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Performance of different locality variable samples of *Tecomella undulata* (Sm.) Seem. under controlled environmental conditions

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Abstract
The present investigation was conducted in the laboratory of Seed Science & Technology, Chaudhary Charan Singh Haryana Agricultural University, Hisar. Various trees of *Tecomella undulata* were selected according to characters of economic interest. There were 15 locations selected on the desirable interest and sufficient amount of samples (pods or seeds) were collected from that tree species. Seed quality parameters of all the collected samples such as seed length seed width, teat weight and seed colour were recorded and then these selected material was taken under the specific environmental conditions of laboratory for further testing of germination, moisture and vigour etc. Maximum standard germination percentage, moisture content, seedling length, seedling dry weight, vigour index I and vigour index II was recorded for ATU14 (69.34%), ATU12 (5.77%), ATU12 (10.24 cm), ATU9 (484.85 mg), ATU12 (710.09) and ATU12 (33450.23), respectively. Most of the characters were superior in ATU12 trees which belonging to the samples from Ghanghu, Churu (Rajasthan). Hence we concluded that samples from these location's trees can be utilize in the improvement of the breeding material and further used for development of new varieties.

Keywords: Tecomella undulata, seed, samples, germination, new variety

Introduction
Tecomella undulata (Sm.) Seem. Family Bignoniaceae is an economically important tree species of arid and semi-arid regions, which is locally known as Rohida or Teak of Marwar. It is mainly used as a source of timber for high prize furniture, carving and agricultural implements (Aslam *et al*., 2009) [2]. T. *undulata* has been identified as an important agroforestry species and plays important role in arid zone as a stabilizer of shifting sand dunes and providing shelter for wild life. It is also used an important afforestation species of the drier tracts due to its drought and fire resistant properties.
Tecomella undulata is nearly evergreen small tree with dropping branches and curved trunk. It attains height ranging from 4 to 8 m with circumference of trunk from 50 to 80 cm and is extremely slow growing with deep root system. It is a medium sized tree that produces quality timber and is the main source of timber amongst the indigenous tree species of desert regions of Shekhawati and Marwar in Rajasthan with the result its trade name is Desert teak' or Marwar teak.Its wood is very hard and often used for fine carving work, furniture, agricultural implements, cots, doors and windows (Jindal *et al.*, 1987) [6].
Three colour morphotypes viz. yellow, orange and red flowers, of this important agroforestry tree are usually available under natural conditions. In addition to its use for the phytoremediation of chromium and crude petroleum oil (Mathur *et al*. 2010) [11] contaminated soils, biosorptive removal of inorganic arsenic and fluoride from aqueous medium using Tecomella stem (Brahman *et al*. 2016) [3], removal of dyes such as direct blue and orange II (Katyal and Daga 2003) [8], it is also used for the synthesis of silver nanoparticles (Chaudhuri *et al*. 2016) [4], rehabilitation of lignite mine backfills (Kumar *et al*. 2011) [9], as bio-fertilizer to improve soil health through its mycorrhizal rhizosphere (Srivastava *et al*. 2004) [13], shelterbelt plantations and sand dune stabilization. In the present investigation, quality pods or seeds are collected from agroclimatic zones of Haryana and Rajasthan to test their different seed quality parameters under the controlled conditions of laboratory

Material and Methods
Present study was carried out under controlled conditions in the laboratory of Seed Science &

Technology, CCSHAU, Hisar (Haryana). A total of fifteen samples were collected from assigned locations and accession codes were decided. Different pod and seed character (pod length, pod width, seed length, seed width, seed thickness and 100 seed weight) were examined by simple observatory or simple instrument such as measuring scale, digital caliper etc. After that other parameters or specific parameter were assessed under controlled condition of laboratory. The seed moisture content was assessed by keeping the seed sample for 24 hours at temperature of 50^0C and available moisture content in seed was estimated using the following formula:

$$\text{Seed Moisture Content (\%)} = \frac{\text{Fresh weight (g)} - \text{Dry weight (g)}}{\text{Weight of working sample}} \times 100$$

50 seeds per genotype, in three replications were placed in between germination papers and kept at 25ºC temperature in seed germinator which have facility of regulatory temperature. First check of typical seedlings was recorded on seventh day and last depends on fourteenth day and just ordinary seedlings were considered for percent germination. Randomly selected normal seedlings were taken from all the samples of standard germination test for measurement of root length in centimeters. Average root length was worked out. Randomly selected normal seedlings were taken from all the samples of standard germination test for measurement of shoot length in centimeters. Average shoot length was worked out. As per Abdul-Baki and Anderson (1972) [1] the vigour index was calculated by following formula:

a) Vigour index-I = Standard Germination (%) X Seedling length (cm)
b) Vigour Index-II = Standard Germination (%) X Seedling dry weight (mg)

Table 1: Locations of selecting quality material of *Tecomella undulata*

Sr. No.	Location	Longitude	Lattitude	Accession Code
1	Dharwanbas, Tosham, Haryana	28.709^0 N	75.821^0 E	ATU1
2	Bhadra, Churu, Rajasthan	29.103^0 N	75.165^0 E	ATU2
3	Sidhmukh, Churu, Rajasthan	28.886^0 N	75.286^0 E	ATU3
4	Rajgarh, Churu, Rajasthan	28.653^0 N	75.390^0 E	ATU4
5	Ratanpura, Churu, Rajasthan	28.535^0 N	75.258^0 E	ATU5
6	Balsamand, Haryana	29.074^0 N	75.486^0 E	ATU6
7	CAZRI Campus, Jodhpur, Rajasthan	26.263^0 N	72.997^0 E	ATU7
8	KVK, Barmer, Rajasthan	25.753^0 N	71.295^0 E	ATU8
9	CAZRI, Jaisalmer, Rajasthan	26.924^0 N	70.973^0 E	ATU9
10	Mahendergarh, Haryana	28.264^0 N	76.152^0 E	ATU10
11	CAZRI Campus, Pali, Rajasthan	25.802^0 N	73.291^0 E	ATU11
12	Ghanghu, Churu, Rajastahan	28.328^0 N	75.120^0 E	ATU12
13	Dhadhar, Churu, Rajastahan	28.331^0 N	75.063^0 E	ATU13
14	Alipure, Jhunjhunu, Rajastahn	28.227^0 N	75.530^0 E	ATU14
15	Udaipur, Rajastahn	24.643^0 N	73.715^0 E	ATU15

Result and Discussion

A quality material is a pre requirement of a successful tree improvement programme. For that a successful selection was carried out in Haryana and Rajasthan which are the natural habitat of *Tecomella undulata*. Sufficient amount of pods were collected from selected tree of different agroclimatic region. A total of 15 locations were decided to take the samples which are presented in Table 1. There longitudinal and latitudinal variations were also show for clear differentiation between the samples. For the different parameter of pods and seeds observation were recorded by simple measuring methods (Table 2).

Table 2: Pod and seed characters of selected trees of *Tecomella undulata*

Accession code	Pod length (cm)	Pod width (mm)	Seed length (mm)	Seed width (mm)	Seed thickness (mm)	100 Seed weight (g)	Seed colour
ATU1	27.67	9.72	10.37	8.80	0.84	0.78	2
ATU2	37.27	10.84	11.13	7.36	0.88	1.21	4
ATU3	23.10	10.34	10.48	7.01	0.77	0.69	3
ATU4	27.83	8.74	11.07	6.87	0.57	0.54	2
ATU5	36.13	11.63	13.27	7.99	1.00	1.25	4
ATU6	37.67	10.18	12.11	8.12	0.87	1.16	1
ATU7	30.67	10.17	10.89	6.74	0.58	1.07	2
ATU8	27.80	10.67	10.64	7.46	0.93	0.93	1
ATU9	23.57	9.44	10.27	8.18	0.90	0.94	2
ATU10	28.20	9.63	10.75	7.92	0.86	0.80	3
ATU11	24.17	7.62	10.41	7.35	0.85	1.00	3
ATU12	33.17	9.66	10.57	6.84	0.83	1.10	1
ATU13	29.30	7.78	11.02	7.34	0.99	1.17	2
ATU14	30.03	11.32	12.50	7.17	0.94	0.81	3
ATU15	24.47	8.87	10.82	7.74	0.82	0.88	3
Range	23.10-37.67	7.62-11.63	10.27-13.27	6.74-8.80	0.57-1.00	0.54-1.21	1 – 4
Mean	29.40	9.77	11.09	7.53	0.84	0.96	-

Pod length was varied from 23.10 to 37.67cm with an average of 29.40cm. Maximum pod length was observed for ATU6

from Balsamand, Haryana while minimum for ATU3 from Sidhmukh, Rajasthan. Similarly pod width varied from 7.62 to 11.63 mm with an average of 9.77mm. Maximum pod width was recorded for ATU5 from Ratanpura, Rajasthan while minimum for AT11 from CAZRI, Pali, Rajasthan. For other characters such as seed length, seed width, seed thickness and 100 seed weight a particular range was observed. Maximum seed length (13.27mm), seed width (8.80mm), seed thickness (1.00 mm) and 100 seed weight (1.21 g) were observed for ATU5 from Ratanpura, Rajasthan, ATU1 from Dharwanbas, Haryana, ATU5 from Ratanpura, Rajasthan and ATU2 from Bhadhra, Rajasthan, respectively while minimum seed length (10.27 mm), seed width (6.74 mm), seed thickness (0.57 mm) and 100 seed weight (0.54 g) were recorded for ATU9 from CAZRI, Jaisalmer, Rajasthan, ATU7 from CAZRI, Jodhpur, Rajasthan, ATU4 from Rajgarh, Rajasthan and ATU4 from Rajgarh, Rajasthan, respectively. Seed colour was observed by giving visual index scoring from 1 to 4. 4 was given to maximum dark coloured seed while light colour seed having score 1. Our results were showing similarity with the results of Johar *et al*., 2015 in *Melia composita*, Daneva *et al*., 2018 [5] in *Ailanthus excelsa* and Singh *et al*., 2019 in *Prosopis cineraria.*

Mainly three types of substrata were used i.e. top of paper, between paper and silica sand in laboratory conditions on different temperatures 20˚C, 25˚Cand 30˚C. On checking temperature and substrata condition, maximum germination was found in Between paper substrata at 25^0C while minimum was observed in Silica sand at 20^0C. Among all three substrata maximum germination was found at 25^0C while at other temperature germination was less as compare to germination at 25^0C.

Table 3: Seed parameters of *Tecomella undulata* testing under controlled conditions

Accession Code	Moisture Content (%)	Germination (%)	Seedling length (cm)	Seedling Dry Weight (mg)	Vigour Index-I	Vigour Index-II
ATU1	3.74	50.22	7.02	320.34	352.35	16090.18
ATU2	4.02	55.41	7.50	350.29	415.61	19407.30
ATU3	5.53	58.32	7.80	375.92	454.75	21918.91
ATU4	5.49	64.66	8.74	433.19	565.13	28010.00
ATU5	4.47	66.32	9.25	465.14	613.46	30844.91
ATU6	2.94	64.57	8.60	435.24	555.39	28106.02
ATU7	4.8	68.34	9.93	469.57	679.08	32075.81
ATU8	3.76	57.15	7.66	301.72	437.83	17239.56
ATU9	4.63	65.74	9.02	484.85	593.05	31879.55
ATU10	3.93	62.51	8.34	428.38	521.34	26772.47
ATU11	5.15	67.31	9.79	478.82	659.20	32240.42
ATU12	5.73	69.34	10.24	482.67	710.09	33450.23
ATU13	4.79	63.56	8.51	451.18	540.87	28676.82
ATU14	5.77	56.55	7.53	365.68	425.81	20692.72
ATU15	3.74	61.48	8.23	419.75	505.88	25806.08
Range	2.94-5.77	50.22-69.34	7.02-10.24	301.72-484.85	352.35-710.09	16090.18-33450.23
Mean	4.57	62.10	8.54	417.52	535.32	26214.07

Hence, substrata between paper and temperature 25^0C were found best for seed analysis under controlled conditions for further experimental results. Standard germination and other seed parameters of 33 plus trees of *Tecomella undulata* were tested under laboratory conditions just after the collections of the seeds. Standard germination (%), Moisture content (%), Seedling length (cm), Seedling dry weight (mg), Vigour Index I and Vigour Index II for fresh seeds are presented in Table3. Maximum standard germination percentage, moisture content, seedling length, seedling dry weight, vigour index I and vigour index II was recorded for ATU14, ATU12, ATU12, ATU9, ATU12 and ATU12 respectively from the selected locations wile a lot of variability in found for minimum value of above characters. Minimum value of both the vigour index I and II was found in ATU1 from Dharwanbas, Haryana. Similar study was attained by Kant and Kumari, 2016 [7] and Kumar *et al*, 2016 in Tecomella undulata which gave relevance tour study. Similar studies were also held in other forest tree species by different researchers.

Conclusion

The seeds collected from ATU12 from Ghanghu, Churu region of Rajasthan represent the best performance under the controlled environmental conditions. The seeds of this source were found to be significantly better in performance as compared to others. It is possible that due to natural selection from these collections got specific advantages for adaptation and performance. It would be interesting to utilize this investigation for further improvement and breeding programmes and also utilize for genetic makeup study of *Tecomella undulata.*

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