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Flowering and fruiting Phenology of Some Tree Species in Zalingei Area, Central Darfur State, Sudan

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Abstract

Flowering and fruiting as phenological events of three tree species in semi-arid Savannah zone Zalingei area were examined over a period of one year these species namely *Albizia amara*, *Faidherbia albida* and *Balanites aegyptiaca*. According to Adam (2003) five trees were selected from each species to this study. Observations were taken weekly during the year 2015 and included the time, duration and peak time of flower production - Time, duration and peak time of fruit production - Time, duration and peak time of flushing - Time, duration and peak time of leaf shedding. The results showed that Flowers of *Albizia amara* start to

emerge at the beginning of September and continues until the end of November, while fruiting starts to emerge at the end of October and continues until the beginning of April. A flower of *Faidherbia albida* starts to emerge at the end of October and continues until the beginning of January, while fruiting starts to emerge at the end of November and continues until the beginning of April. A flower of *Balanites aegyptiaca* starts to emerge at the beginning of November and continues until the end of December, while the fruiting starts at the beginning of December and continues until the end of March.

Keywords: Phenology, Tree Species, Flowering, Fruiting Zalingei

1. Introduction

The combination of rainfall and soil texture determines the distribution of vegetation cover in Sudan (Smith 1949^[19]; Harrison and Jackson 1958)^[11]. Sudan forests extend across several agro-ecological zones, which imply the existence of a diversity of fauna and flora species that contribute directly or indirectly to the sustainable livelihood of local communities (El Amin, 2000)^[5]. Ecologically the Sudan can be classified into five main vegetation zones. The description provided by Harrison and Jackson (1958)^[11] has been reviewed and provided in various text (Sahni, 1968; Bayoumi *et al.*, 1984; Gorashi, 1998; Elsiddig *et al.*, 2007)^[18, 4, 8, 7]. HTS maps for the study area (1958 and 1983) explain that the dominant trees species at Zalingei and Teraje as mosaics are *Anogeissusleiocarpus/Albiziaamara*, *Balanitesaegyptiaca/Ziziphusspina-christi* on the upper terraces and *Faidherbiaalbida* on the lower terraces. Phenology can be defined as scientific study of the seasonal timing of life events. In plants, it is related with dates of plant growth phenomenon, such as flowering, leaf flushing or ripening of fruit (Rathcke & Lacey 1985)^[16]. Phenology of tree in any ecosystem and community strongly determines the flowering periods which is indirectly dependent on the environmental variations (Rivera *et al.*, 2002; Hamann, 2004)^[17, 10]. Phenological information with respect to flowering and fruiting evaluated against leafing and leafless periods is scarce in semi-arid area in Sudan. The phenology of tree species has given conclusive knowledge about vegetation's annual pattern of vegetative and floral biology (Prasad and Hegde, 1986; Kushwaha and Singh, 2005)^[15, 14]. This information is useful to assess the influence of phenological events or faunal feeding, movement pattern and sociality (Wada, 1983; Appanah, 1985)^[20, 3].

2. Materials and methods

2.1 Study area

Zalingei locality, marked by latitude 12° 30' - 13° 30'N and longitude 30° 23' - 45° 23'E (Hadi, 2004)^[9], with altitude varies from 890 m to 1121 m above the sea level. The climate is generally characterized by cold dry winter and hot rainy summers. The beginning of the rainy season is typical of the semi-arid savannah which is marked by great irregularity. The average

temperature does not vary significantly between months especially during the rainy seasons, where the relative humidity is high. The potential evapotranspiration is about 170cm/annum, with maximum of 20 cm in May and minimum of 8cm in December and January. The annual mean temperature ranges from 24C°-26C°. The hottest month during the year is May (17C°min-42C°max), while the coldest month is January (7C°min-34C°max). In Zalingei, the temperature in the Wadi bed can be as much as 4C° lower than the recorded screen temperature in the town. Frost can be expected to occur along the Wadi Azum. Localized hail storms may also be expected (Wickens, 1976) [21]. The area lies on the semi-arid Savannah zone, which affected by the elevation of Jabel Marra Massif. The woody vegetation composition in the study area showed three dominant tree species, namely; *Albizia amara*, at lower hill slope *Balanitesa egyptiaca* at upper terraces and *Faidherbia albida* at lower terraces. These three species were selected for their dominance to conduct the phenological study. According to Adam (2003) [1] five trees were selected from each species to this study. Observations were taken weekly during the year 2014, and included the following: Time, duration and peak time of flower production - Time, duration and peak time of fruit production - Time, duration and peak time of flushing - Time, duration and peak time of leaf shedding

3. Results and discussion

Flowers of *Albizia amara* start to emerge at the beginning of September and continues until the end of November, while fruiting starts to emerge at the end of October and continues until the beginning of April (Table 1 and Fig 1). These results agreed with Sahni (1968) [18] who reported that the flowering of *Albizia amara* occurs during the rainy season and the period of fruiting is from November to April. However, the results of this study, disagree with Ali (2012) [2] who mentioned that the flowering of *Albizia amara* takes

place from May to June and the period of fruiting is from October to November.

Flowers of *Faidherbia albida* starts to emerge at the end of October and continues until the beginning of January, while fruiting starts to emerge at the end of November and continues until the beginning of April (Table 1 and Fig 2). This result is similar to Sahni (1968) [18], Elkhalfifa (1996) [6]. It also in line with Ali (2012) [2] for the fruiting period because he found that the period of fruiting of *Faidherbia albida* is from December to January.

Flowers of *Balanitesa egyptiaca* starts to emerge at the beginning of November and continues until the end of December, while the fruiting starts at the beginning of December and continues until the end of March (Table 1 and Fig 3). These results disagree with Sahni (1968) [18], Elkhalfifa (1996) [6] and Ali (2012) [2]. Elkhalfifa 1996 [6] reported that flowers of *Balanitesa egyptiaca* starts in November and continues until April, while the fruiting starts in December and continues until January. Ali (2012) [2] reported that Flowers of *Balanitesa egyptiaca* starts at May and continues until September, while the fruiting starts in September and continues until October. This variation is due to the bio annual flowering and fruiting of some trees.

Flushing of *Albizia amara* starts at the end of May and continues until the beginning of November, while the leaf shedding starts in the end of October and continues until the end of May. *Faidherbia albida* flushes at the beginning of October and continue until the end of May, while the leaf shedding starts in the beginning June and continues until the end of October. These results agreed with Sahni (1968) [18], Elkhalfifa (1996) [6] and Ali (2012) [2].

Tree that evergreen state is *Balanitesa egyptiaca*, starts in the end of April and continues until the beginning of December. However, the tree starts shedding it is leaves from the end of November to the end of February. This results also similar to Sahni (1968) [18], Elkhalfifa (1996) [6] and Ali (2012) [2].

Table 1: Phenology of dominant tree species at Zalingei area

Species	Tree No	Flower production		Fruit production		Tree in leaves		Leafless period	
		Time	D	Time	D	Time	D	Time	D
<i>Albizia amara</i>	1	13/9- 2/11 (31)	49	30/10- 7/4 (112)	159	1/6- 3/11 (123)	155	4/11-31/5	210
	2	30/9- 8/11 (29)	38	1/11- 28/3 (98)	117	22/5- 31/10 (142)	162	1/11-21/5	203
	3	3/9-17/11 (41)	74	4/11-5/4 (113)	152	26/5-13/10 (121)	140	14/10-25/5	225
	4	22/9- 21/11 (38)	60	29/10- 19/4 (116)	172	11/6- 20/10 (118)	131	21/10-10/6	234
	5	7/9-9/11 (43)	62	21/10-31/3 (102)	130	17/5-13/ 10 (128)	146	12/10-16/5	219
Average		(36.4)	56.6	(108.2)	146	(126.4)	146.8	-	218.2
<i>Faidherbia albida</i>	1	13/11- 26/12 (30)	44	30/11- 9/4 (91)	130	9/10-11/6 (237)	245	12/6- 8/10	120
	2	19/11- 24/12 (23)	36	11/12- 11/4 (79)	121	28/10-1/6 (198)	209	2/6- 27/10	147
	3	29/10- 2/1 (41)	65	13/12- 26/3 (76)	103	29/9-26/5 (231)	241	27/5-28/9	124
	4	31/10- 7/1 (52)	69	16/12- 19/4 (89)	124	16/10-7/6 (224)	236	8/6- 15/10	129
	5	4/11- 8/1 (46)	66	4/12- 23/ 3 (72)	109	19/10-3/6 (217)	229	4/6-18/ 10	136
Average		(48)	56	(81.4)	117.4	(221.4)	232	-	131.2
<i>Balanitesa egyptiaca</i>			Flower production	Fruit production		Tree in leaves without Shedding		Sheds leaves period	
			Time	D	Time	D	Time	D	D
	1	13/11- 26/12 (31)	43	15/12-19/3 (76)	95	30/4-7/12 (220) 14/2-29/4 (74)	294	8/12- 13/2	71
	2	1/11- 17/12 (29)	47	3/12-6/4 (98)	123	30/4-1/12 (218) 28/2-29/4 (61)	279	30/11-27/2	86
	3	16/11- 16/12 (21)	31	13/12- 26/3 (91)	103	30/4-26/11 (209) 1/3-29/4 (58)	267	25/11-28/2	98
	4	7/11- 19/12 (33)	42	12/12-4/4 (86)	112	30/4-5/12 (217) 21/2 - 29/4 (67)	284	8/12-20/2	81
5	30/11- 7/1 (22)	38	29/12- 30/3 (74)	93	30/4-16/11 (199) 4/3- 29/4 (56)	255	17/11-3/3	110	
Average		(25.8)	36.9	(85)	(105.2)		275.8	-	89.2

*D = Duration * Fig between two brackets is peak time

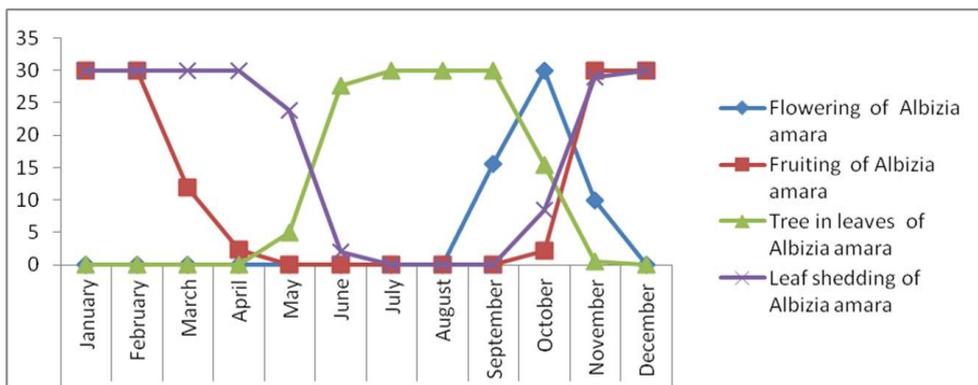


Fig 1: Phenology of Albizia amara at Zalingei area

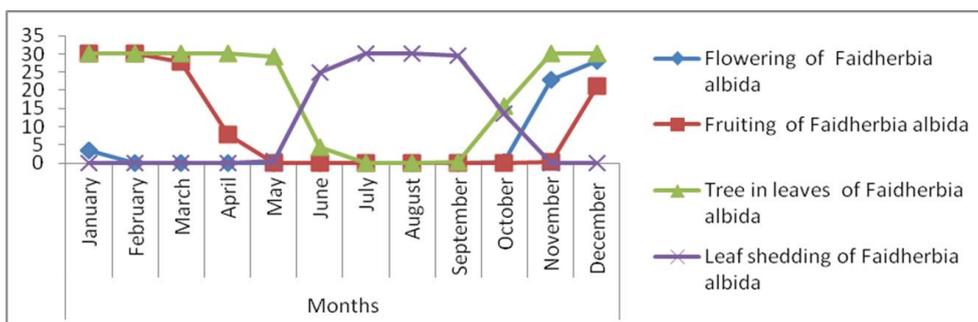


Fig 2: Phenology of Faidherbia albida at Zalingei area

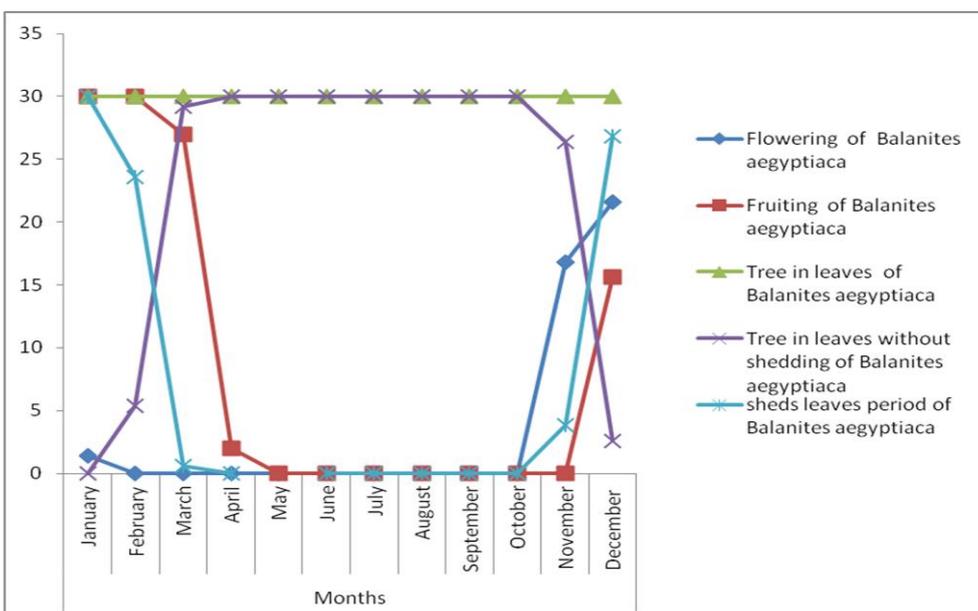


Fig 3: Phenology of Balanites aegyptiaca at Zalingei area

4. Conflicts of interest

The authors declare no conflicts, interests.

5. Conclusion

We concluding that the most important phenology of dominant tree species like *Albizia amara*, *Faidherbia albida*, *Balanites aegyptiaca*, will be beginning the flowering time during the rainy season and the fruiting time within autumn and winter. Therefore, our outcomes raised will be resulting in the future to promote sustainable agroforestry, ecological restoration, and afforestation program of degradation lands in arid, semi-arid regions.

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