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Studies on seed maturity indices of acacia nilotica in Uttar Pradesh

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Abstract

An investigation was carried out to determine the exact maturity stage for seed collection of *Acacia nilotica* at three locations of Uttar Pradesh i.e. Agra (S₁), Mathura (S₂) and Hathrus (S₃). Among the different collection dates, 2nd week of June (5th collection) across the sites was found best as it resulted maximum germination (85.2±0.46 % at S₁, 86.7±0.94 % at S₂ and 86.2±0.45% at S₃). The results also revealed that moisture content decreased with advancement of maturity. At maturity, moisture content came down from 42.2±0.66 to 21.4 ±0.31 % at Agra, 41.8 ±0.22 to 22.4±0.26 % at Mathura and 43.5±0.34 to 23.9±0.23 % at Hathrus. At this stage, the colour of pod and seed was yellowish white and brownish black, respectively. Present study revealed that pods of *Acacia nilotica* may be harvested during 2nd week of June to get maximum germination in Uttar Pradesh.

Keywords: moisture content, pod colour, seed germination

Introduction

Acacia nilotica belong to family Leguminosae (Mimosoideae), is an extremely valuable source of fuel wood and charcoal of excellent quality with calorific value of 4950 K-Cal/kg (Simmons, 1981) [18]. It is almost evergreen in habitat attaining height of 18 m and girth 90cm in favourable sites. It generally flowers from June to September, but some trees may be seen in flower during December-January. *Acacia nilotica* is widely distributed particularly in Punjab, Uttar Pradesh, Madhya Pradesh, Rajasthan Gujarat, Odisha, Chhattisgarh, Bihar, Tamil Nadu. (Anonymous, 2005) [1]. It provide high quality animal feed (pod), fodder, fuel wood, charcoal, gums and tannins as well as contributing to soil stabilization and improvement through nitrogen fixation. The leaves and pods are widely used as fodder and constitute the chief diet for goat and sheep in arid and semi-arid region. They are rich in crude protein 14-20%, ether extract 2.2 to 5.1%, nitrogen free extract 51 to 70%, mineral content 4.8 to 11%. Its wood is heavy (air dry weight 760 kg/m³), very hard, strong, tough resistant to termites and impervious to water. The pressure on our existing forests and agriculture fodder resources have been constantly increasing with the ever-increasing human and cattle population. The situation has reached at alarming proportion in several parts of the country and massive efforts are afoot to not only rehabilitate the degraded forests but also to bring more area under forest cover. Availability of mature and viable seeds is a pre-requisite for raising the quality seedlings at massive scale. Germinability of seeds is strongly influenced by the stage of harvesting and maturity of seeds. The knowledge of stage and time of maturity of seeds is essential for collection of abundant quantity of healthy and vigorous seeds. Keeping in view the importance of species and lack of information on seed maturity indices of this species in arid and semi-arid condition of Uttar Pradesh, present study was carried out.

Materials and Methods

The present study was conducted in Agra (S₁), Mathura (S₂) and Hathrus (S₃) sites of Uttar Pradesh which lies between 27° 10' N to 26° 4' N latitude and 78°02' E to 79°7'E longitude between elevation 165 and 179.8 m amsl. Five trees with clear bole, compact crown, having fair number of pods were selected for the study at each site. The pods of *Acacia nilotica* were collected from the all three sites at different dates. First pod collection was made on 2nd week of April 2004 and subsequent collections were made at bi-weekly intervals, until the completion of natural seed fall. Pods from different tree species were separately sealed in plastic bags and brought to the laboratory. Before the seed extraction and cleaning, pod parameters like length, width, moisture content (%), weight of 100 pods, number of pod per 100g were measure for each collection dates. The size dimensions were recorded with manual vernier caliper and digital electronic balance was used for weighing of pod weight.

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Moisture content (%) was determined on fresh weight basis by drying (over drying) the material at $103\pm 2^\circ\text{C}$ for 16 ± 1 hrs (ISTA, 1981) [9]. The pods were dried for 4-5 days and thereafter beaten with a stick and cleaned by winnowing to release seeds. After the process of seed extraction and cleaning, 3 replicates of 10 seeds were measured for seed length, width and size using Vernier' scalliper and weight parameters like number of seed/g, weight of 100 seeds. Moisture content was recorded on fresh weight basis by drying seeds at $103\pm 1^\circ\text{C}$ for 16 ± 1 hrs (ISTA, 1981) [9] and moisture content was calculated as:

$$\text{Moisture content \%} = \frac{\text{Fresh weight} - \text{Dry weight}}{\text{Fresh weight}} \times 100$$

The seeds were surface sterilized with 0.1 HgCl₂. Seeds were rinsed thoroughly to remove traces of mercuric chloride before putting for germination. For germination, 3 replicates of 100 seeds each were used. The germination was carried out in Petri dish at laboratory (room temperature) for each collection date. Germination was counted when visible radicle develops. Germination percent was calculated as follow:

$$\text{Germination (\%)} = \frac{\text{Number of germinated seed (vissible redicle of seeds)}}{\text{Total number of seeds put in petridish}} \times 100$$

Data recorded for different characters on different sites have been tested for their significance by using statistical technique of analysis of variance with Randomized block design suggested by Panse and Sukhatame (1961) [12].

Result and Discussion

The change in colour of pod/fruit is an indicator of maturity. The results presented in Table 1 showed that the pod colour changed from the green colour (2nd week of April) to yellowish white (2nd week of June) across all the collection sites. Similarly, the seed colour changed from bright green to brownish black at maturity (Table 2). The change in pod colour with the advancement of maturity was also reported by other researchers, also, in different tree species {Bonner, (1976), Ramakrishan *et al.* (1990), Bharathi *et al.* (1996), Rai *et al.* (1988) and Shah, (2005)} [3, 16, 2, 15, 17]. With the advancement of maturity, the moisture content in pods also decreased. During the first collection in the month of April it was found maximum in all sites and thereafter it declined with the advancement of collection dates. At Agra site (S₁), the pod moisture content decreased from 52.3 % to 26.8 %, whereas

at Mathura (S₂) and Hathrus sites (S₃) it decreased from 52.9 % to 28.6 % and 54.5 % to 29.1 %, respectively (Table 1). The average pod moisture content at (S₁), (S₂) and (S₃) was 42.54 %, 43.62 % and 44.66, respectively. (Table 1). Similarly, the seed moisture content also declined with the advancement of maturity. Maximum seed moisture (S₁ 42.2 %, S₂ 41.8 %, and S₃ 43.5 %) was observed in seeds collected during April month in all sites and the minimum (S₁ 21.4 %, S₂ 22.4 %, and S₃ 23.9 %) was in the seeds collected during 2nd week of June (Table 2). Loss of water during seed maturity is more inherent phase of seed development. The decline in seed moisture content during pod/seed development is often attributed to the continued deposition of storage material in seeds (Ellis *et al.* 1987) [7]. Change in colour and decrease in moisture content were also identified as maturity indicator by many researchers (Grover *et al.*, 1963, Carl and Snaw 1971, Edward 1980, Cram and Linqvist 1982, Welbaun and Bradford 1988, Maideen *et al.* 1990, Singh, 1998 and Phartyal *et al.* 2002) [8, 4, 6, 5, 20, 10, 19, 14]. The mean pod/fruit length and width were recorded 13.82 cm and 11.66 mm (S₁), 13.35 cm and 10.14 mm (S₂) and 12.70 cm and 10.86 mm (S₃).

The data on seed germination (Table 2) revealed that the maximum germination (85.2 % at S₁, 86.7% at S₂ and 86.2 % at S₃) was recorded in the seeds collected during the 2nd week of June for all the sites. At this collection date, the pods and seeds were having yellowish white and brownish black, respectively. At this stage the seed moisture content was 21.4 % S₁, 22.4 % S₂ and 23.9 % S₃, the size of seeds was 47.6 mm² (S₁), 43.3 mm² (S₂) and 42.4 mm² (S₃), seed weight/ 100 seeds was 11.5 g (S₁), 11.2 g (S₂), 10.9g (S₃). Pandit *et al.*, (2002) [11] also found the similar observation in *Populus ciliata*, the drop in moisture content of capsules from 80% to 60% during maturation coincided with the maximum germination in seeds.

Moisture content of pods and seeds was significantly different across collection dates and sites, and interactions between collection dates x sites was also significantly different. Pod moisture content was negatively correlated with seed germination (%) and positively correlated with seed moisture content, but seed moisture content was negatively correlated with seed germination per cent ($P < 0.05$). The seed germination per cent was significantly different across the collection dates and sites, interaction between sites x collection dates was also significantly different ($P < 0.05$).

Table 1: Physical parameters of pods of *Acacia nilotica* over the collection period from April to June at different sites

Site	Date	Day of collection	Week	Pod colour	Pod length (cm)	Pod width (mm)	Wt. of 100 pod (g)	No. of pod/100 gm	Pod moisture content (%)
S ₁	10/4	D ₁	II nd Of April	Green	12.3±0.59	6.0±0.30	620.3±1.30	16.74±0.19	52.3±0.34
	25/4	D ₂	IV th Of April	Green	12.7±0.43	11.0±0.21	627.3±1.50	17.17±0.21	47.2±0.39
	10/5	D ₃	II nd Of May	Yellow green	13.9±0.43	13.0±0.54	595.9±1.00	16.9±1.04	42.3±0.42
	25/5	D ₄	IV th Of April	Brown green side yellow	14.7±0.71	13.5±0.40	602.6±1.99	19.3±0.54	44.1±0.29
	10/6	D ₅	II nd Of June	Yellowish white	15.5±0.53	14.8±0.13	376.9±1.76	26.3±0.60	26.8±0.49
			Mean			13.82	11.66	564.6	19.28
S ₂	11/4	D ₁	II nd Of April	Green	11.7±0.38	5.0±0.21	598.0±3.23	18.8±0.59	52.9±0.31
	26/4	D ₂	IV nd Of April	Green	12.2±0.44	9.7±0.26	592.4±1.61	17.8±0.21	48.3±0.31
	11/5	D ₃	II nd Of May	Yellow green	13.8±0.42	12.0±0.39	589.7±1.68	17.0±0.39	42.8±0.43
	26/5	D ₄	IV th Of May	Brown green side yellow	14.2±0.59	12.2±0.25	645.9±3.78	17.9±0.59	45.5±0.34
	11/6	D ₅	II nd Of June	Yellowish white	14.7±0.39	11.8±0.29	368.6±9.86	29.2±1.08	28.6±0.23
			Mean			13.35	10.14	558.9	20.17
S ₃	12/4	D ₁	II nd Of April	Green	11.4±0.27	5.0±0.21	605.0±1.63	20.0±0.82	54.5±0.38
	27/4	D ₂	IV th Of April	Green	11.8±0.48	10.0±0.33	590.9±1.90	20.1±0.21	48.8±0.61
	12/5	D ₃	II nd Of May	Yellow green	12.3±0.32	12.0±0.36	592.9±2.02	19.1±0.53	43.0±0.54
	27/5	D ₄	IV th Of May	Brown green side yellow	13.1±0.58	15.2±0.25	617.6±2.47	20.1±0.88	46.7±0.32
	12/6	D ₅	II nd Of June	Yellowish white	14.8±0.38	12.1±0.23	366.3±9.51	31.2±0.85	29.1±0.32

	Mean			12.7	10.86	554.3	20.64	44.66
Average of Across all site				13.29	10.89	559.33	20.03	43.53
SEm _± for site				0.05	0.03	1.64	0.07	0.044
F-test				*	*	NS	*	*
CD				0.10	0.06	-	0.14	0.087
SEm _± for Date/day				1.68	0.11	5.46	0.23	0.145
F-test				*	*	*	*	*
CD for day				0.33	0.22	10.93	0.46	0.290
SEm _± for SxD				0.06	0.044	2.19	0.094	0.058
F-test				NS	*	NS	*	NS
CD for SxD				-	0.088	-	0.19	-

NS- Non Significant, *- Significance at 5% (P<0.05)

Table 2: Physical parameters of seeds of *Acacia nilotica* over the collection period from April to June at different site

Site	Date	Day of collection	Week	Seed colour	Seed length (mm)	Seed width (mm)	Seed size (mm)	No. of seed/100 g	Seed wt/100 seed	Seed (mm) diameter	No. of seed/ pod	Seed moisture content (%)	Germination (%)
S ₁	10/4	D ₁	II nd Of April	Bright green	6.3±0.15	5.3±0.21	33.5±1.59	294.2±0.76	32.4±0.56	2.5±0.27	11.3±0.30	42.2±0.66	0±0
	25/4	D ₂	IV th Of April	Bright green	6.5±0.17	5.4±0.22	34.5±1.88	344.3±1.47	27.8±0.36	2.6±0.27	11.7±0.21	40.8±0.37	10.5±0.30
	10/5	D ₃	II nd Of May	Light yellowish green	6.6±0.31	5.5±0.17	38.5±1.33	398.2±2.20	29.4±0.97	3.3±0.26	12.5±0.27	45.2±0.18	24.8±0.78
	25/5	D ₄	IV th Of April	Greenish brown	6.7±0.26	5.7±0.15	41.2±1.22	295.5±2.19	31.95±1.22	3.4±0.16	11.7±0.37	42.1±0.22	61.2±0.56
	10/6	D ₅	II nd Of June	Brownish black	7.7±0.21	6.0±0.15	47.6±1.51	875.5±2.27	11.5±0.02	3.5±0.17	11.8±0.46	21.4±0.31	85.2±0.46
		Mean			6.76	5.58	39.1	441.58	26.6	3.06	11.82	38.37	36.33
S ₂	11/4	D ₁	II nd Of April	Bright green	6.2±0.24	5.2±0.25	33.2±1.87	304.6±4.75	31.0±0.25	2.2±0.13	10.6±0.31	41.8±0.22	0±0
	26/4	D ₂	IV th Of April	Bright green	6.3±0.15	5.4±0.22	34.1±1.79	347.0±1.61	26.10±0.40	2.4±0.22	11.0±0.21	41.2±0.25	17.2±0.24
	11/5	D ₃	II nd Of May	Light yellowish green	6.4±0.16	5.4±0.16	34.6±1.48	407.9±2.86	26.67±0.66	3.1±0.28	11.7±0.34	46.6±0.41	30.5±0.50
	26/5	D ₄	IV th Of May	Greenish brown	6.6±0.27	5.4±0.16	36.6±2.39	307.5±8.59	23.1±0.74	3.3±0.15	11.0±0.33	43.5±0.26	53.1±0.24
	11/6	D ₅	II nd Of June	Brownish black	7.6±0.16	5.7±0.15	43.3±1.43	905.7±30.30	11.2±0.37	3.3±0.15	10.9±0.40	22.4±0.26	86.7±0.94
		Mean			6.62	5.42	36.36	454.5	23.6	2.86	11.04	39.11	37.52
S ₃	12/4	D ₁	II nd Of April	Bright green	5.7±0.21	5.1±0.23	31.1±1.87	302.2±9.08	29.8±0.45	2.2±0.13	9.9±0.23	43.5±0.34	0±0
	27/4	D ₂	IV th Of April	Bright green	6.1±0.10	5.3±0.15	31.7±1.29	352.2±1.47	25.1±0.36	2.4±0.16	10.7±0.26	42.2±0.39	19.10.39±
	12/5	D ₃	II nd Of May	Light yellowish green	6.2±0.20	5.5±0.17	33.4±0.93	417.9±3.80	24.7±0.38	3.2±0.20	11.4±0.43	47.1±0.68	32.0±0.66
	27/5	D ₄	IV th Of May	Greenish brown	6.7±0.15	5.3±0.15	36.6±1.48	327.6±14.69	23.3±1.01	2.4±0.16	11.0±0.29	44.3±0.21	44.5±0.23
	12/6	D ₅	II nd Of June	Brownish black	7.6±0.16	5.6±0.16	42.4±0.98	889.2±20.51	10.9±0.25	3.2±0.13	10.8±0.29	23.9±0.23	86.2±0.45
		Mean			6.46	5.36	35.04	457.78	22.7	2.68	10.76	40.22	36.36
Average of Across all site					6.61	5.45	36.83	451.29	24.3	2.87	11.21	39.23	
SEm _± for site					0.023	0.20	0.17	1.23	0.068	0.22	0.037	0.04	0.051
F-test					NS	NS	*	NS	*	*	*	*	*
CD					-	-	0.35	-	0.135	0.043	0.073	0.081	0.102
SEm _± for Date/day					0.076	0.06	0.58	4.09	0.23	0.072	0.122	0.136	0.170
F-test					*	*	*	*	*	*	*	*	*
CD for day					0.152	0.13	1.16	8.19	0.45	0.144	0.244	0.271	0.341
SEm _± for SxD					0.030	0.028	0.23	1.64	0.09	0.29	0.049	0.054	0.868
F-test					NS	NS	NS	NS	*	NS	NS	*	*
CD for SxD					-	-	-	-	0.18	-	-	0.109	0.137

NS- Non Significant, *Significance at 5% (P<0.05)

Conclusion

From the present study, it may be concluded that colour as well as moisture content of pods and seeds are good indicators of maturity. Second week of June is a suitable period for pod collection of *Acacia nilotica* as maximum seed germination was recorded from the seeds collected during this period in all the sites.

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