Effects of different dates of sowing on the growth and fibre yield of roselle, *Hibiscus sabdariffa* L. in the Guinea savanna zone of Ghana

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SUMMARY

Experiments were carried out at the Nyankpala Agricultural Experiment Station in the northern Guinea savanna zone of Ghana for 6 years to investigate the effects of different dates of sowing on the growth and fibre yield of roselle (*Hibiscus sabdariffa* L.). Early sowing produced tall plants with big stalks. Vegetative period and flowering time were shortened by delay in sowing. Yield of fresh green stalks and dry retted fibre were influenced by time of sowing. Late sowing generally produced very low yields of dry retted fibre. The highest yield of dry retted fibre was produced during May and June sowing.

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RÉSUMÉ

ASANTE, A. K. & AMANKWATIA, Y. O.: Effets de différents dates de semis sur la croissance et le rendement d'Hibiscus sabdariffa *L. dans la zone guinée savane du Ghana.* Des essais ont été faits au centre de récherche à Nyankpala dans la zone guinée savane du Ghana pendant six ans pour étudier des effets de différents dates de semis sur la croissance et le rendement de la fibre *d'Hibiscus sabdariffa* L. La semis en bons temps a produit des plantes bien taillée. La période vegétative et le temps de la floraison ont été raccourcis par la tardivement de semis. Le rendement de frais tiges verts et des fibes rouis séches étaient influencés par le temps de semis. Genérallement, la semis tardive a produite des mauvaises rendement de fibres rouis séches. Le plus haut rendment des fibres rouis séches a été produit par des tiges semée en Mai et Juin.

Introduction

Roselle (*Hibiscus sabdariffa* L.) is an annual bast fibre plant which belongs to the family Malvaceae. The plant is believed to be a native of tropical Africa (Watt, 1908; Kirby, 1963).

In Florida, Jamaica and Zambia, the plant is cultivated on a small scale for the fleshy calyces from which jelly, a kind of beverage, is prepared. In Brazil, roselle is grown as an ornamental plant and for the leaves which are used for seasoning soup and stew (Kirby, 1963).

The plant has been cultivated in India, Asia, North America, Australia and throughout Africa since the eighteenth century (Cobley, 1965). In Ghana, the leaves are used as a vegetable source and the plant is usually found growing in pockets around settlements in some parts of the country.

Roselle plant, when harvested at the correct time and processed with care, produces fibre which is fine, silky, soft, shiny and light yellow, and can be used as a substitute for jute fibre (Cobley, 1965).

Attempts to develop it as a jute substitute in Ghana have been very recent, since earlier attempts to cultivate it in the forest savanna transition zone did not show any promising result (Amanquah, 1968).

Roselle is more tolerant to drought than kenaf (*H. cannabinus* L.). It can be grown successfully in areas with less rainfall (Dempsey, 1962). However, the production of finest quality roselle fibre is dependent on an environment that promotes continuous and rapid growth of the plant with 25.4

mm of rainfall per month, fairly distributed during the growing period (Kirby, 1963).

Evidence of higher yields from early planting has been reported elsewhere. In California, USA, field trials were carried out to study the effects of three planting dates of kenaf (20 May, 20 June and 20 July). The total dry matter yield (TDMY) was highest for the early planting, i.e. 20 May and decreased significantly with delayed planting (Bhangoo, Tehrani & Henderson, 1986)

In field trials carried out at a central location in Bangladesh by Shamsuzzaman *et al.* (1988) during 1978 and 1979, the standard jute cv. D154, one early flowering mutant and four late flowering mutants were snow on seven dates, at 15 or 16-day intervals starting on 15 February. Results indicated that sowing time and genotype markedly affected the duration of the vegetative and flowering phases. The mutant C28 yielded 17 per cent more than D154 when sown on 15 March, which was the beginning of the normal sowing time.

Work carried out in other areas indicates that the highest yields and strongest fibre are obtained when roselle is harvested between 140 and 160 days (Dempsey, 1962).

Since bast fibre plants are grown under rainfed conditions in Ghana, it is important to determine the optimum time of sowing for good plant growth and high yield of fibre.

This paper, therefore, the effects of sowing dates on the growth and fibre yield of roselle.

Materials and methods

The trial was conducted at Nyankpala, northern Ghana. The experimental design was a completely randomized block with four replications. The plot size was 3 m × 2.4 m. Three seeds were sown per hill at 5 cm within rows spaced 20 cm apart. Sowing was done at 2-week intervals at the onset of the rains from May to August each year during the experimental period from 1971 to 1987, except in 1985 when sowing was started in June. The work was done in tswo phases, 1971 - 1973 and 1985 - 1987. Three weeks after emergence, the seedlings were thinned out to one per stand.

Compound fertilizer (NPK) 15-15-15, was applied 2 weeks after seedling emergence at the rate of 100 kg/ha and sulphate of ammonia applied as side dressing at the rate of 50 kg/ha when the plants were 6 weeks old.

Weeding by hoeing was done twice during the growing period. Ten plants per plot were selected from the middle row of each plot and tagged for plant height and stem diameter measurements. Records of rainfall were collected from the Ghana Meteorological Department sub-station at Nyankpala, Tamale.

Height measurements were taken from the ground level to the growing tip at harvest. The stem diameter was measured with a caliper at 8 cm from the ground. The stalks were weighed together with the leaves at harvesting, 150 days after sowing. Weight of dry retted fibre was recorded for each treatment and analysed statistically.

Results and discussion

Plant height and stem diameter

Measurements of plant height and stem diameter are given in Tables 1 - 6 and Fig. 1. The analyses of the data showed significant differences (P = 0.05) in the different times of sowing in all the years.

In 1971, 1972 and 1973, sowing in May produced the tallest plants. However, the height of plant sown in 1985 were the highest. In both 1986 and 1987, plants sown in June produced the greatest heights. In the early years of the trial, rainfall started early every year and this might have contributed to the tallest plants in May. However, after some years, weather changes affected the rainfall pattern which resulted in delaying the sowing period to June and July.

Differences in stem diameter of harvested stalks were significant (P = 0.05). Stem diameter decreased with late sowing. Taller plants generally produced bigger stems than the shorter ones.

Significant (P=0.05) differences were observed in the number of days to first flower in 1972, 1973, 1985 and 1987. Lately-sown plants took shorter period to flower than early-sown ones except in 1986 when the reverse was observed. This might

TABLE 1

Effects of Time of Planting of Roselle on Plant Height, Stem Diameter and Fibre Yield at Nyankpala (1971)

Date of sowing	*Days to 1st flower*	*Height at harvest (cm)*	*Stem diameter at harvest (cm)*	*Mean yield of fresh stalk (kg)*	*Mean fibre yield/ha (g)*	*Mean fibre yield/ha (kg)*	*Percent yield of fibre*
25/5/71	159.50	202.12	0.84	23.30	800.50	2733.06	
8/6/71	145.25	166.37	0.66	14.32	378.00	1290.52	47.21
22/6/71	136.00	164.71	0.81	9.55	213.50	729.45	26.60
6/7/71	121.75	136.20	0.56	7.61	143.50	490.34	17.90
20/7/71	107.50	125.85	0.65	3.30	145.00	495.27	18.11
3/8/71	98.50	100.07	0.56	3.30	67.00	228.18	8.3
17/8/71	91.50	76.64	0.35	2.16	24.50	183.63	6.7
LSD 0.01	8.28	36.14	0.20	5.20	231.26		
LSD 0.05	6.04	26.38	0.14	3.81	163.44		
CV (percent)	3.2	13.88	1.5	12.05	48.78		

TABLE 2

Effects of Time of Planting of Roselle on Plant Height, Stem Diameter and Fibre Yield at Nyankpala (1972)

Date of sowing	*Days to 1st flower*	*Height at harvest (cm)*	*Stem diameter at harvest (cm)*	*Mean yield of fresh stalk (kg)*	*Mean fibre yield (g)*	*Mean fibre yield/ha (kg)*	*Percent yield of fibre*
23/5/72	144.25	197.86	0.79	12.72	594.00	1078.11	
6/6/75	141.00	166.68	0.65	10.56	503.50	903.85	83.83
20/6/72	139.00	193.04	0.82	8.75	421.50	765.02	70.95
4/7/72	108.50	188.02	0.94	6.13	356.50	647.04	60.66
18/7/72	99.50	164.71	0.77	3.18	223.25	405.19	37.58
1/8/72	86.50	134.68	0.57	3.63	106.00	192.39	17.80
17/8/72	82.15	95.56	0.46	1.70	103.50	187.85	17.42
LSD 0.01	7.04	36.19	0.21	2.71	138.80		
LSD 0.05	5.09	26.42	0.15	1.98	101.33		
CV (per cent)	2.82	2.77	1.47	0.90	20.68		

be due to insufficient rains, dry weather, shorter day-length of 11 h and 42 min (Meteorological Department) during the growing period (August - December). These unfavourable conditions possibly forced the plants to flower prematurely.

This confirms the findings of Saha & Sengupta (1965) that vegetative period and flowering time of *Hibiscus cannabinus*, a closely related species of roselle, were shortened with delay in sowing. Flowering prematurely adversely affected both the height and diameter, since after flowering the roselle plant ceases to increase in height (Kirby, 1963). The results confirm the report of Dempsey (1962) that plant height decreases with delay in sowing.

Yield of fresh green stalks

Mean yields of fresh green stalks (with leaves) were significantly ($P = 0.05$) higher with the early sowing plants than the late sowing. Early sowing produced significantly higher mean yields of fresh green stalks (with leaves) than late sowing.

Generally, sowing in May and early June gave the highest yields of fresh green stalks, and thereafter, yield decreased with subsequent sowing.

TABLE 3

Effects of Time of Planting of Roselle on Plant Height, Stem Diameter and Fibre Yield at Nyankpala (1973)

Date of sowing	*Days to 1st flower*	*Height at harvest (cm)*	*Stem diameter at harvest (cm)*	*Mean yield of fresh stalk (kg)*	*Mean fibre yield (g)*	*Mean fibre yield/ha (kg)*	*Percent yield of fibre*
24/5/73	120.00	275.52	1.95	54.75	891.00	2377.85	
7/6/73	120.00	266.06	1.96	45.50	472.00	1070.85	45.03
21/6/73	116.58	144.58	1.15	19.50	237.00	337.69	14.20
5/7/73	113.00	168.91	0.64	25.00	184.00	491.05	20.65
19/7/73	104.00	122.93	0.42	13.50	209.75	559.77	23.54
2/8/73	97.00	113.98	0.46	8.00	68.00	181.47	7.63
14/8/73	80.00	106.46	0.45	8.00	55.50	125.91	5.29
LSD 0.01	5.81	24.10	0.62	16.43	329.44		
LSD 0.05	4.24	17.58	0.45	11.99	240.50		
CV (percent)	2.66	1.75	3.05	24.57	53.52		

TABLE 4

Effects of Time of Planting of Roselle on Plant Height, Stem Diameter and Fibre Yield at Nyankpala (1975)

Date of sowing	*Days to 1st flower*	*Height at harvest (cm)*	*Stem diameter at harvest (cm)*	*Mean yield of fresh stalk (kg)*	*Mean fibre yield (g)*	*Mean fibre yield/ha (kg)*	*Percent yield of fibre*
21/6/85	121.50	163.00	0.99	25.25	947.50	2193.28	83.30
5/7/85	106.50	182.30	0.95	27.75	1137.50	2633.10	
19/9/85	103.00	194.37	0.95	11.25	632.50	1464.12	55.60
2/8/85	101.00	160.60	0.78	10.25	442.50	1024.30	38.90
16/8/85	99.50	149.70	0.84	10.25	420.00	972.22	36.92
30/8/85	87.50	148.47	0.73	9.75	555.00	1284.72	48.79
LSD 0.01	4.37	36.00	0.21	5.99	604.26		
LSD 0.05	3.16	26.04	0.15	4.34	502.16		
CV (percent)	2.03	10.38	1.19	11.86	48.35		

However, in 1985, sowing in early July produced mean yield of 27.27 kg of fresh stalks which was the highest in the year as compared with the yield of 25.25 kg obtained from plants sown in June.

Higher yield from plants sown in July might be due to the fact that rains came in late in that year. Growth period of plants sown in July coincided with the late rains and might have accounted for the good vegetative growth of the plants and subsequently high yield of fresh green stalks.

Big stalks produced by early sowing might be due to the fact that the growing period from May to September coincided with the peak period of the rains which were also fairly well distributed (Table 7).

Day length of 12 h and 20 min (Meteorological Department) coupled with high relative humidity from May to September might have also contributed to the high yield of fresh green stalks by early sowing.

Dry retted fibre

In all the experiments, sowing in May produced the highest yields of dry retted fibre than subsequent sowing. The differences in fibre yields were significant ($P = 0.05$).

TABLE 5

Effect of Time of Planting of Roselle on Plant Height, Stem Diameter and Fibre Yield at Nyankpala (1986)

Date of sowing	*Days to 1st flower*	*Height at harvest (cm)*	*Stem diameter at harvest (cm)*	*Mean yield of fresh stalk (kg)*	*Mean fibre (g)*	*Mean fibre yield/ha (kg)*	*Percent yield of fibre*
28/5/86	137.00	182.00	0.98	28.80	686.50	1553.96	
11/6/86	129.50	178.30	0.91	27.30	725.50	1294.39	83.29
25/6/86	124.00	191.40	0.92	12.80	584.00	1072.40	69.01
9/7/86	108.00	173.80	0.79	9.80	308.50	604.50	38.90
23/7/86	95.50	151.00	0.92	10.60	245.00	573.79	36.92
6/8/86	87.50	147.50	0.71	9.50	352.50	657.78	42.32
LSD 0.01	3.9	32.80	0.20	5.40	614.00		
LSD 0.05	2.9	24.50	0.15	4.10	459.60		
CV (percent)	2.0	10.30	12.10	18.20	45.10		

TABLE 6

Effect of Time of Planting of Roselle on Plant Height, Stem Diameter and Fibre Yield at Nyankpala (1987)

Date of sowing	*Days to1st flower*	*Height at harvest (cm)*	*Stem diameter at harvest (cm)*	*Mean yield of fresh stalk (kg)*	*Mean fibre (g)*	*Mean fibre yield/ha (kg)*	*Percent yield of fibre*
22/5/87	157.50	130.03	0.72	41.00	940.00	2650.27	
4/6/87	147.00	139.50	0.80	45.50	890.00	2592.21	97.80
17/6/87	133.50	160.80	0.82	21.00	101.50	1386.61	52.31
30/6/87	119.50	134.50	0.77	17.30	490.00	2035.51	76.80
13/7/87	123.00	112.83	0.67	7.30	590.00	806.01	30.41
26/7/87	91.00	78.15	0.65	2.83	310.75	433.74	16.36
8/8/87	89.50	50.15	0.47	3.05	270.60	377.04	14.22
LSD 0.01	0.14	30.74	0.09	12.10	52.00		
LSD 0.05	0.30	22.81	0.07	8.80	38.70		
CV (per cent)	1.63	13.11	5.82	30.12	24.01		

Fibre yields were progressively reduced when sowing was delayed. For instance, fibre yield was reduced to only 6.7 per cent in 1971 when sowing was done in late August.

The results show that early sowing of roselle for fibre in the Guinea savanna zone is very desirable. They also show that early sowing resulted in good vegetative growth, high yields of fresh green stalks and dry retted fibre, as reported by Baker (1970), Amankwatia (1974) and Rao *et al.* (1983).

The yield of fibre depends, mainly, on height, stem diameter and age at harvest (Kirby, 1963; Nelson & Wilson, 1965). The results of the experiment have indicated that late sowing reduced both plant height and diameter. The reduction in both height and diameter adversely affected fibre yield, since the two are the main contributory factors of fibre yield.

The results also show that rainfall started earlier during the first 3 years of the experiment (i.e. May/June) but after 10 years, the global climatic changes adversely affected the latter 3 years planting, thus

TABLE 7

Record of Rainfall Measured at 09 hours GMT and Entered against Days Preceding that on which Read in mm at Nyankpala Agricultural Experimental Station

Year	*Jan*	*Feb*	*Mar*	*Apr*	*May*	*Jun*	*Jul*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*
1971	0.0	16.6	188.5	78.8	122.1	156.4	186.6	72.2	272.9	134.0	0.0	20.6
1972	0.0	0.0	77.8	72.7	227.7	94.3	130.8	115.9	257.6	103.4	0.0	0.0
1973	0.0	8.1	25.6	22.8	93.5	85.1	110.5	204.4	224.0	33.5	18.3	0.0
1985	0.0	0.0	28.9	82.3	52.3	131.8	27.2	229.9	147.8	33.9	1.5	0.0
1986	0.0	0.0	96.8	21.8	59.1	93.7	116.1	146.0	202.4	9.8	46.0	0.0
1987	0.0	0.0	14.8	30.6	89.5	133.5	128.6	233.3	115.3	69.6	0.0	9.7

Source: Nyankpala Meteorological Sub-station, Tamale.

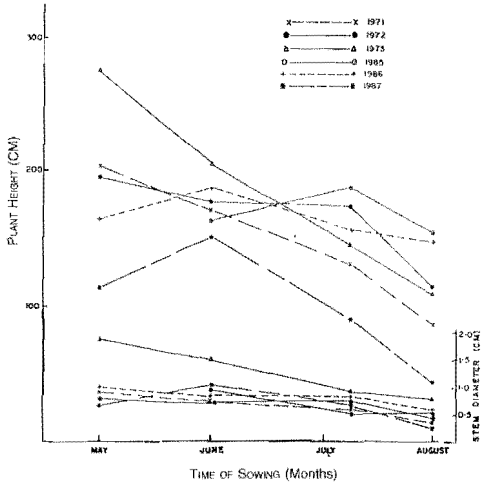

Fig. 1. Effects of different dates of sowing on plant height and stem diameter.

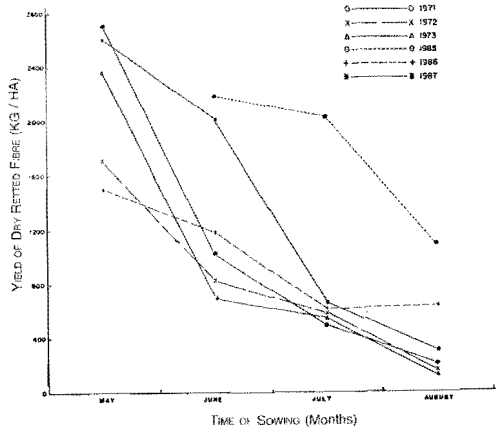

Fig. 2. Effects of different dates of sowing on fibre yield of roselle.

delaying optimum planting time to June and July.

The results have shown that late sowing adversely affected plant stand establishment which also accounted for low yield of dry retted fibre per hectare. For good yield of dry retted fibre, roselle should be sown in May and June in the Guinea savanna zone.

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