Environment & Ecology 27 (2A) : 771—776, 2009
 ISSN 0970-0420

Status and Prospects of Litchi Cultivation in Cooch Behar District of West Bengal

N. BHOWMICK, RANJIT K. PAL, C. P. SURESH, P. K. PAUL, AND S. K. GHOSH

Department of Pomology & Post Harvest Technology, Faculty of Horticulture
Uttar Banga Krishi Viswavidyalaya
Pundibari 736165, India
E-mail : nileshbhowmick@hotmail.com

Abstract

Litchi (*Litchi chinensis* Sonn.) is one of the important fruit crops of India. It is an essentially sub-tropical fruit crop and its exact climatic requirement limited its expansion under commercial cultivation. The agro-climatic condition of Cooch Behar district of West Bengal is quite suited for commercial cultivation of litchi and this area may be the potential area for expansion of litchi cultivation. In the present investigation attempts were made to assess the present status and prospects of litchi cultivation and performance of litchi in Cooch Behar district by dividing the litchi plants into five different age groups. Among the plants 62.50% were drooping in nature, rests were spreading or upright in nature. Date of starting of flowering observed from February third week to March first week and flowering continued upto March second week to fourth week. About 44% plants showed compact inflorescence, and others showed medium and loose inflorescence. Maximum trees showed mild biennial in bearing habit (62.5%), which might be due to the poor management practices and inferior planting materials and it decreased gradually with the advancement of the age of the litchi plants. Extent of fruit drop was high in 27.78% of trees and it was low in 20.83% of trees; rest plants showed medium extent of fruit drop. However, the extent of fruit cracking is lower in 62.5% of trees and rest showed medium (27.78%) and high (9.72%) extent of fruit cracking. Maximum (86%) trees gave red colored fruit and rest gave greenish red or greenish yellow types of fruit. Aril juiciness varied from high (90.28%) to medium (9.72%). Average TSS, fruit weight and yield of the litchi plants were recorded as 17.71^0 Brix, 12.47g and 44.06 kg/tree, respectively.
Key words : Litchi cultivation, Status, Prospect, Fruit drop, Yield.

Litchi (*Litchi chinensis* Sonn.) is an excellent, delicious juicy fruit of India. The litchi ranks next to citrus and avocado in importance in sub-tropical region (1). China is the largest producer of litchi followed by India. West Bengal ranks second in India in the production of litchi with 8,050 ha area under its cultivation and a production of 74,195 tones (2). An Agri-Export Zone for litchi was formed in West Bengal in 2002 covering the districts of Malda, Murshidabad, North and South 24 Parganas. The area under its cultivation is expanding but considering its global demand, the rate of expansion appears to be slow because of its exact climatic requirement. Litchi cultivation is successful in areas having average minimum temperature of 10 C from December to February and 32 C in April to June is considered more congenial. Climate is the most important limiting factor in the expansion of area under this fruit (3). In Cooch Behar district the average minimum temperature is 10.3 C during December to February and average maximum temperature is 30.87 C during April to June. It indicates that though the prevailing climatic condition is suitable for successful commercial cultivation of litchi in Cooch Behar district, its area under cultivation is only 235 ha with a productivity of 7.91 tones per ha. It stands for only 4.59% of area with 2.53% production under total fruit cultivation of Cooch Behar district (2). So there is an immense scope to increase the area under the litchi cultivation in this district. Considering the foregoing points, an attempt was made in 2008 to assess the present status and prospects of litchi cultivation in Cooch Behar district of West Bengal.

The total area under the cultivation of litchi in India is 60,000 ha with production of 368,600 MT. The state wise production of litchi is given on Table 1 (4). Litchi stands an important fruit crop of West Bengal and its productivity is high comparable to the na-

Table 1. Area and production of litchi in India (2004-05).

	States	Area ('000ha)	Production ('000MT)	Productivity (MT/ha)
1	Bihar	28.4	204.9	7.21
2	West Bengal	7.2	69.9	9.71
3	Assam	4.5	22.5	5.00
4	Orissa	3.9	11.9	3.05
5	Uttaranchal	6.7	8.9	1.33
	Total	60.00	36.86	6.14

tional average (2). The status of litchi production in West Bengal is given in Table 2. The climatic condition is quite congenial for litchi cultivation in Cooch Behar district. The average climatic condition is shown in Table 3.

Table 3. Average climatic condition of Cooch Behar district (1997—2006).

Months	Temperature (C) Max	Min	Relative humidity (%) Max	Min	Total rainfall (mm)	No. of rainy days
Jan	22.8	9.2	90	69	3.4	1
Feb	25.5	10.5	89	65	11.7	2
Mar	29.6	15.5	88	60	46.1	3
Apr	30.2	18.3	88	72	173.6	11
May	30.8	21	88	76	271.2	13
Jun	31.6	22.9	91	79	594.6	17
Jul	30.3	23.8	89	79	600.4	17
Aug	32	22.1	88	77	416.2	14
Sep	31.7	23.3	91	80	335.8	12
Oct	30.3	20.3	89	77	229	7
Nov	28.1	15.6	89	73	2.6	1
Dec	25.1	11.2	91	68	8.8	1

Methods

The study was carried out during February to May 2008 in the Cooch Behar district of West Bengal. During the investigation 72 numbers of litchi plants of various ages were studied for recording the parameters. Most of the parameters were recorded or observed following standard methods (5). According to the age of the plants, the 72 numbers of plants were sub-divided into five age groups : i.e. Group A (0—5 years), group B (6—10 years), group C (11—15 years), group D (16—20 years), group E (more than 20 years). The different parameters or characters studied were as follows. Plant Habit : Age of the plants expressed in year; planting materials, source of planting materials, seed or layered; tree height; tree girth.

Flowering Characteristics : Date of start of flowering; date of end of flowering; inflorescence shape—pyramidal or broadly pyramidal; inflorescence compactness—loose or medium or compact. Fruiting Characteristics : Fruiting habit—regular or mild biennial or biennial; Fruit shape—oval or round; fruit weight (g); yield (kg/tree); extent of fruit drop—low or medium or high; fruit cracking—low or medium or high; fruit color—red or greenish red or greenish yellow; tubercles shape—flattened or medium flattened; aril color—white or creamy white or yellow; aril flavor—strong or medium; aril juiciness—high or medium; and TSS (^{o}brix).

Among the different parameters tree height, tree girth, fruit weight, TSS were recorded through quantitative method, whereas the other parameters like the tree habit, inflorescence shape, inflorescence compactness, fruiting habit, extent of fruit drop, fruit shape, fruit color, tubercles shape, aril color, aril fla-

Table 2. Status of litchi production in West Bengal (2005-06).

	Districts	Area (ha)	Production (MT)	Productivity (MT/ha)
1	Murshidabad	2750	26405	9.60
2	Malda	895	7370	8.23
3	Nadia	790	9130	11.56
4	North 24 Parganas	735	7315	9.95
5	Uttar Dinajpur	492	3936	8.00
6	South 24 Parganas	472	4713	9.99
7	Cooch Behar	235	1860	7.91
	Total	8050	74915	9.31

Table 4. Age groups of litchi plants studied under investigation.

	Age group	Age of the plants	Number of plants
1	Group A	0—5 years	8
2	Group B	6—10 years	25
3	Group C	11—15 years	8
4	Group D	16—20 years	9
5	Group E	More than 20 years	22
	Total		72

Table 5. Plant habit, flowering and fruiting characteristics of litchi plants.

	Character/parameter	Range	Average	Nature/habit	Extent (%)
1	Age of the Plants (Year)	4—35	15.76	–	–
2	Planting materials	–	–	Seed	5.56
				Layered	94.44
3	Tree height (m)	2.1—10.5	5.83	–	–
4	Tree girth (cm)	20—230	90.85	–	–
5	Tree habit	–	–	Upright	5.56
				Spreading	31.94
				Drooping	62.50
6	Inflorescence Shape	–	–	Pyramidal	90.28
				Broadly Pyramidal	9.72
7	Inflorescence compactness	–	–	Loose	26.39
				Medium	29.17
				Compact	44.44
8	Start of flowering	Feb 3rd week to March 1st week	–	–	–
9	End of flowering	Mar 2nd to Mar 4th week	–	–	–
10	Fruiting habit	–	–	Regular	36.11
				Mild biennial	62.50
				Biennial	1.39
11	Extent of fruit drop	–	–	Low	20.83
				Medium	51.39
				High	27.78
12	Fruit shape	–	–	Oval	94.44
				Round	5.56
13	Fruit weight (g)	8.09—21.52	12.47	–	–
14	yield (kg/tree)	6.5—70	44.06	–	–
15	Fruit color	–	–	Red	86.12
				Greenish red	6.94
				Greenish yellows	6.94
16	Tubercle shape	–	–	Flattened	65.28
				Medium flattened	34.72
17	Aril color	–	–	White	72.22
				Creamy yellow	11.11
				Creamy white	16.67
18	Aril flavor	–	–	Strong	12.50
				Moderate	87.50
19	Aril juiciness			High	90.28
				Medium	9.72
20	TSS	15.00—20.8	17.71	–	–
21	Fruit cracking	–	–	Low	62.50
				Medium	27.78
				High	9.72

vor, aril juiciness, extent of fruit cracking, yield were recorded by their degree of magnitude following standerd methods (5) through eye estimation or as reported by the growers. The data are finally expressed in terms of percentage over the average value for each category of age groups and also for all the 72 plants investigated. The number of litchi plants under each group varied due to their availability during the course of investigation (Table 4).

For calculating the fruit weight, TSS ten numbers of fruit were taken rendomly for each plant and then average value was determined for the each and every age group and also for the total 72 numbers of plants. For obtaining the yield data the approximate

Table 6. Plant habit and flowering characteristics of the litchi plants. Gr.—Group, L—Layered, NS—North-South, EW—East-West, U—Upright, S—Spreading, D—Drooping, P—Pyramidal, BP—Broadly pyramidal, L—Loose, M—Medium, C—Compact.

Age of the plants (years)	Age Gr.*	Plant age Gr.* (No.)	Planting material used (%)		Tree height (m)	Tree girth (cm)	Tree habit (%)		
			L*	Seed			U*	S*	D*
0—5	A	8	87.5	12.50	4.31	31.50	12.50	37.50	50.00
6—10	B	25	92	8.00	5.11	53.60	8.00	52.00	40.00
11—15	C	8	100	0	5.96	78.75	12.50	50.00	37.50
16—20	D	9	100	0	6.13	86.56	0	22.22	77.78
More than 20 years	E	22	95.45	4.55	7.02	160.9	4.55	4.55	90.90
Among the total number of plants		72	94.44	5.56	5.83	90.85	5.56	31.94	62.50

Table 6. Continued.

Age of the plants (years)	Age Gr.*	Inflorescence type (%)		Inflorescence compactness			Start of flowering	End of flowering
		P*	BP*	L*	M*	C*		
0—5	A	75.00	25.00	25.00	62.50	12.50	4th week Feb to 1st week Mar	4th week of Mar
6—10	B	92.00	8.00	40.00	28.00	32.00	4th week Feb to 1st week Mar	2nd week Mar to 4th week Mar
11—15	C	75.00	25.00	12.50	50.00	37.50	3rd week Feb to 1st week Mar	2nd week Mar to 4th week Mar
16—20	D	100	0	22.22	33.34	44.44	3rd week Feb to 1st week Mar	2nd week Mar to 4th week Mar
More than 20 years	E	95.45	4.55	18.18	9.09	72.73	3rd week Feb to 4th week Feb	2nd week Mar to 4th week Mar
Among the total number of plants		90.28	9.72	26.39	29.17	44.44	3rd week Feb to 1st week Mar	2nd week Mar to 4th week Mar

yield estimated by the growers for the previous year was mentioned.

Results and Discussion

The average age of the litchi plants studied was 15.76 years. Table 5 shows that about 94% of plants were layered plant and rest were from seedling origin. The range of tree height and tree girth varied from 2.1 to 10.5 m and 20—230 cm with an average of 5.83 m and 90.85 cm respectively. The tree height and girth followed an increasing trend with the advancement of age groups (Table 6). Table also showed 5 that 62.50% of the plants are drooping in nature, followed by spreading and upright nature. Among the different age groups, drooping nature of tree habit is maximum for group E (90.90%) followed by group D (77.78%), whereas the upright nature of plants are maximum (12.50%) for group A and group C. The shape of inflorescence is pyramidal for maximum number of plants (90.28%). Maximum numbers of plant shows compact inflorescence and the compactness of the inflorescence increases with the advancement of the age of trees (Table 6). Flowering of plants started from third week of February and continued up to February first week of March and it ended between second week of March to four week of March. Maximum number of plants (62.50%) showed mild biennial type of fruiting habit and the nature of mild biennial habit decreased gradually with the advancement of age of litchi plants (Table 7). Group E plants showed highest percentage (63.64%) of regular bearing habit. The irregular cropping pattern of the trees may be due to the poor management practices or may be due to the

Table 7. Fruiting characteristics of litchi plants. *R—Regular, MB—Mild biennial, B—Biennial, L—Low, M—Medium, H—High, Ov—Oval, Ro—Round, GR—Greenish red, GY—Greenish yellow, F—Flattened, MF—Medium flattened, W—White, CY—Creamy Yellow, CW—Creamy white.

Age group	Fruiting habit (%)			Extent of fruit drop (%)			Fruit shape (%)		Fruit weight	Yield	Fruit color (%)		
	R*	MB*	B*	L*	M*	H*	Ov*	Ro*	(g)	(kg/tree)	Red	GR*	GY*
A	12.5	87.5	0	12.5	62.5	25	75	25	12.80	10.75	62.5	0	37.5
B	20	80	0	4	52	44	92	8	11.68	39.88	88	12	0
C	25	62.5	12.5	0	50	50	100	0	12.86	42.50	75	25	0
D	44.44	55.56	0	0	100	0	100	0	13.03	51.56	88.89	0	11.11
E	63.64	36.36	0	59.09	27.27	13.64	100	0	12.89	58.45	95.45	0	4.55
Av. of 72 plants	36.11	62.5	1.39	20.83	51.39	27.78	94.44	5.56	12.47	44.06	86.12	6.94	6.94

Table 7. Continued.

Age group	Tubercles shape (%)		Aril color (%)		Aril flavor (%)			Aril juiciness (%)		TSS (^{0}brix)	Fruit cracking (%)		
	F*	MF*	W*	CW*	CY*	Strong	Med	High	Med		Low	Med	High
A	75	25	62.5	25	12.5	12.5	87.5	87.5	12.5	17.49	62.5	25	12.5
B	52	48	68	16	16	12	88	92	8	17.18	52	40	8
C	62.5	37.5	100	0	0	37.5	62.5	75	25	19.98	50	37.5	12.5
D	88.89	11.11	66.67	22.22	11.11	11.11	88.89	100	0	16.99	44.44	44.44	11.12
E	68.18	31.82	72.73	18.18	9.09	4.55	95.45	90.91	9.09	17.87	86.36	4.55	9.09
Av. of 72 plants	65.28	34.72	72.22	16.67	11.11	12.50	87.50	90.28	9.72	17.71	62.50	27.78	9.72

poor varietal resource. Extent of fruit drop was medium for 51.39% of trees and rest showed high (27.78%) and low (20.83%) percentage of fruit drop. In group E plants about 59% of the showed low extent of fruit drop. The extent of fruit drop was reduced with the advancement of plant age (Table 7). The shape of litchi fruit was maximum (94.44%) oval and showed similar trend in all age group (Table 6). The average fruit weight was 12.47 g (Table 6) and it is maximum (12.89%g) for the age group E. The average yield was 44.06 kg/tree and it showed an increasing thend among the age groups with the advancement of the age. Regarding fruit color, 86.12% of fruit showed red colored fruit and it was maximum among all the age groups. The extent of fruit cracking is low for maximum (62.50%) plants and among the different age groups; group E showed maximum (86.36%) extent of low fruit cracking. The tubercles shape and aril color were flattened (65.28%) and white (72.22%) respectively for maximum cases. Aril flavor was medium for maximum cases (87.50%) and showed similar trend among all age groups. The aril juiciness was high for maximum (90.28%) cases and which also showed similar trend among the different age groups.

Some early findings regarding the status of litchi cultivation are mentioned below. Sharma and Roy (6) evaluated five litchi cultivars in northern Bihar and they reported the flowering period ranging from 27 days in cv Shahi to 38 days in cv Bedana, flower emergence beginning in the second week of March and continuing up to the third week of April. Yield/tree was highest in China (104.6 kg) and lowest (71.4 kg) in Bedana. Sarkar and Bandyopadhyay (7) reported from Nadia district in West Bengal that among the eight cultivars Bedana was the first to produce panicles, while late panicle emergence was noted in Elachi and Nafarpal. Duration of flowering varied from 24 days (Kasba) to 14—15 days (Elachi). Knight et al. (8) reported that air layering became an improved propagation techniques of litchi using polyethylene plastic and sphagnum moss, which made the mass production of nursery stocks. From Bangladesh, Ullah et al. (9) informed that among the 15 cultivars/lines, flowering period varied between the first week of

December to mid-March and harvesting data varied from the first week to the last week of May. Bombai produced the highest number of fruits per plant (3,330) and highest yield (46.62 kg per plant). Fruit weight varied from 12.00 (Sonapur) to 23.00 g (V-3, Bari). The percentage of edible portion varied from 57.14 (Bombai) to 78.26 (V-3, Bari).

Conclusion

The desirable traits of fruiting characteristics like high aril juiciness, low extent of fruit cracking, attractive red colored fruit, whitish aril color, goodTSS content of fruit already exist among the litchi plants investigated in the Cooch Behar district of West Bengal. However, mild biennial nature of fruiting habit, medium extent of fruit drop, comparable low yield to some extent limits the expansion of commercialization of litchi. But these traits may be intervened by adopting recommended improved package of practices with the introduction of elite type of planting materials and popularize the litchi cultivation by creating the awareness among the growers of this area.

This investigation is a preliminary approach to assess the present status, prospects and limitation of litchi growing in Cooch Behar district of West Bengal. This investigation may be carried for 2-3 more years and bio-chemical analysis of fruits, post harvest life of fruits, harvesting season with duration may be recorded. The yield of litchi plants mentioned in the present experiment is as stated by the growers and it may be recorded as quantitative method for future reference. The package of practices followed by the growers may also be noticed to assess the correlation with the yield. Lastly attempts are to be made for identifying the trees which produce a good crop and show maximum number of desirable traits like high fruit weight, aril recovery, yield, TSS/acid ratio, attractive fruit color, low fruit drop; and these types of plants may be used as mother plants to meet the local demand of planting materials until there is a recommendation for cultivation of particular type of elite cultivar for this particular area.

References

1. Ochese J. J., M. J. (Jr.) Soule, M. J. Dhiman and C. Wehilburg. 1961. Other fruit Crops. *In* Tropical and sub-tropical agriculture, volume 1. MacMillan Publ. Co., New York, USA.
2. Anonymous. 2006. Annual report 2003-04, 2004-05, 2005-06. Dep. Food Processing indust. and Hor., Govt. West Bengal. India.
3. Chauhan K. S. 2001. Litchi-Botany, production and tilization. Kalyani Publ., New Delhi, India.
4. Anonymous. 2005. Indian horticulture database-2005. Area and production of fruits at a glance (2004-05). Nat. Hort. Bd, Gurgaon, India, Annexture-IX.
5. Anonymous. 2002. Litchi (*Litchi chinensis* (Gaertn.) Sonn.). Pages 132—137 *in* Minimal descriptors of agri-hortcultural crops, part III. Fruit crops. Nat. Bur. Pl. Gene. Resour., New Delhi, India.
6. Sharma S. B. and P. K. Roy. 1987. Flowering and fruiting behaviour of some litchi cultivars. Haryana J. Hort. Sci. 16 : 168—174.
7. Sarkar T. K. and A. Bandyopadhyay. 1989. Flowering behavior of some important litchi *Litchi chinensis* varieties of the Gangetic plains of West Bengal. Environ. Ecol. 7 : 189—192.
8. Knight R. J. (Jr.), Hui Bai Huang, and C. Menzel. 2001. The lychee's history and current status in Florida. Acta Horticulturae 55 : 41—44.
9. Ullah M. A., M. A. Mannan and M. S. Islam. 2001. Studies on growth, flowering, yield potential and fruit characteristics of fifteen litchi cultivars. Bangladesh J. Training and Devel. 14 : 49—56.