01 ± 0.430	8.40 ± 0.390
Larger sized seed lot	31.72 ± 1.396	10.57 ± 0.466	8.26 ± 0.484
Ungraded seed lot	21.63 ± 7.882	10.77 ± 2.330	7.23 ± 1.985
Mean	24.62	10.37	7.72
SEm(±)	6.54	1.96	0.96
CDat 1%	2.88	0.44	0.37

± Standard deviation of mean

Table 2. Seed weight, number of seed per kg and their proportional

Classes	Seed weight(g)	Seed number perkg	Seed Proportional(%
Smaller sized seed lot	93.00	1075.00	20
Medium sized seed lot	127.00	787.00	50
Larger sized seed lot	138.00	724.00	30
Ungraded seed lot	121.00	876.00	—
Mean	119.7	865.5	
SEm(±)	9.54	121.73	
CDat 1%	4.20	1.82	

sized seed lot. The graded seeds lot such as smaller sized, medium sized and larger sized showed that mean germination time (MGT) was found i.e. 12.57, 10.36 and 7.58 days respectively. However, the ungraded seed lot the mean germination time (MGT) was recorded 11.22 days. The maximum germination value 9.68was recorded in larger sized seed lot and minimum 7.52germination value was recorded in smaller sized seed lot (Table 3).

The testa of the seed split and the radicle emerged from the blunter end and descended. Meanwhile the cotyledonary petioles elongated rapidly, enabling the plumule to emerge and ascend. The fleshy cotyledons remained above the sand within the testa, remaining attached to the seedlings for several months and supplying it with nutriment. The present results revealed that highest length of the cotyledon 31.15 mm. was recorded in larger sized seed lot and lowest length of the cotyledon 22.24mm was observed in smaller sized seed lot. Maximum breadth of the cotyledon 10.85 mm was recorded in larger sized seed lot and minimum breadth of the cotyledon 9.37 mm was observed in smaller sized seed lot. Similar trend has also been observed in case of cotyledon thickness. It is evident from the data, that the maximum dimension of cotyledon was recorded in larger sized seed lot (Table 4).

Table 3. Seed germination behaviour

Classes	Germination(%)	Mean germination time (days)	Germination value
Smaller sized seed lot	78.54 ± 5.69	12.57	7.52
Medium sized seed lot	81.87 ± 6.38	10.36	8.14
Larger sized seed lot	88.65 ± 4.87	7.58	9.68
Ungraded seed lot	80.94 ± 5.69	11.22	7.95
Mean	82.50	10.43	8.32
SEm(±)	6.82	2.88	0.94
CDat 1%	1.57	0.84	1.92

± Standard deviation of mean

Table 4. Cotyledon dimension of seed

Classes	Cotyledon length (mm)	Cotyledon breadth (mm)	Cotyledon thickness(mm)
Smaller sized seed lot	22.24 ± 1.203	9.37 ± 0.530	4.05 ± 0.739
Medium sized seed lot	27.47 ± 1.112	10.07 ± 0.536	4.33 ± 0.287
Larger sized seed lot	31.15 ± 3.169	10.85 ± 0.612	4.77 ± 0.609
Ungraded seed lot	24.56 ± 2.140	9.86 ± 0.698	4.21 ± 0.874
Mean	26.35	10.04	4.34
SEm(±)	2.32	0.46	0.24
CDat 1%	0.56	0.94	0.73

± Standard deviation of mean

Seeds of *D. butyracea* were sorted out into three grades of smaller sized, medium sized and larger sized, based on their dimension (length x breadth). The graded and ungraded seeds were sown in sand medium to evaluate the best seed sized for production of quality stock. For growth performance of seedling, root length was recorded 8.96, 9.87, 11.54 and 9.17 cm in smaller sized seed lot, medium sized seed lot, larger sized seed lot and ungraded seed lot, respectively. The maximum root length of seedling 11.54 cm was recorded in larger sized seed lot and minimum root length of seedling 8.96 cm was recorded in smaller sized seed lot. The shoot length was recorded 5.39, 6.52, 7.58 and 6.98 cm in smaller sized seed lot, medium sized seed lot, larger sized seed lot and ungraded seed lot, respectively. The maximum shoot length of seedling 7.58 cm was recorded in larger sized seed lot and minimum shoot length of seedling 5.39 cm was recorded in smaller sized seed lot. The seedling vigour index was recorded 703.71, 808.05, 1023.02 and 742.21 in smaller sized seed lot, medium sized seed lot, larger sized seed lot and ungraded seed lot, respectively. The highest seedling vigour index 1023.02 was recorded in larger sized seed

Table 5. Seedling vigour index

Classes	Root length(cm)	Shoot length(cm)	Seedling vigour index
Smaller sized seed lot	8.96 ± 1.22	5.39 ± 0.98	703.71
Medium sized seed lot	9.87 ± 1.52	6.52 ±1.02	808.05
Larger sized seed lot	11.54 ±1.32	7.58 ±1.24	1023.02
Ungraded seed lot	9.17 ±1.48	6.98 ±1.54	742.21
Mean	9.88	6.62	819.24
SEm(±)	0.72	0.50	63.51
CDat 1%	0.68	0.58	12.84

± Standard deviation of mean

lot and lowest seedling vigour index 703.71 was recorded in smaller sized seed lot (Table 5).

Seed - size variation of a species may have ecological significance in a number of ways. The characteristic seed mass of a plant species probably represents a compromise between the requirements for dispersal and for establishment [15]. Larger sized seed has higher germination than that of smaller sized seeds such as *Lupinus texensis* [4], *Impatiens capensis* [16], *Mirabilis hirsuta* [5], *Xanthium strumarium* [6], *Agropyron psammophilum* [17], *Panicum virgatum* [18] and *Erica vagans* [19]. [20] studied the seed size variation and its effect on germination, growth and seedling survival in *Acacia nilotica* and [21] studied the influence of seed size on seedling growth of *Albizia procera* under different soil water levels. The seedling from a smaller sized seed is dependent from a very early phase in growth on its own independent assimilation. In contrast, the seedling from a larger sized seed may have sufficient reserves to continue growth for a much longer period [22]. Seed size and seed weight relationships are useful to estimate the requirements of fruit collection and obtain seed of predetermined quantity for meeting plantation needs. Such relationships also provide reliable estimates of seed availability from selected tree or stands especially from the seed orchards where quality seed production is limited and is therefore, highly valuable [23].

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