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RESEARCH ARTICLE

EVALUATION OF CASSIA (*CINNAMOMUM CASSIA* (L.)) GENOTYPES FOR GROWTH AND YIELD

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ABSTRACT

The experiment was conducted at Horticultural Research Station, Pechiparai, Kanniyakumari District, Tamil Nadu Agricultural University, Tamil Nadu from 2007 to 2017. The aim of the study is to evaluate the performance of cassia accessions for maximum dry leaf and bark yield. The experiment was laid out with four genotypes (C1, D1, D3 and D5) along with a local check in line planting. It was laid out in Randomized Block Design (RBD) with four replications and the results were statically analyzed. Among the different genotypes, the accession D3 recorded maximum plant height (5.50 m), stem girth (32.88 cm), dry leaf yield (469.57 kg/ ha) and dry bark yield (259.42 kg/ha) compared to local check recorded the plant height (2.75 m), stem girth (17.51 cm), dry leaf yield (300.72 kg/ ha) and dry bark yield (182.43 kg/ha) .

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INTRODUCTION

Cinnamon is an evergreen bushy tree of Lauraceae whose bark and leaves are strongly aromatic. In addition to its culinary uses in Asian and European recipes, it has important applications in medicine. Two types of volatile oils are commercially extracted from cinnamon: bark oil and leaf oil. Bark oil is used in perfumery, flavouring, liquors and medicines4. Leaf oil is employed in perfumes, toiletries, seasoning and the manufacture of eugenol and vanillin 2,5. Leaf oil is a rich source of eugenol. The other constituents of the oil are cinnamic aldehyde, benzaldehyde, pinene, phellandrene, dipentenesafrole, methyl eugenol, borneol, geraniol, caryophyllene, terpineol, linalool, cinnamyl alcohol and traces of over 15 compounds 4,6,7. Next to Sri Lanka, India is the largest producer of cinnamon. Wide variability of the plant occurs in Western Ghats and in some parts of Assam and north eastern states. It is largely cultivated in the state of Kerala.

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Much of the research and development were carried out considering it as a tree spice for its quills and bark yield [3]. Very little importance was given to leaf oil. On account of the industrial potential of cinnamon leaf oil, the present study was carried out with the objective of studying the interrelationship between the growth, yield and quality parameters in cinnamon and identifying elite types for aromatic leaf oil and eugenol yields. Cinnamon is an evergreen bushy tree of Lauraceae whose bark and leaves are strongly aromatic. In addition to its culinary uses in Asian and European recipes, it has important applications in medicine. Two types of volatile oils are commercially extracted from cinnamon: bark oil and leaf oil. Bark oil is used in perfumery, flavouring, liquors and medicines4. Leaf oil is employed in perfumes, toiletries, seasoning and the manufacture of eugenol and vanillin 2,5. Leaf oil is a rich source of eugenol. The other constituents of the oil are cinnamic aldehyde, benzaldehyde, pinene, phellandrene, dipentenesafrole, methyl eugenol, borneol, geraniol, caryophyllene, terpineol, linalool, cinnamyl alcohol and traces of over 15 compounds 4,6,7. Next to Sri Lanka, India is the largest producer of cinnamon. Wide variability of the plant occurs in Western Ghats and in some parts of Assam and north eastern states. It is largely cultivated in the state of Kerala. Much of the research and development were carried out considering it as a tree spice for its quills and bark yield [3].

Very little importance was given to leaf oil. On account of the industrial potential of cinnamon leaf oil, the present study was carried out with the objective of studying the interrelationship between the growth, yield and quality parameters in cinnamon and identifying elite types for aromatic leaf oil and eugenol yields. Cassia cinnamon (*Cinnamomum cassia* (L.)) is a type of cinnamon. It is an evergreen bushy tree whose bark and leaves are strongly aromatic. In addition to its culinary uses in Asian and European recipes, it has important applications in medicine. Two types of volatile oils are commercially extracted from cinnamon: bark oil and leaf oil. Bark oil is used in perfumery, flavouring, liquors and medicines. Leaf oil is employed in perfumes, toiletries, seasoning and the manufacture of eugenol and vanillin. Leaf oil is a rich source of eugenol. The other constituents of the oil are cinnamic aldehyde, benzaldehyde, pinene, phellandrene, dipentenesafrole, methyl eugenol, borneol, geraniol, caryophyllene, terpineol, linalool, cinnamyl alcohol and traces of over 15 compounds. Next to Srilanka, Wide variability of the plant occurs in Western Ghats and in some parts of Assam and north eastern states. It is largely cultivated in the state of Kerala. Much of the research and development were carried out considering it as a tree spice for its leaves and bark yield. On account of the industrial potential of leaf oil and bark oil, the present study was carried out with the objective of studying the interrelationship between the growth and yield parameters in cassia cinnamon and identifying elite types for aromatic leaf and bark oil yields.

MATERIALS AND METHODS

The experiment was conducted at Main Farm, Horticultural Research Station, Tamil Nadu Agricultural University, Pechiparai, Kanniyakumari District, Tamil Nadu during the period from 2007- 2017.The aim of the study is to evaluate the performance of cassia accessions for maximum height (cm), stem girth (cm), dry leaf yield (kg/ha) and dry bark (kg/ha) .The experiment was laid out with five genotypes C1, D1, D3, D5and local check in line planting. It was laid out in Randomized Block Design (RBD) with four replications and the results were statically analyzed.

RESULTS AND DISCUSSION

Plant height (m): Among the different genotypes, the accession D3 recorded maximum plant height (m) during 2007-08 (2.73 m), 2008-09 (3.04 m), 2009-10(3.50 m), 2010-11(4.50 m), 2011-12(5.78 m), 2012-13(5.84 m), 2013-14(5.90 m), 2014-15(6.50 m), 2015-16(7.70 m) and 2016-17 (9.50 m) (Table 1).

Stem girth (cm): Among the different genotypes, the accession D3 recorded maximum stem girth (cm) during 2007-08 (11.80 cm), 2008-09 (12.10 cm), 2009-10 (18.00 cm), 2010-11(24.00 cm), 2011-12 (40.00 cm), 2012-13(40.78 cm), 2013-14(40.79 cm), 2014-15(43.80 cm) 2015-16(45.00 cm) and 2016-17 (52.00 cm) (Table 2).

Dry leaf yield (g/ plant): Among the different genotypes, the accession D3 recorded maximum dry leaf yield (g/ plant) during 2007-08 (573.50 g/ plant), 2008-09(500 g/ plant), 2009-10(335 g/ plant), 2010-11 (376 g/ plant), 2011-12(390 g/ plant), 2012-13 (396.70 g/ plant), 2013-14(396.78 g/ plant), 2014-15(410.50 g/ plant), 2015-16 (420.50 g/ plant) and 2016-17 (430.00 g/ plant) (Table 3).

Dry leaf yield (kg/ ha): Among the different genotypes, the accession D3 recorded maximum dry leaf yield (kg/ ha) during 2007-08(637.16 kg/ ha), 2008-09(555.50 kg/ ha), 2009-10(372.19 kg/ ha), 2010-11(417.74 kg/ ha), 2011-12(433.29 kg/ ha), 2012-13(439.96 kg/ ha), 2013-14(439.96 kg/ ha), 2014-15 (455.51 kg/ ha), 2015-16 (466.62 kg/ ha) and 2016-17 (477.73 kg/ ha) (Table 4).

Dry bark yield (g/plant): Among the different genotypes, the accession D3 recorded maximum dry bark yield (g/plant) during 2007-08(349.80 g/plant), 2008-09(125.00 g/plant), 2009-10 (185.00 g/plant), 2010-11 (210.00 g/plant), 2011-12(226.00 g/plant), 2012-13 (226.00 g/plant), 2013-14(226.12 g/plant),2014-15(250.50 g/plant),2015-16(258.50 g/plant) and 2016-17 (280 g/plant) (Table 5).

Dry bark yield (kg/ha): Among the different genotypes, the accession D3 recorded maximum dry bark yield (kg/ha) during 2007-08(387.74 kg/ha), 2008-09 (387.74 kg/ha), 2009-10(138.87 kg/ha),2010-11(205.54 kg/ha), 2011-12(233.31 kg/ha),2012-13(251.09 kg/ha), 2013-14(251.09 kg/ha), 2014-15(251.09 kg/ha), 2015-16(286.64 kg/ha)and 2016-17(311.08 kg/ha) (Table 6). The Sreekundra Estate under Brook Bond Tea Ltd., at Valparai has 35 lines of Chinese cassia. They are developed from the open pollinated progenies of cassia trees introduced during the early 1950s from China. At the Aromatic and Medicinal Plants Research Station of Kerala, Agricultural University, Odakkali, Kerala, 236 cinnamon lines are being maintained. These lines are mainly derived from seed progenies of the material maintained at Ancharakandi. Flavonoid analysis indicated absolute similarity between Cinnamomumverum collections cultivated in India and those introduced from Sri Lanka, illustrating the common origin of both (Shylaja, 1984; Ravindran *et al*., 1992). At the Indian Institute of Spices Research, Calicut, 291 lines of cinnamon were evaluated for quality characteristics and nine elite lines were identified. Clonal progenies of some of these lines with high quality parameters were evaluated in replicated trials. Four of the lines were poor in establishment and subsequently discarded. SL63 and IN189 were finally selected based on the regeneration capacity, fresh bark yield, dry bark yield, leaf oil, percentage of eugenol in leaf oil and cinnamaldehyde in bark oil, etc. (Krishnamoorthy *et al*., 1996). These lines, named as Navasree (SL63) and Nithyasree (IN189), were released for cultivation and are being popularized in India.

Haldankar *et al*. (1994) screened 300 seedlings of cinnamon collected from Indian Institute of Spices Research, Calicut for isolating promising genotypes and four promising selections were further tested in field trials for yield and quality characteristics. One selection, B-iv exhibited the highest yield of fresh and dried bark (289.7 g and 84.5 g, respectively) bark oil (3.2%) with a good percentage of Review of Literature 30 cinnamaldehyde (70.2%). Leaf oil content was 2.28%, having 75.5% eugenol. This was released as„ Konkan Tej‟ for the Konkan region in Maharashtra area of India. Joy *et al*. (1998) evaluated 234 accessions of cinnamon maintained at the Aromatic and Medicinal Plants Research Station, Odakkali, based on growth, yield and quality parameters. They identified three superior accessions (ODC-130, ODC10 and ODC-67) as the most promising. The best accession ODC-130 had given 18.34 kg fresh leaf per tree per year, 294.7 ml leaf oil per tree per year, and oil recovery of 1.6% and a Eugenol content of 93.7% in the oil.

Table 1. Performance of cassia accessions with respect to plant height (m)

Genotypes	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	Mean
C1	1.54	1.86	1.96	2.16	2.62	2.78	3.00	4.50	5.50	6.50	3.24
D1	1.62	1.93	1.98	2.13	2.56	2.67	2.70	3.20	4.10	5.80	2.90
D3	2.73	3.04	3.50	4.50	5.78	5.84	5.90	6.50	7.70	9.50	5.50
D5	1.64	1.95	2.25	2.45	2.68	2.75	2.79	3.80	4.60	7.50	3.24
Local check	1.35	1.58	1.75	1.95	0.22	2.78	2.80	3.90	4.35	6.80	2.75
SEd	0.29	0.28	0.31	0.29	0.14	0.14	0.16	0.10	0.15	0.18	0.20
CD (p=0.5)	0.65	0.69	0.67	0.48	0.03	0.03	0.24	0.29	0.31	0.35	0.37

Table 2.Performance of cassia accessions with respect to stem girth (cm)

Genotypes	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	Mean
C1	8.50	8.80	9.50	11.50	22.41	22.56	22.57	24.50	25.80	32.50	18.86
D1	7.10	7.40	7.60	7.89	23.20	23.58	23.58	25.10	26.60	36.50	18.86
D3	11.80	12.10	18.00	24.00	40.0	40.78	40.79	43.80	45.00	52.50	32.88
D5	10.90	11.20	11.50	11.78	30.17	30.68	30.69	36.50	37.90	46.50	25.78
Local check	6.50	6.90	7.20	7.55	19.50	20.60	20.63	25.61	26.1	34.50	17.51
SEd	1.00	0.40	0.07	0.06	0.03	0.03	0.04	0.07	0.09	0.08	0.19
CD (p=0.5)	2.15	1.0	0.09	0.08	0.06	0.06	0.06	0.09	0.10	0.20	0.39

Table 3.Performance of cassia accessions with respect to dry leafyield (g/tree)

Genotypes	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	Mean
C1	217.00	275.00	265.00	255.00	279.10	280.78	280.80	292.00	325.50	350.00	282.02
D1	308.00	340.50	238.00	287.50	313.67	315.86	315.89	325.10	375.50	360.00	318.00
D3	573.50	500.00	335.00	376.00	390.00	396.70	396.78	410.50	420.50	430.00	422.90
D5	512.00	407.00	292.00	312.00	352.00	358.20	358.23	372.50	392.50	395.00	375.14
Local check	205.00	255.50	220.50	240.50	278.64	278.94	278.97	293.50	310.10	350.00	271.17
SEd	11.73	55.54	15.58	14.90	14.03	14.03	14.13	15.10	15.25	14.50	18.48
CD (p=0.5)	24.3	135.9	29.50	28.50	29.45	29.45	29.48	31.50	32.30	31.50	40.19

Table 4.Performance of cassia accessions with respect to dry leaf yield (kg/ha)

Genotypes	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	Mean
C1	241.08	305.53	294.42	283.31	309.97	311.08	311.08	324.41	361.08	388.85	313.08
D1	342.18	378.30	264.42	318.86	347.74	349.97	349.97	361.08	416.63	399.96	352.91
D3	637.16	555.50	372.19	417.74	433.29	439.96	439.96	455.51	466.62	477.73	469.57
D5	568.83	452.18	324.41	346.63	391.072	397.74	397.74	413.29	435.51	438.84	416.62
Local check	227.76	283.31	244.42	266.64	308.56	308.86	308.86	325.52	344.41	388.85	300.72
SEd	13.25	16.45	17.55	17.00	16.25	15.56	16.65	17.35	17.45	16.65	17.55
CD (p=0.5)	28.55	30.05	35.58	32.45	31.56	34.86	33.46	35.41	34.32	33.62	34.52

Table 5.Performance of cassia accessions with respect to dry bark yield (g/tree)

Genotypes	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	Mean
C1	100.00	98.00	110.00	145.00	195.12	197.89	197.90	220.50	240.00	250.00	175.44
D1	125.40	76.00	132.00	135.00	215.00	225.60	225.65	245.50	252.50	260.00	189.27
D3	349.80	125.00	185.00	210.00	226.00	226.00	226.12	250.50	258.50	280.00	233.69
D5	316.00	102.00	126.00	137.00	200.45	210.45	210.49	225.10	232.50	240.00	119.99
Local check	90.50	85.00	105.00	115.00	190.60	197.70	197.78	218.25	225.00	220.00	164.48
SEd	14.58	18.3	17.50	18.50	15.30	14.30	12.33	12.45	12.49	13.42	17.12
CD (p=0.5)	32.64	41.18	38.50	37.5	33.67	33.67	32.68	31.78	34.82	33.76	35.42

Table 6.Performance of cassia accessions with respect to dry bark yield(kg/ha)

Genotypes	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	Mean
C1	111.10	108.88	122.21	161.09	216.65	218.87	218.87	244.42	266.64	277.75	194.65
D1	138.88	84.83	146.65	149.98	238.87	249.98	249.98	272.20	279.97	288.86	210.02
D3	387.74	138.87	205.54	233.31	251.09	251.09	251.09	277.75	286.64	311.08	259.42
D5	351.08	113.32	139.99	152.21	222.20	233.31	233.31	249.98	257.75	266.64	221.98
Local check	99.99	94.43	116.65	127.77	211.09	218.87	218.87	242.20	249.98	244.42	182.43
SEd	11.52	12.54	10.52	13.84	12.54	13.52	14.24	15.13	13.42	12.62	13.54
CD (p=0.5)	25.35	21.15	22.35	23.54	21.16	22.15	24.12	23.51	23.14	22.14	25.45

The eugenol yield per tree per year was 275.1 ml. This line was released under the name Sugandhani, exclusively for leaf oil production purpose. Krishnamoorthy *et al*. (1991) also reported significant variation in progeny performance of nine lines for plant height, number of branches per tree, fresh and dry weight of bark and percentage recovery of bark. Krishnamoorthy *et al*. (1999) evaluated cassia germplasm maintained at IISR, Calicut for morphological and quality parameters with an objective to select high yielding clones with high bark recovery and high regeneration capacity and growth. Based on quality and other characteristics, four promising lines were identified. Two lines (A1 and C1) have high bark oleoresin (10.2% and 10.5% respectively) and two others D1 and D3 have high bark oil (4.7% and 4.9% respectively) and high cinnamaldehyde in bark oil (91.0% and 90.5% respectively). Taking the overall yield, chemical and flavor profiles, C1, D1, and D3 were selected for pre-release yield evaluation trials. In field plantations of cinnamon in the Orissa state, Paul and Sahoo (1993) recorded wide variations in many characteristics such as plant height (2.17-3.37m), stem girth (7-16.6cm), leaf oil (0.38-1.80%), eugenol in leaf oil (traces to 80-98%) and bark oil (0.05-2.18%).

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