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PHENOLOGY, GROWTH, FIBRE YIELD AND QUALITY STUDIES IN KENAF (HIBISCUS CANNABINUS L.)

D. V. Deshmukh
All India Network Project on Jute and Allied Fibres,
Mahatma Phule Krishi Vidyapeeth, Rahuri-413 722, Dist.: Ahilyanagar (M.S.),
India.
Dvdeshmukh19@gmail.com

Abstract
Six kenaf genotypes were evaluated in randomized block design with four replications during *kharif*- 2022-23 under irrigated conditions at Cotton Improvement Project, MPKV, Rahuri (Ahmednagar) to study the phenology, growth, fibre yield and quality studies in kenaf (*Hibiscus cannabinus* L.). The principal growth stages for fibre yield are observed through BBCH scale (Biologische Bundesanstalt, Bundessortenamt and CHemische Industrie). It is observed that genotypes JRK-2019-2 and JRK-2019-1 required higher number of days to 50% flowering flowering. Genotype JRK-2019-3 shows superior performance in growth parameters. Genotype JRHC-15 shows superior performance in absolute growth rate, relative growth rate and leaf area duration. Genotype JRK-2019-2 shows good performance in leaf area index and unit area efficiency. Highest canopy temperature at top, middle and bottom and chlorophyll content is observed in JRK-2019-3. The genotype AMC 108 has better light extinction coefficient while, highest light intensity at top, middle and bottom and light transmission ratio is observed in JRHC-15. Genotype JRK-2019-1 was reported to be the highest green weight (q/ha) at harvesting. JRK-2019-2 showed better performace in yield and yield contributing characters. Genotypes JRK-2019-2 and JRK-2019-1 was reported to be the highest root content (wt.%). Genotypes JRK-2019-2 and JRK-2019-3 was reported to be the lesser defects (wt.%). Good tenacity is observed in JRK-2019-3 Genotypes followed by JRK-2019-2. Highest fineness is observed in JRK-2019-1. Genotypes JRK-2019-2, JRK-2019-1, JRHC-15 shows heavy bodied bulk density and HC 583, JRK-2019-3, AMC 108 shows medium bodied bulk density. The fibre of all genotypes appeared creamy white in colour. The yield contributing characters were significantly associated with fibre yield per plant.

Keywords: Phenology, growth parameters, canopy temperature, light intensity, fibre quality

1. INTRODUCTION
Kenaf (*Hibiscus cannabinus* L.) is an herbaceous annual fibre crop belongs to *Malvaceae* family. It grows to 1.5-4.5 m tall with woody base. The prickly unbranched stems are mostly 1.5-2.5 cm in diameter. The 10-15 cm long leaves are alternate from side to side on stalk and branches. The younger leaves on all kenaf plant are very simple, entire and cordate. The leaves near the base of stems are deeply lobed with 3-7 lobes, while leaves near the top of stem are shallowly lobed. Kenaf plant produces large showy, white, light yellow, creamy colour flowers with maroon or purple colour center. The flowers are bell shaped, widely open, solitary, auxiliary having 8-15 cm diameter with 5 petals, 5 sepals and numerous stamens [1]. Kenaf plant contains three type of fibres i.e. bast, core and pith [2]. Kenaf requires a warm, moist and tropical-subtropical climate and thrives with abundant solar radiation and high rainfall. Kenaf grows at latitude 30^0N and 30^0S and at altitude upto 1.25 m with mean relative humidity are 68%-85% and the optimum range of temperature ranging from 20^0C-30^0C. Kenaf is a versatile plant that offers a wide range of uses across various industries, making it a valuable resource for fibre, food, medicine, oil, chemical absorbent, mushroom cultivation, natural

fibre, textile application, construction, housing industries, environmental cleaning, and bioenergy production. In the fibre industry, kenaf's strong and durable fibres are utilized for making products such as ropes, twines, canvas, and burlap sacks. Its fibres can also be blended with other materials to create composite materials for construction and automotive parts. Phenology in plants refers to the study of cyclic and seasonal patterns of plant life events and their relationships with environmental factors, such as temperature, light, and precipitation [3]. In essence, the BBCH scale serves as a valuable tool for monitoring and understanding the phenological development of crops, enhancing agricultural practices, and contributing to the advancement of crop science and management.

2. MATERIAL AND METHODS

2.1 Location

The experiment was conducted at Cotton Improvement project, MPKV, Rahuri during *kharif* 2022. The centre is located in the Agro-Ecological region (AER) 6.0 [Deccan Plateau, Hot Semi-Arid Eco-Region] [Agro-Ecological Sub Region 6.1]. It is situated 33 km away from Ahmednagar on Ahilyanagar- Manmad state Highway No.14. It lies between 19°-48° N and 19°-57° N latitude and between 74°-32°E and 76°-19° E longitude and at altitude of 657 meters above mean sea level.

2.2 Experimental Design and Procedures

Six genotypes of kenaf (JRHC-15, JRK-2019-1, JRK-2019-2, JRK-2019-3, HC 583, AMC- 108 were evaluated in randomized Block Design with four replications at Cotton Improvement to study the phenology, growth, fibre yield and quality. The 30 x 5-7 cm spacing was adopted. The gross and net plot sizes were 6.00 x 4.50 m and 5.40 x 3.90 m, respectively. The fertilizer dose was applied as per recommended dose of 60:30:30 N, P_2O_5 and K_2O kg/ha, the first half dose of nitrogen and full dose of P and K was given at the time of sowing and remaining dose of nitrogen was applied in 2 equal splits as top-dressing at 35-40 and 65-70 days of crop-age. Protective irrigations were given as when required. Five plants in each plot were randomly selected in a net plot area and tagged for recording the various growth traits, yield and other physiological parameters. The fibre quality parameters were estimated in laboratory after the harvesting of genotypes. Principal growth stages (days) were recorded as per the BBCH-scale [4]. The growth parameters viz. plant height, basal diameter, number of leaves and leaf area was recorded at 20 days interval from sowing. The physiological parameters viz. chlorophyll content, canopy temperature at top, middle and bottom level and light intensity at top, middle and bottom bevel was recorded at initiation of flowering by using SPAD meter, infra red thermometer and lux meter, respectively at initiation of flowing. The growth rates and physiological parameters were calculated by using following formulae.

Parameter	Formulae
Absolute Growth Rate (cm/day) [5]	$\mathrm{AGR} = \frac{h1 - h2}{t2 - t1}$
Relative Growth Rate (cm/cm/day) [6]	$\mathrm{RGR} = \frac{Logeh1 - Logeh2}{t2 - t1}$
Leaf Area Index [6]	$\mathrm{LAI} = \frac{Total\ leaf\ area\ per\ plant}{ground\ srea\ occupied\ by\ the\ plant}$
Leaf Area Duration [7]	$\mathrm{LAD} = \frac{(L1 + L2)}{2} X\ (\mathrm{t2} - \mathrm{t1})$
Light Extinction Coefficient	$\mathrm{K} = \frac{LogeI/I0}{LAI}$
Light Transmission Ratio (LTR)	$\mathrm{LTR} = \frac{I}{I0}$
Unit Area Efficiency (UAE)	$\mathrm{UAE} = \frac{Fibre\ yield}{Land\ area} X \frac{1}{Duration\ of\ crop}$

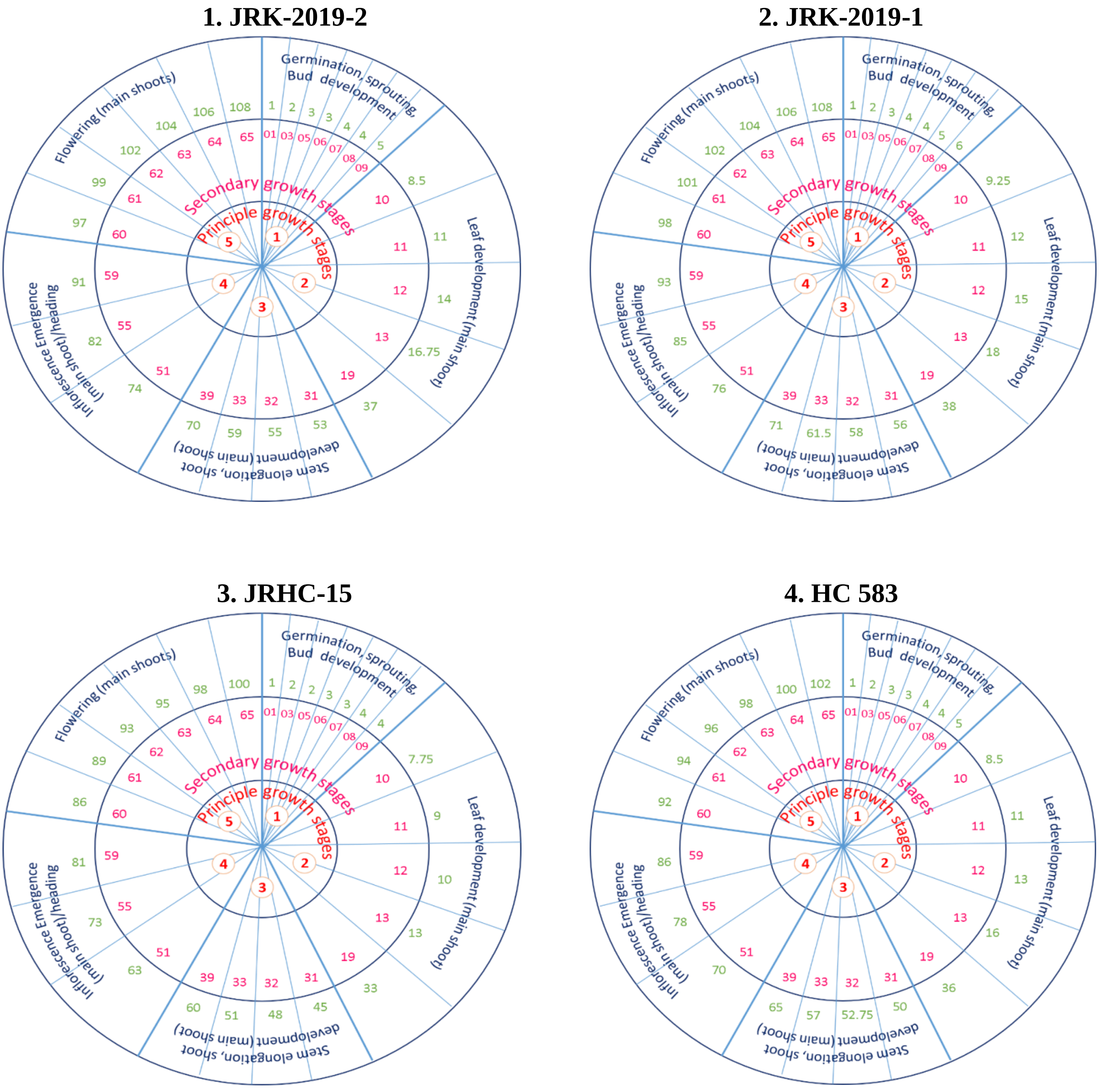
Where, h1 and h2 are the plant height at t1 and t2 times, respectively, L1 and L2 = LAI at the first stage and second stage, Io and I are the light intensity at top and bottom of a population with LAI. Fibre yield and yield attributes and fibre quality characters were recorded after harvesting and retting. The data analyzed for coefficient of variation through randomized block design by Panse and Sukhatme [8].

3. RESULTS AND DISCUSSION

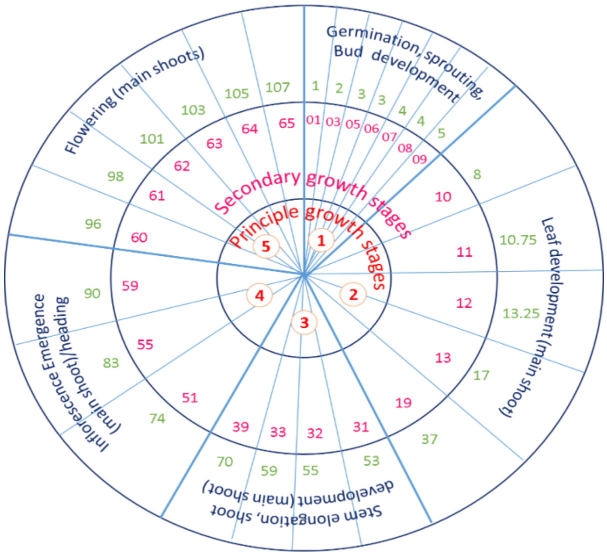
3.1 Crop Phenology

The data on various principle growth stages such as germination, leaf and shoot development, inflorescence emergence and flowering in days through BBCH scale are presented in table 1 and depicted in figure 1. The extended BBCH scale considers 10 principal growth stages in roselle is evidenced and numbered from 0 to 9 [9]. Starting at germination (stage 0) and ending at the beginning of the rest period (stage 9). Based on BBCH scale, nine phenological stages were recorded for roselle that included: (0) Germination, (1) Leaf development, (2) Formation of side shoots, (3) Main stem elongation, (5) Inflorescence emergence, (6) Flowering, (7) Development of bolls, (8) ripening of sepals and (9) seeds Senescence.

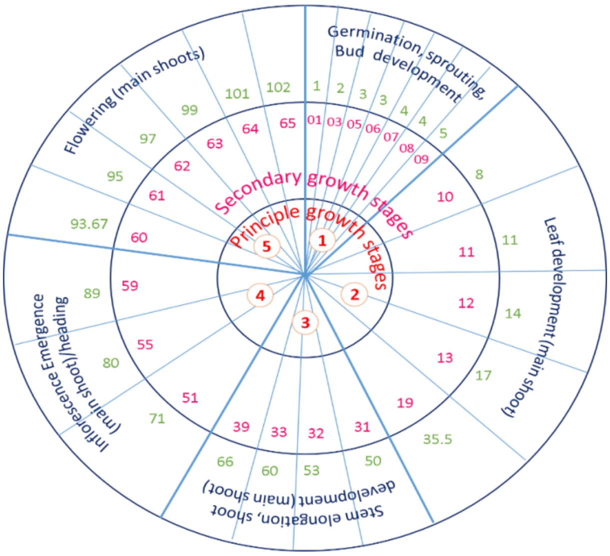
Figure 1: Phenological development influenced by kenaf genotypes



5. JRK-2019-3



6. AMC 108



3.1.1 Germination, sprouting and bud development

Days required for germination, sprouting and bud development are 1 to 6. The genotype JRK-2019-1 (6 days) required highest number of days while genotype JRHC-15 (4 days) required less number of days for germination, sprouting and bud development among 6 kenaf genotypes.

3.1.2 Leaf development (main shoot)

Days required for leaf development (main shoot) are 7 to 38. The genotype JRK-2019-1 required highest number of days (9.25 days) for first true leaf emergence, cotyledons completely unfolded and first leaves separated and (38 days) to more true leaves unfolded among 6 kenaf genotypes. The genotype JRHC-15 required less number of days (7.75 days) for first true leaf emergence, cotyledons completely unfolded and first leaves separated and (33 days) to more true leaves unfolded among 6 kenaf genotypes.

3.1.3 Stem elongation, shoot development (main shoot)

Days required for stem elongation and shoot development (main shoot) are 45 to 71 days. The genotype JRK-2019-1 required highest number of days (56 days) for stem 10% of final length (diameter); 1 node detectable and (71 days) to maximum stem length diameter reached or more nodes detectable among 6 kenaf genotypes. The genotype JRHC-15 required less number of days (45 days) for stem 10% of final length (diameter); 1 node detectable and (60 days) to maximum stem length diameter reached or more nodes detectable among 6 kenaf genotypes.

3.1.4 Inflorescence emergence (main shoot) / heading

Days required for inflorescence emergence or heading are 63 to 93 days. The genotype JRK-2019-1 required highest number of days (76 days) for beginning of heading and (93 days) to first flower petals visible and inflorescence fully emerged. The genotype JRHC-15 required less number of days (63 days) for beginning of heading and (81 days) to first flower petals visible and inflorescence fully emerged among 6 kenaf genotypes.

3.1.5 Flowering (main shoot)

Days required for inflorescence emergence and flowering are 86 to 108 days. The genotype JRK-2019-1 required highest number of days (98 days) for first flowers open (sporadically) and (108 days) to full flowering i.e. 50% of flowers open, first petals may be fallen. The genotype JRHC-15 required less number of days (86 days) for first flowers open (sporadically) and (100 days) to full flowering i.e. 50% of flowers open, first petals may be fallen among 6 kenaf genotypes. There were significant differences in the number of days to reach 50% flowering, 50% fruiting, and physiological maturity among the treatments [10].

Table 1: Phenological development influenced by kenaf genotypes

	Principle growth stages (days)	JRK-2019-2	JRK-2019-1	JRHC-15	HC 583	JRK-2019-3	AMC 108
1.	**Germination, Sprouting, Bud development**						
01	Beginning of seed imbibition, Beginning of bud swelling (P,V)	1	1	1	1	1	1
03	Seed imbibition complete; End of bud swelling (P, V)	2	2	2	2	2	2
05	Radicle (root)emerged from seed; Perennating organs forming roots (P, V)	3	3	2	3	3	3
06	Elongation of radicle, formation of root hairs and lateral roots	3	4	3	3	3	3
07	Coleoptile emerged from caryopsis (G); Hypocotyl with cotyledons or shoot breaking through seed coat (D, M), Beginning of sprouting or bud breaking (P, V)	4	4	3	4	4	4
08	Hypocotyl with cotyledons growing towards soil surface (D),Shoot growing towards soil surface (P, V)	4	5	4	4	4	4
09	Emergence: Coleoptile breaks through soil surface (G), Emergence: Cotyledons break through soil surface (except hypogeal germination D, M); Emergence: Shoot/leaf breaksthrough soil surface (D, V); Bud shows green tips (P)	5	6	4	5	5	5
2	**Leaf development (main shoot)**						
10	First true leaf emerged from coleoptile (G); Cotyledons completely unfolded (D, M); First leaves separated (P)	8.5	9.25	7.75	8.5	8	8
11	First true leaf, leaf pair or whorlunfolded; First leaves unfolded(P)	11	12	9	11	10.75	11
12	true leaves, leaf pairs or whorls unfolded	14	15	10	13	13.25	14
13	true leaves, leaf pairs or whorls unfolded	16.75	18	13	16	17	17
19	more true leaves, leaf pairs or whorls unfolded	37	38	33	36	37	35.5
3	**Stem elongation, shoot development (main shoot)**						
31	Stem 10% of final length (diameter); 1 node detectable (G)	53	56	45	50	53	50
32	Stem 20% of final length (diameter); 2 nodes detectable(G)	55	58	48	52.75	55	53
33	Stem (rosette) 30% of final length (diameter); 3 nodes detectable(G), Stages continuous till.	59	61.5	51	57	59	60
39	Maximum stem length diameterreached; or more nodes detectable (G 9)	70	71	60	65	70	66
4	**Inflorescence emergence (main shoot) / heading**						
51	Inflorescence or flower buds visible; Beginning of heading (G)	74	76	63	70	74	71

55	First individual flowers visible (still closed); Half ofinflorescence emerged (G)	82	85	73	78	83	80
59	First flower petals visible (inpetalled forms); Inflorescence fully emerged (G)	91	93	81	86	90	89
5Flowering (main shoot)							
60	First flowers open (sporadically)	97	98	86	92	96	93.67
61	Beginning of flowering: 10% of flowers open	99	101	89	94	98	95
62	20% of flowers open	102	102	93	96	101	97
63	30% of flowers open	104	104	95	98	103	99
64	40% of flowers open	106	106	98	100	105	101
65	Full flowering: 50% of flowers open, first petals may be fallen	108	108	100	102	107	102

3.2 Growth parameter

The data on various growth characters viz. plant height (cm), basal diameter (cm), number of leaves and leaf area/plant (dm^2) influenced by kenaf genotypes at various stages of growth are presented in Table 2. The differences among the genotypes were statistically significant for all the growth characters at various stages of growth. Kenaf has an indeterminate type of growth, with rapid growth rate increases until the appearance of the first flower and gradual decreases afterwards [11].

In the present study, the plant height and basal diameter increased progressively with the advancing age of the crop, whereas, number of leaves and leaf area increased progressively upto 80 DAS and thereafter it was decreased towards advancing age of the crop due to defoliation. The genotype, JRK-2019-3 maintained higher plant height (387.50 cm) and basal diameter (2.35 cm) at harvesting as well as at various stages of growth. The genotypes, JRK-2019-2 (386.25 cm, 2.28 cm) and JRHC-15 (385.75 cm, 2.21 cm) were also promising for maintaining plant height and basal diameter at various stages of growth. On an average, genotype JRK-2019-2 recorded the highest number of leaves (366.70) and leaf area (425.37 dm^2) at 80 DAS as well at various stages of growth. In addition to this, JRK-2019-3 maintained higheer number of leaves (364.79) and leaf area (386.75 dm^2) at 80 DAS as well at various stages of growth. The kenaf varieties has significant difference between the, in terms of height, basal diameter and biomass [12].

Table 2: Growth characters influenced at various stages of growth

Genotype	20 DAS	40 DAS	60 DAS	80 DAS	100 DAS	120 DAS
Plant height (cm)						
JRK-2019-2	50.50	146.91	261.40	315.75	358.95	386.25
JRK-2019-1	40.20	133.68	239.47	299.62	346.25	374.00
JRHC-15	43.28	137.53	251.90	307.50	354.00	385.75
HC 583	34.33	122.58	234.18	288.95	343.50	366.00
JRK-2019-3	52.70	150.03	266.75	317.00	362.45	387.50
AMC 108	37.75	128.20	244.50	301.00	348.05	371.50
SE±	0.98	1.45	2.03	2.26	1.68	1.75
CD at 5 %	2.96	4.38	6.13	6.82	5.07	5.23
Basal diameter (cm)						
JRK-2019-2	0.80	1.38	1.71	1.97	2.11	2.28
JRK-2019-1	0.65	1.17	1.55	1.83	1.98	2.19
JRHC-15	0.73	1.25	1.62	1.89	2.02	2.21
HC 583	0.63	1.13	1.50	1.76	1.90	2.17
JRK-2019-3	0.90	1.51	1.74	2.02	2.16	2.35
AMC 108	0.77	1.31	1.61	1.89	2.05	2.24
SE±	0.069	0.099	0.019	0.023	0.028	0.017
CD at 5 %	NS	NS	0.058	0.071	0.08	0.053

No. of leaves						
JRK-2019-2	52.30	201.50	357.60	366.70	271.00	133.25
JRK-2019-1	42.75	193.75	323.75	341.00	235.75	118.75
JRHC-15	48.25	187.75	260.50	298.75	213.25	90.25
HC 583	36.25	176.25	258.50	315.50	220.00	98.25
JRK-2019-3	57.00	207.00	364.00	364.79	277.65	138.60
AMC 108	46.25	198.00	286.50	316.00	222.50	109.75
SE±	1.926	2.519	2.351	1.993	2.396	1.923
CD at 5 %	5.80	7.59	7.08	6.007	7.22	5.81
Leaf area (dm^2)						
JRK-2019-2	19.35	130.95	343.30	425.37	308.94	147.90
JRK-2019-1	9.83	93.00	229.83	310.31	209.81	102.12
JRHC-15	16.88	114.52	231.85	331.61	228.25	93.75
HC 583	10.87	96.93	206.83	318.65	215.60	92.35
JRK-2019-3	18.81	122.13	309.44	386.75	285.97	139.98
AMC 108	12.16	102.95	217.75	304.62	207.59	99.12
SE±	2.1041	2.8159	2.7658	2.2779	3.0369	2.7162
CD at 5 %	6.6060	8.5078	8.3576	6.8939	9.1708	8.2090

3.3 Growth rates

The data on various growth rates viz. AGR (cm/day), RGR (cm/cm/day), LAI and LAD (days) influenced by kenaf genotypes at various stages of growth are presented in Table 3. It revealed that, the AGR increased progressively upto 40-60 DAS, rate was declined towards reproductive growth. However, RGR declined with the advancing age of the crop. LAI and LAD increased progressively upto 60-80 DAS, rate was declined towards reproductive growth due to defoliation. The genotype JRK-2019-3 maintained higher AGR at 0-20 DAS (32.70 cm/day), 20-40 DAS (77.33 cm/day) and 40-60 DAS (96.72 cm/day), whereas, JRK-2019-1 (40.15 cm/day) at 60-80 DAS, HC 583 (34.55 cm/day) at 80-100 DAS and JRHC-15 at 100-120 DAS (11.75 cm/ day) recorded higher AGR. The genotype HC 583 (0.027 cm/cm/day) at 20-40 DAS, HC-583 and AMC 108 (0.014 cm/cm/day) at 40-60 DAS, JRK-2019-1 (0.0048 cm/cm/day) at 60-80 DAS, HC 583 (0.0037 cm/cm/day) and JRHC-15 (0.0018 cm/cm/day) recorded higher RGR at respective growth stages. The genotypes JRK-2019-2 (236.31) and JRK-2019-3 (214.86) recorded higher LAI at 80 DAS as well as various stages of growth. Similarly, JRK-2019-2 (4270.38) and JRK-2019-3 (3867.72) recorded higher LAI at 60-80 DAS as well as various stages of growth.

Table 3: Growth rates influenced by kenaf genotypes at various stages of growth

Genotypes	0-20 DAS	20-40 DAS	40-60 DAS	60-80 DAS	80-100 DAS	100-120 DAS
Absolute growth rate (cm/day)						
JRK-2019-2	30.50	76.41	94.49	34.35	23.20	7.30
JRK-2019-1	20.20	73.48	85.79	40.15	26.63	7.75
JRHC-15	23.28	74.25	94.37	35.60	26.50	11.75
HC 583	14.33	68.25	91.60	34.77	34.55	2.50
JRK-2019-3	32.70	77.33	96.72	30.25	25.45	5.05
AMC 108	17.75	70.45	96.30	36.50	27.05	3.45
Mean	23.12	23.12	73.36	93.21	35.27	27.23
Relative growth rate (cm/cm/day)						
JRK-2019-2		0.023	0.012	0.0041	0.0027	0.0015
JRK-2019-1		0.026	0.012	0.0048	0.0031	0.0016
JRHC-15		0.025	0.013	0.0043	0.0030	0.0018
HC 583		0.027	0.014	0.0045	0.0037	0.0013
JRK-2019-3		0.022	0.012	0.0037	0.0029	0.0014
AMC 108		0.026	0.014	0.0045	0.0031	0.0014

Mean		0.025	0.013	0.0043	0.0031	0.0015
			Leaf area index			
JRK-2019-2	10.75	72.75	190.72	236.31	171.63	82.16
JRK-2019-1	5.46	51.66	127.68	172.39	116.56	56.73
JRHC-15	9.37	63.62	128.80	184.22	126.80	52.08
HC 583	6.038	53.85	114.90	177.02	119.77	51.30
JRK-2019-3	10.45	67.85	171.91	214.86	158.87	77.76
AMC 108	6.75	57.19	120.97	169.23	115.33	55.07
Mean	8.13	61.15	142.50	192.34	134.83	62.52
			Leaf area duration			
JRK-2019-2		835.00	2634.72	4270.38	4079.50	2538.00
JRK-2019-1		571.27	1793.50	3000.77	2889.55	1732.94
JRHC-15		730.00	1924.27	3130.33	3110.33	1788.88
HC 583		598.88	1687.55	2919.33	2968.05	1710.83
JRK-2019-3		783.00	2397.61	3867.72	3737.33	2366.38
AMC 108		639.51	1781.66	2902.08	2845.66	1704.00
Mean		692.94	2036.55	3348.43	3271.74	1973.50

3.4 Chlorophyll content and canopy temperature

The SPAD meter (Soil Plant Analytical Development) is a simple hand held and portable instrument that is widely used for the rapid, accurate and non-destructive measurement of leaf chlorophyll concentrations. Canopy temperature (IRT) is an integrative trait that reflects the plant water status or the resultant equilibrium between the root water uptakes and shoots transpiration [13]. The SPAD chlorophyll meter reading at initiation of flowering in kenaf genotypes ranges from 38.8 (HC 583) to 47.63 (JRK-2019-3). At initiation of flowering, canopy temperature at top, middle and bottom level ranges from 25.2 to 35.1 (^{0}C). Genotype JRK-2019-3 at top (35.10^{o}C), middle (30.15^{o}C) and bottom (27.7^{o}C) level recorded significantly highest canopy temperature. Genotype JRHC-15 showed lowest canopy temperature at top (32.50^{o}C) and middle (27.50^{o}C) level, while at bottom level genotype JRK- 2019-1 (25.2^{o}C) showed lowest canopy temperature at initiation of flowering (Table 4).

Table 4: Chlorophyll content, canopy temperature influenced by kenaf genotypes

Genotype	**Chlorophyll Content (SPAD)**	**Canopy Temperature (IRT)**		
		Top	**Middle**	**Bottom**
JRK-2019-2	42.63	34.40	30.15	25.6
JRK-2019-1	42.75	33.70	29.43	25.2
JRHC-15	44.83	32.50	27.50	26.4
HC 583	38.80	33.20	28.50	25.5
JRK-2019-3	47.63	35.10	30.15	27.7
AMC 108	41.89	34.12	30.10	26.2
SE$\pm$	1.5178	0.4298	0.5637	0.5117
CD at 5%	4.5752	1.2955	1.6992	1.5424

3.5 Light intensity and unit area efficiency

A genetic, molecular, physiological, biochemical, and functional genomics approach, significant developments have been made in identifying genes and molecular mechanisms underlying the relationship of light intensity and photosynthesis [14]. In simple crop models such as LINTUL, extinction coefficient of light (KL) is widely used to calculate light interception by the canopy and to predict biomass yields based on the light use efficiency concept [15]. At initiation of flowering, light intensity by using LUX meter at top, middle and bottom level ranges from 8000 to 72000 LUX. At top, middle and bottom level genotype JRHC-15 recorded significantly highest light intensity. Genotype JRK-2019-2 shows lowest lux meter reading at top and bottom level while genotype JRK-2019-3 shows lowest lux meter reading at middle level at initiation of flowering. The mean light extinction coefficient (K) was of 0.004353. The genotype AMC 108 (0.004901) JRK-2019-2 (0.003429) recorded highest and lowest light extinction coefficient (K), respectively. The mean light transmission ratio was of 0.14. The genotypes, JRHC-15 (0.167) JRK-2019-2 (0.123) recorded highest and lowest light transmission ratio, respectively. The mean unit area efficiency was 0.001391. The genotype JRK-2019-2 (0.001610) andHC 583 (0.001293) recorded the highest and lowest unit area efficiency, respectively (Table 5).

Table 5: Light intensity and unit area efficiency influenced by kenaf genotypes

Genotype	Light Intensity (LUX Meter)			Light extinction coefficient (K)	Light transmission ratio	Unit area efficiency
	Top	Middle	Bottom			
JRK-2019-2	65000	26000	8000	0.003429	0.123	0.001610
JRK-2019-1	70000	30000	10000	0.004791	0.143	0.001308
JRHC-15	72000	38000	12000	0.004558	0.167	0.001522
HC 583	71000	30000	10000	0.004657	0.141	0.001293
JRK-2019-3	68000	25000	8500	0.003783	0.125	0.001350
AMC 108	70000	35000	10500	0.004901	0.150	0.001264
SE±	859.08	896.13	617.59			
CD at 5%	2589.55	2701.24	1861.64			

3.6 Yield and yield contributing characters

The data on yield and yield contributing characters are presented in table 6. The differences among the genotypes were statistically significant for all the yield and yield contributing characters (Table 6). The genotype JRK-2019-1 (539.13 q/ha) and HC 583 (485.89 q/ha) produced highest and lowest green weight, respectively. The highest and lowest fibre yield was recorded by the genotype JRK-2019-2 (34.93 q/ha) and AMC 108 (27.44 q/ha), respectively. The genotype JRK-2019-2 (365.72 q/ha) showed significantly highest stick yield followed by JRHC-15 (353.2 q/ha), JRK-2019-3 (325.88 q/ha). The highest fibre recovery was recorded by the genotype JRK-2019-2 (8.71 %) and the lowest fibre recovery was recorded by the genotype JRK-2019-3 (8.29 %).

Table 6: Yield and yield contributing characters influenced by kenaf genotypes

Genotype	Green weight (q/ha)	Fibre yield (q/ha)	Stick yield (q/ha)	Fibre Recovery (%)
JRK-2019-2	511.67	34.93	365.72	8.71
JRK-2019-1	539.13	28.38	303.94	8.51
JRHC-15	532.51	33.02	352.20	8.55
HC 583	485.89	28.06	300.90	8.55
JRK-2019-3	526.93	29.29	325.88	8.29
AMC 108	507.04	27.44	296.55	8.47
SE±	10.615	0.59	10.17	
CD at 5%	32.289	1.823	30.65631	

Fibre quality parameter

The data on fibre quality parameter such as root content, defects, tenacity, fineness, colour, bulk density and BIS Grade are presented in table 7. The genotypes JRK-2019-2 and JRK-2019-1 recorded highest (40 wt. %) root content, while genotypes HC 583, JRK-2019-3 and AMC 108 recorded lowest (12 wt. %) root content. Genotypes JRK-2019-2 and JRK-2019-3 was reported to be the lesser defects (0.5 wt. %), whereas, genotypes JRHC-15 and AMC 108 recorded highest defects (1.5 wt. %). The genotype JRK-2019-2 (26 g/tex) and AMC 108 (23.6 g/tex) showed significantly highest and lowest tenacity, respectively. The mean fineness (tex) was 4.98 and it ranged between 4.5 tex (HC 583) to 5.5 tex (JRK-2019-1) fineness. All genotypes showed creamy white fibre colour. The genotypes JRK-2019-2, JRK-2019-1 and JRHC-15 shown heavy bodied bulk density while other three genotypes HC 583+, JRK-2019-3 and AMC 108+ shown medium bodied bulk density. The genotypes JRK-2019-2, JRHC-15 and AMC 108 recorded M3+70% BIS grade while genotypes JRK-2019-3 and JRK-2019-3 recorded M3+30% BIS grade. The genotype HC 583 recorded M2+10% BIS Grade.

Table 7: Fibre quality parameter influenced by kenaf genotypes

Genotype	Root content (wt.%)	Defects (wt.%)	Tenacity (g/tex)	Fine-ness(tex)	Colour	Bulk Density	BIS Grade*
JRK-2019-2	40	0.5	25.6	5.1	Creamy white	Heavy Bodied	M3+70%
JRK-2019-1	40	1.0	24.1	5.5	Creamy white	Heavy Bodied	M3+30%
JRHC-15	20	1.5	25.4	4.8	Creamy white	Heavy Bodied	M3+70%
HC 583	12	1.0	25.2	4.5	Creamy white	Medium Bodied	M2+10%
JRK-2019-3	12	0.5	26	4.6	Creamy white	Medium Bodied	M2+30%
AMC 108	12	1.5	23.6	5.4	Creamy white	Medium Bodied	M3+70%

4. CONCLUSIONS

The genotype JRHC-15 required less number of days (100) for 50% of flowering and JRK-2019-1 (108 days) and JRK-2019-3 (107 days) required more number of days for 50% of flowering. Genotype JRK-2019-3 shows superior performance in growth and development. Genotype JRHC-15 shows superior performance in AGR, RGR and LAD, while, JRK-2019-2 shows good performance in LAI and unit area efficiency. Genotype AMC 108 performed better results in light extinction coefficient while, highest light intensity at top, middle and bottom and light transmission ratio is observed in JRHC-15. JRK-2019-2 shows better performance in yield and yield contributing characters. Genotypes JRK-2019-2 and JRK-2019-1 was reported to be the highest root content (wt. %), JRK-2019-2 and JRK-2019-3 was reported to be the lesser defects (wt.%), JRK-2019-3 and JRK-2019-2 has good tenacity and JRK-2019-1 had Higher fibre fineness. Genotypes JRK-2019-2, JRK-2019-1, JRHC-15 shows heavy bodied bulk density and HC 583, JRK-2019-3, AMC 108 shows medium bodied bulk density. All genotypes appeared creamy white fibre in colour. The yield contributing characters were significantly associated with fibre yield per plant.

DISCLOSURE STATEMENT

The paper is original. No part of the manuscript has been published before, nor is any part of it under consideration for publication in another journal. In addition, we affirm that all the authors have approved the manuscript for submission.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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