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Evaluation of castor hybrids / varieties employing growth and yield characters for exploitation in seed production and ERI silkworm rearing

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Abstract
In the current investigation, each of five castor (*Ricinus communis* L.) hybrids (DCH-4, DCH-117, DCH-177, DCH-519 and GCH-4) and varieties (DCS- 9, 48-1, JC-12, local green and local pink) raised under irrigated condition showed significant variation with regard to growth and yield attributes. Among the castor hybrids/varieties, DCH-519 hybrid showed significantly superior plant height, number of branches/plant, number of leaves /plant, leaf area, leaf area index, leaf area duration, leaf yield and seed yield followed by DCS-9 variety, GCH-4 hybrid, DCH-177 hybrid and 48-1 variety. However, local green and local pink castor varieties had inferior values for all these attributes.

Keywords: Castor, eri silkworm, hybrids, *Ricinus communis*, varieties.

1. Introduction
Castor (*Ricinus communis* L.; family: Euphorbiaceae) is a wild plant and has been in exploitation by man chiefly for collection of oil seeds since ancient times in Gangetic plains and South Africa. It is monotypic and is the only species with most polymorphic forms (Weiss, 2000). Castor grows in perennial form in tropical and sub-tropical regions of the world in varied types of agro-climatic conditions. The major castor growing countries in the world include India, China, Brazil, USSR, Thailand, Ethiopia and Philippines. The castor cultivated area occupies nearly 1,525,000 ha falling in 30 countries with a production of 1,581,000 MT of seeds per annum (Damodaram and Hegde, 2010) [4].

In India, castor grows under natural conditions and spreads through semi-wild and wild perennial forms in diverse habitats like forest, sea coast, river bund, railway track, garbage dump and waste land. India is in possession of 4373 castor accessions of which 3416 have been maintained by the Directorate of Oil Seeds Research, Hyderabad, and the remaining 957 conserved by the National Bureau of Plant Genetic Resources (NBPGR), New Delhi (Anjani and Hegde, 2007) [2]. In India, castor is found growing in wild conditions in the states of Bihar, Uttar Pradesh and Madhya Pradesh with approximately 14 ft tall and woody perennial types bearing big leaves (Anjani, 2012) [1]. In north eastern India, castor has been found in wild form and exclusively used for rearing of eri silkworm for cocoon production. It has diverse morphological variants in many parts of the world with regard to plant height, branching, stem colour, leaf size, waxy coating, length, shape and compactness of raceme, pedicle length as well as size and shape of capsule and seed (Moshkin, 1986) [8]. In the current study, an attempt has been made to record the growth and yield attributes of a few selected castor hybrids/varieties with a view to identify their suitability for both seed production and eri silkworm rearing.

2. Materials and Methods
Cultivation of castor
In all, five each of castor hybrids and varieties have been selected for the current study. Seeds of the castor hybrids (DCH-4, DCH-117, DCH-177, DCH-519 and GCH-4) and varieties (DCS- 9, 48-1, JC-12, Local green and Local pink) were sown at 90 x 60 cm in plots of 5.0 x 4.0 m adopting Randomized Block Design (RBD) with three replications at Immavu village, Nanjangud Taluk, Mysuru District, keeping two local varieties as control.

The crops were raised as per the recommended package of practices under irrigated condition (Anonymous, 2000) [3]. Data on growth and yield parameters were documented at 60, 75, 90 and 105 days after sowing.

Growth parameters

Plant height

Five plants were randomly selected to measure their height (cm) from the base of the plant to tip of the upper most fully opened leaf in each castor hybrid/variety under each replication.

Number of shoots/plant

Number of shoots in five randomly selected plants was counted in each castor hybrid/variety for each replication.

Number of leaves/plant

Number of leaves was counted in five randomly selected plants under each castor hybrid/variety in three replications.

Leaf area

Leaf area (cm^2) was calculated using the following formula:

$$A = \frac{a}{x} \; x \; y$$

Where,

A = Leaf area

a = Area of leaf bit

x = Weight of leaf bit

y = Weight of whole leaf

Leaf area Index

Leaf area index was calculated employing the formula shown below.

$$\text{Leaf area index} = \frac{\text{Leaf area } (cm^2)}{\text{Plant spacing } (cm^2)}$$

Leaf area duration

Leaf area duration (days) was estimated adopting the formula detailed hereunder.

$$\text{Leaf area duration} = \frac{L_1 + L_2}{2\,(t_2 - t_1)\,2}$$

Where,

L_1 = Leaf area at the time t_1

L_2 = Leaf area at the time t_2

t_1 = Time of first observation

t_2 = Time of second observation

Yield parameters

Leaf yield

Leaf yield (g/plant) was recorded replication-wise by harvesting fresh leaves from five randomly selected plants in each castor hybrid/variety and leaf yield per hectare (kg) was computed.

Seed yield

Five plants were selected randomly in each castor hybrid/variety under each replication at various pickings and mean weight (g/plant) was calculated apart from computing seed yield per hectare (kg).

Data recorded on growth and yield parameters of castor were analyzed statistically for the test of significance using Fisher's method of "Analysis of Variance" (ANOVA) and the level of significance was tested at $p \leq 0.05$ as per the procedure outlined by Cochran and Cox (2000)**.**

3. Results

Plant height, number of branches and leaves in selected castor hybrids and varieties at different days of sowing (Table 1).

Plant height

60 Days After Sowing (DAS)

Plant height exhibited significant variation among most castor hybrids/varieties with the values ranging from 74.38 ± 2.748 cm (DCH-519) to 47.55 ± 1.747 cm (DCH-4) among hybrids and from 63.82 ± 2.196 cm (DCS-9) to 41.53 ± 0.783 cm (local green) among varieties. In general, the values registered by hybrids were relatively superior to those by varieties.

Table 1: Plant height, number of branches and leaves in selected castor hybrids and varieties at different days of sowing

Hybrid / Variety	Plant height (cm)				Number of branches/plant		Number of leaves/plant			
	60 Days	75 days	90 days	105 days	90 days	105 days	60 Days	75 days	90 days	105 days
1. DCH-4	47.55 ± 1.747	80.41 ± 2.531	125.1 ± 3.774	195.9 ± 7.242	6.000 ± 0.839	6.294 ± 0.547	6.113 ± 0.443	7.000 ± 0.333	18.33 ± 3.746	21.55 ± 2.297
2. DCH-117	48.56 ± 0.986	88.22 ± 1.736	181.2 ± 7.831	207.3 ± 9.165	6.111 ± 0.801	6.889 ± 0.401	6.667 ± 0.511	13.44 ± 1.254	26.00 ± 5.783	25.37 ± 1.260
3. DCH-177	64.29 ± 0.846	145.2 ± 8.867	196.3 ± 17.68	250.2 ± 8.677	7.222 ± 1.252	8.152 ± 0.758	8.633 ± 0.356	22.73 ± 2.255	30.52 ± 0.901	28.22 ± 3.684
4. DCH-519	74.38 ± 2.748	141.3 ± 3.528	229.9 ± 16.95	250.2 ± 8.677	9.111 ± 0.588	10.04 ± 0.526	9.000 ± 0.510	20.11 ± 2.916	42.89 ± 2.940	29.67 ± 1.348
5. GCH-4	61.55 ± 2.989	139.9 ± 7.974	219.3 ± 13.00	239.3 ± 6.868	9.001 ± 0.840	9.344 ± 0.662	8.003 ± 0.333	18.55 ± 0.565	36.67 ± 1.171	25.67 ± 4.140
6. DCS-9 (Jyothi)	63.82 ± 2.196	140.9 ± 12.81	201.7 ± 14.16	246.6 ± 17.89	7.297 ± 0.042	7.911 ± 0.311	8.367 ± 0.367	18.78 ± 2.599	31.78 ± 2.257	26.56 ± 2.944
7. 48-1 (Jwala)	53.98 ± 3.756	133.7 ± 10.03	186.0 ± 4.851	230.7 ± 26.88	6.500 ± 0.500	7.059 ± 0.308	7.330 ± 0.577	18.52 ± 1.356	29.78 ± 3.530	25.52 ± 2.936
8. JC-12	31.72 ± 0.393	61.57 ± 1.433	84.21 ± 1.557	164.1 ± 5.554	5.222 ± 0.889	5.597 ± 0.441	5.487 ± 0.183	6.111 ± 0.619	15.12 ± 0.227	17.14 ± 1.111
9. Local green	41.53 ± 0.783	56.51 ± 1.342	75.47 ± 3.175	147.9 ± 13.42	3.889 ± 0.484	5.227 ± 0.138	5.443 ± 0.294	5.976 ± 0.154	12.50 ± 0.532	16.30 ± 0.591
10. Local pink	42.55 ± 1.176	71.18 ± 3.200	110.5 ± 1.534	169.4 ± 4.081	5.889 ± 0.676	5.773 ± 0.220	5.557 ± 0.113	6.555 ± 0.401	14.99 ± 0.297	21.11 ± 0.728
F-test	*	*	*	*	*	*	*	*	*	*

S.E(m) ±	2.057	6.654	10.41	12.67	0.755	0.469	0.394	1.573	2.762	2.425
S.E(d) ±	2.909	9.410	14.72	17.91	1.068	0.664	0.558	2.225	3.906	3.429
C.D. at 5%	6.111	19.77	30.92	37.63	2.243	1.394	1.172	4.674	8.205	7.204
C.V. (%)	6.723	10.88	11.20	10.44	19.74	11.85	9.675	19.78	18.50	17.71
% increase in hybrids over varieties	21.17	22.06	30.89	16.13	23.10	14.81	16.22	31.64	32.54	18.28

Sl. No. 1 to 5: Hybrids Sl. No. 6 to 10: Varieties ±: Standard Error (SE) values *: Significant at $p \leq 0.05$

75 DAS

Significant variation was observed in plant height among castor hybrids with the highest and least values were associated with DCH-177 (145.2 ± 8.867 cm) and DCH-4 (80.41 ± 2.531 cm), respectively. With regard to the varieties, maximum and minimum heights were observed with DCS-9 (140.9 ± 12.81 cm) and local green (56.51 ±1.342 cm), respectively. Further, considerable superiority was noticed with respect to this parameter for hybrids when the results were compared with those for varieties.

90 DAS

Marked variation was recorded in plant height among the castor hybrids. Among these, a great deal of superiority was found with DCH-519 (229.9 ±16.95 cm), GCH-4 (219.3 ± 13.00 cm) and DCH-177 (196.3 ± 17.68 cm). Insofar as the varieties were concerned, DCS-9 (201.7 ± 14.16 cm) and 48-1 (186.0 ± 4.851 cm) showed distinct superiority over the rest of the varieties.

105 DAS

A great deal of fluctuation in plant height was evident among the castor hybrids with the results ranging from 250.2 ± 8.677 cm (DCH-177 & DCH-519) to 195.9 ± 7.242 (DCH-4). The performance of DCH-177 and DCH-519 was identical and that of GCH-4 (239.3 ± 6.868 cm) was almost similar to these hybrids. With regard to varieties, appreciably better performance was realized with DCS-9 (246.6 ± 17.89 cm) and 48-1(230.7 ± 26.88 cm) with the remaining ones being far inferior.

No. of branches/plant

90 DAS

With respect to the number of branches/plant, castor hybrids *viz*., DCH-519 (9.111 ± 0.588) and GCH-4 (9.001 ± 0.840) exhibited marked superiority when compared with rest of the hybrids amongst which the highest one being DCH-177 (7.222 ± 1.252). Among the varieties, the values for most of them remained almost *at par* with maximum and minimum number of branches observed for DCS-9 (7.297 ± 0.042) and local green (3.889± 0.484), respectively.

105 DAS

The values for the parameter among the hybrids were distinctly greater with DCH-519 (10.04 ± 0.526), GCH-4 (9.344 ± 0.662) and DCH-177 (8.152 ± 0.758). Among the varieties, DCS-9 (7.911 ± 0.311) and 48-1 (7.059 ± 0.308) showed significantly higher performance when compared with the rest of the ones that revealed comparable values with the highest one being noticed with local pink (5.773 ± 0.220).

No. of leaves/plant

60 DAS

The number of leaves/plant was highest with DCH-519 (9.000 ± 0.510) and the values registered with DCH-177 (8.633 ± 0.356) and GCH-4 (8.003 ± 0.333) were almost comparable and significantly higher than those with DCH-177 (6.667 ± 0.511) and DCH-4 (6.113 ± 0.443). Significantly superior values were obtained for the varieties *viz*., DCS-9 (8.367 ± 0.367) and 48-1 (7.330 ± 0.577) as compared to rest of the varieties where the maximum value was scored with local pink (5.557 ± 0.113).

75 DAS

Among the hybrids, the results fluctuated from 22.73 ± 2.255 (DCH-177) to 7.000 ± 0.333 (DCH-4). The values scored for DCH-177, DCH-519 (20.11 ± 2.916) and GCH-4 (18.55 ± 0.565) were almost comparable and significantly superior as against the remaining hybrids. With regard to the varieties, comparable and significantly greater values were noticed with DCS-9 (18.78 ± 2.599) and 48-1 (18.52 ± 1.356). The results obtained for the remaining varieties were far inferior with the greatest value being 6.555 ± 0.401 (local pink).

90 DAS

With regard to hybrids, maximum and minimum values were registered by DCH-519 (42.89 ± 2.940) and DCH-4 (18.33 ± 3.746), respectively, with most values being comparable with each other. Considering the varieties, the results realized with DCS-9 (31.78 ± 2.257) and 48-1 (29.78 ± 3.530) while showing similarity were significantly greater than the other varieties showing the greatest value with JC-12 (15.12 ± 0.227).

105 DAS

Comparison of the mean values scored among hybrids indicated a great deal of similarity with the highest and least values being realized with DCH-519 (29.67 ± 1.348) and DCH-4 (21.55 ± 2.297), respectively. As far as the varieties were concerned, the performance of DCS-9 (26.56 ± 2.944) and 48-1 (25.52 ± 2.936) while being comparable was significantly superior to JC-12 (17.14 ± 1.111) and local green (16.30 ± 0.591). However, the performance of local pink (21.11 ± 0.728) falls in line with DCS-9 and 48-1.

Leaf area and leaf area index in selected castor hybrids and varieties at different days of sowing (Table 2).

Leaf area

60 DAS

A great deal of variation for this parameter was observed among both hybrids and varieties. While the hybrids showed a fluctuation from 893.3 ± 6.794 cm^2 (DCH-519) to 475.3 ± 37.33 cm^2 (DCH-4), the varieties exhibited a variation ranging from 647.2 ± 41.55 cm^2 (DCS-9) to 418.2 ± 29.09 cm^2 (local green). Comparison of mean values among the hybrids indicated a significant variation. Likewise, the results did reveal significant difference among the values.

Table 2: Leaf area and leaf area index in selected castor hybrids and varieties at different days of sowing

Hybrid / Variety	Leaf area (cm^2)				Leaf area index			
	60 Days	75 Days	90 Days	105 Days	60 Days	75 Days	90 Days	105 Days
1. DCH-4	475.3 ± 37.33	740.9 ± 37.04	1,051 ± 170.5	655.2 ± 25.61	0.059 ± 0.004	0.091 ± 0.005	0.130 ± 0.021	0.081 ± 0.003
2. DCH-117	551.3 ± 17.63	797.5 ± 59.42	958.0 ± 89.99	703.5 ± 25.87	0.068 ± 0.002	0.098 ± 0.008	0.118 ± 0.011	0.087 ± 0.003
3. DCH-177	800.0 ± 79.57	1169 ± 126.5	960.7 ± 122.0	855.6 ± 39.81	0.099 ± 0.010	0.144 ± 0.016	0.119 ± 0.015	0.106 ± 0.005
4. DCH-519	893.3 ± 6.794	1159 ± 32.99	1,026 ± 29.79	946.8 ± 108.5	0.110 ± 0.001	0.143 ± 0.004	0.127 ± 0.004	0.117 ± 0.014
5. GCH-4	608.0 ± 16.66	761.1 ± 52.18	1,006 ± 74.61	842.8 ± 45.98	0.075 ± 0.002	0.094 ± 0.007	0.124 ± 0.009	0.104 ± 0.006
6. DCS-9 (Jyothi)	647.2 ± 41.55	758.9 ± 22.61	1,007 ± 7.312	829.4 ± 107.5	0.080 ± 0.005	0.094 ± 0.003	0.124 ± 0.001	0.102 ± 0.013
7. 48-1 (Jwala)	579.1 ± 25.95	782.6 ± 101.4	972.0 ± 133.9	840.0 ± 59.05	0.072 ± 0.003	0.097 ± 0.013	0.120 ± 0.016	0.104 ± 0.007
8. JC-12	479.3 ± 1.010	614.6 ± 9.368	928.7 ± 32.67	640.3 ± 7.468	0.059 ± 0.000	0.076 ± 0.001	0.115 ± 0.004	0.079 ± 0.001
9. Local green	418.2 ± 29.09	592.3 ± 94.89	883.3 ± 24.50	612.8 ± 75.11	0.052 ± 0.004	0.073 ± 0.012	0.109 ± 0.003	0.075 ± 0.009
10. Local pink	471.1 ± 40.97	580.8 ± 15.55	901.7 ± 71.13	635.9 ± 34.89	0.058 ± 0.005	0.072 ± 0.002	0.111 ± 0.009	0.079 ± 0.004
F-test	*	*	NS	*	*	*	NS	*
S.E(m) ±	36.45	66.96	91.23	62.26	0.004	0.008	0.011	0.008
S.E(d) ±	51.55	94.69	129.0	88.04	0.006	0.012	0.016	0.011
C.D. at 5%	108.3	198.9	--	184.9	0.013	0.025	--	0.023
C.V. (%)	10.66	14.58	16.30	14.26	10.51	14.71	16.28	14.23
% increase in hybrids over varieties	22.03	28.04	6.17	11.13	21.89	27.72	6.311	11.31

Sl. No. 1 to 5: Hybrids Sl. No. 6 to 10: Varieties ± : Standard Error (SE) values *: Significant at $p \leq 0.05$

75 DAS

Maximum and minimum values for this parameter ranged from 1169 cm (DCH-177) to 740.9 ± 37.04 (DCH-4) among the hybrids and from 782.6 ± 101.4 cm^2 (48-1) to 580.8 ± 15.55 cm^2 (local pink) among varieties. Statistical analysis of the findings indicated a significant difference for both hybrids as well as varieties.

90 DAS

The results obtained for the parameter under consideration showed an upper value of 1051 ± 170.5 cm^2 (DCH-4) and a lower value of 958.0 ± 89.99 cm^2 (DCH-117) among hybrids. Analysis of the results revealed no significant variation. Similarly, comparison of the values for this parameter, ranging from 1007 ± 7.312 cm^2 (DCS-9) to 883.3 ± 24.50 cm^2 (local green), showed a non-significant fluctuation.

105 DAS

Both hybrids as well as varieties revealed a significant variation with the values ranging from 946.8 ± 108.5 cm^2 (DCH-519) to 655.2 ± 25.61 cm^2 (DCH-4) and from 840.0 ± 59.05 cm^2 (48-1) to 612.8 ± 75.11 cm^2 (local green), respectively.

Leaf area index

60 DAS

Significant difference in values for leaf area index was realized among both hybrids as well as varieties with the results varying from 0.110 ± 0.001 (DCH-519) to 0.059 ± 0.004 (DCH-4) and from 0.080 ± 0.005 (DCS-9) to 0.052 ± 0.004 (local green), respectively.

75 DAS

The maximum and minimum values among the hybrids varied between 0.144 ± 0.016 (DCH-177) and 0.094 ± 0.007 (GCH-4), respectively. Among the varieties, the highest value was scored with 0.097 ± 0.013 (48-1) and least (0.072 ± 0.002) with local pink. Analysis of the mean results among both hybrids as well as varieties indicated significant variation.

90 DAS

The comparison of the values for leaf area index, ranging from 0.130 ± 0.021 (DCH-4) to 0.118 ± 0.011 (DCH-117) for hybrids and from 0.124 ± 0.001 (DCS-9) to 0.109 ± 0.003 (local green) for varieties, exhibited a non-significant difference.

105 DAS

The value for leaf area index was highest with DCH-519 (0.117 ± 0.014) and least with DCH-4 (0.081 ± 0.003) among hybrids. The results for varieties varied between 0.104 ± 0.007 (48-1) and 0.075 ± 0.009 (local green). Analysis of the results for this parameter among the treatments revealed significant variation.

Leaf area duration and leaf and seed yields in selected castor hybrids and varieties at different days of sowing (Table 3).

Leaf area duration

75 DAS

Significant variation was observed in leaf area duration among castor hybrids with the highest and least values being recorded with DCH-519 (68.40 ± 1.123) and DCH-117 (44.96 ± 2.457), respectively. As far as the varieties were concerned, the results for maximum and minimum leaf area were observed with DCS-9 (46.87 ± 0.661) and local green (33.68 ± 3.264), respectively.

Table 3: Leaf area duration and leaf and seed yields in selected castor hybrids and varieties at different days of sowing

Hybrid / Variety	Leaf area duration			Leaf yield		Seed yield	
	75 days	90 days	105 days	kg/plant	kg/ha	kg/plant	kg/ha
1. DCH-4	40.54 ± 1.799	59.71 ± 6.084	56.85 ± 5.323	0.924 ± 0.012	11,410 ± 150.6	0.093 ± 0.001	1,148 ± 12.37
2. DCH-117	44.96 ± 2.457	58.52 ± 3.747	55.39 ± 2.665	0.990 ± 0.031	12,221 ± 386.7	0.092 ± 0.003	1,140 ± 35.15
3. DCH-177	65.62 ± 4.953	70.97 ± 6.921	60.55 ± 5.184	1.036 ± 0.002	12,786 ± 27.53	0.099 ± 0.004	1,226 ± 47.46
4. DCH-519	68.40 ± 1.123	72.83 ± 1.941	65.77 ± 2.634	1.178 ± 0.051	14,546 ± 630.5	0.110 ± 0.003	1,362 ± 40.52
5. GCH-4	45.63 ± 1.593	58.90 ± 3.358	61.62 ± 3.022	1.077 ± 0.069	13,297 ± 855.7	0.103 ± 0.006	1,267 ± 69.24
6. DCS-9 (Jyothi)	46.87 ± 0.661	58.88 ± 0.895	61.23 ± 3.819	1.096 ± 0.064	13,532 ± 794.7	0.105 ± 0.005	1,296 ± 62.14
7. 48-1 (Jwala)	45.39 ± 3.268	58.50 ± 4.712	60.41 ± 2.794	0.995 ± 0.032	12,277 ± 390.9	0.098 ± 0.004	1,214 ± 46.38
8. JC-12	36.46 ± 0.342	51.45 ± 1.383	52.30 ± 0.983	0.881 ± 0.024	10,870 ± 303.2	0.090 ± 0.003	1,111 ± 39.69
9. Local green	33.68 ± 3.264	49.19 ± 3.176	49.87 ± 1.836	0.792 ± 0.011	9,781 ± 132.8	0.049 ± 0.004	604.9 ± 51.42
10. Local pink	35.07 ± 1.165	49.42 ± 2.243	51.25 ± 2.031	0.877 ± 0.035	10,825 ± 435.8	0.050 ± 0.002	617.3 ± 28.49
F-test	*	*	*	*	*	*	*
S.E(m) ±	2.467	3.925	3.305	0.040	488.51	0.004	45.96
S.E(d) ±	3.488	5.550	4.674	0.056	690.86	0.005	64.99
C.D. at 5%	7.328	11.66	9.818	0.118	1451.3	0.011	136.5
C.V. (%)	9.235	11.55	9.951	6.959	6.9610	7.244	7.245
% increase in hybrids over varieties	25.53	16.67	5.02	10.85	10.85	21.13	21.16

Sl. No. 1 to 5: Hybrids Sl. No. 6 to 10: Varieties ±: Standard Error (SE) values *: Significant at $p \leq 0.05$

90 DAS

The results for leaf area duration exhibited significant variation among castor hybrids as well as varieties with the values ranging from 72.83 ± 1.941 (DCH-519) to 58.52 ± 3.747 (DCH-117) and from 58.88 ± 0.895 (DCS-9) to 49.19 ± 3.176 (local green), respectively.

105 DAS

Leaf area duration varied significantly among the castor hybrids with the results varying from 65.77 ± 2.634 (DCH-519) and 55.39 ± 2.665 (DCH-117). With regard to varieties, the data fluctuated between 61.23 ± 3.819 (DCS-9) and 49.87 ± 1.836 (local green) which also revealed significant difference.

Leaf yield

Significant variation was observed in leaf yield among castor hybrids with highest and least values being registered with DCH-519 hybrid (1.178 ± 0.051 kg/plant and 14,546 ± 630.5 kg/ha) and DCH-4 (0.924 ± 0.012 g and 11,410 ± 150.6 kg), respectively. Considering the varieties, maximum and minimum leaf yields were observed with DCS-9 (1.096 ± 0.064 kg/plant and 13,532 ± 794.7 kg/ha) and local green (0.792 ± 0.011 kg/plant and 9,781 ± 132.8 kg/ha), respectively, that showed significant difference.

Seed yield

Seed yield varied considerably and significantly among the castor hybrids with the data ranging from 0.110 ± 0.003 kg/plant and 1,362 ± 40.52 kg/ha (DCH-519) to 0.092 ± 0.003 kg/plant and 1,140 ± 35.15 kg/ha (DCH-117). With reference to varieties, the mean data ranged from 0.105 ± 0.005 kg/plant and 1,296 ± 62.14 kg/ha (DCS-9) to 0.049 ± 0.004 kg/plant and 604.9 ± 51.42 kg/ha (local green). Comparison of the mean values for the varieties too exhibited significant variation.

In general, when the results for growth and yield parameters of castor hybrids and varieties were compared, the performance of hybrids was found relatively superior.

4. Discussion

Altogether, five each of castor hybrids and varieties were evaluated for growth and yield parameters. A great deal of variation was observed with respect to plant height, number of branches/plant and number of leaves/plant for castor hybrids as well as varieties after attaining the growth following a definite number of days after sowing. Further, it was interesting to note that the hybrids showed superiority over varieties in respect of plant height to the tune of 21.17, 22.06, 30.89 and 16.13 % when they attained the growth at 60, 75, 90 and 105 days after sowing, respectively. The extent of improvement recorded for this parameter at 60, 75 and 105 days was comparable, while it was appreciably more at 90 days after sowing. With regard to the number of branches/plant, the increase for the hybrids over the varieties at 90 and 105 DAS was to the tune of 23.10 and 14.81%, respectively. Insofar as the per cent increase in the number of leaves/plant for hybrids was concerned at 75 and 90 DAS, it was of the order of 31.64 and 32.54%, respectively which was nearly two-fold more when compared with varieties at 60 and 105 DAS (16.22 and 18.28%). Considering the leaf area and leaf area index, the values for per cent hike for hybrids over varieties at 60, 75, 90 and 105 DAS were 22.03, 28.04, 6.17 and 11.13 % and 21.89, 27.72, 6.311 and 11.31 %, respectively. With reference to leaf area duration at 75, 90 and 105 DAS, the per cent improvement against varieties stood at 25.53, 16.67 and 5.02, respectively. From the foregoing account, it becomes evident that all the growth parameters for both hybrids and varieties increased up to 90 DAS, except for leaf area, leaf area index and leaf area duration for which the parameters showed improvement up to 75 DAS only. In the current investigation, it was observed

that per cent enhancement in the leaf and seed yields for hybrids over varieties stood at 10.85 and 21.16%, respectively.

Govindan *et al*. (2003) [7] observed a significant variation among castor hybrids/varieties with respect to plant height at different days of sowing. Among these, DCH-177 hybrid recorded higher plant height, number of leaves/plant, leaf area and leaf area index at 45, 90, 105, 120 and 135 days after sowing, respectively in comparison to local pink powdery variety. In respect of seed yield, Govindan *et al.* (2002) [6] obtained a seed yield of 742 kg/ha with SHB-649 genotype, while with genotype SKI-217 it was lowest (314 kg/ha). Among 22 castor accessions studied by Gogoi *et al*. (2005) [5], plant height ranged from 98.00 (Acc. 4) to 179.67 cm (Acc. 15) and the leaf yield/plant from 1.50 to 4.55 kg. Shifa (2011) [10] recorded that plant height, number of leaves/plant and leaf area were significantly greater among the castor genotypes with the plant height being maximum in Acc. 208624 (176.33 cm) and no variation was observed in the number of leaves/plant which varied from 32.77 (local) to 46.22 (Acc. 208624). Further, leaf and seed yields of castor genotypes were higher in Acc. 208624 (13531 and 1971.36 kg/ha), but reduced leaf yield in Bako (7567.4 kg/ha) and declined seed yield in local (732.84 kg/ha).

Castor hybrids/varieties (GCH-4, GCH-5, 48-1, DCH-519, DCH-177, DCH-32 and Jyothi) developed by the Directorate of Oil Seeds Research, Hyderabad, were evaluated by Sarmah and Sarkar (2013) [9] for growth and eri silkworm rearing characters in comparison with local variety (NBR-1). Apart from seed production, it is recommended by these authors that these hybrids/varieties can be effectively utilized for eri silkworm rearing as they have enormous potential to generate additional income in both traditional and non-traditional states of India through production of leaf.

In the current investigation, though castor hybrids/varieties under consideration showed considerable variations in the growth and yield parameters, DCH-519 hybrid stood out to be superior in terms of leaf and seed yields. It is, therefore, obvious that this hybrid can be effectively exploited for seed production as also for rearing of eri silkworm for boosting the income level of farmers.

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