



A high yielding and wilt resistant castor (*Ricinus communis*) hybrid for India

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ABSTRACT

The breeding efforts were made at Sardarkrushinagar (Gujarat) during 2006-07 to 2015-16 for development of castor (*Ricinus communis*) hybrid suitable for irrigated and rainfed condition. The castor hybrid GCH 8 (SHB 896) was evaluated in IVHT, AVHT-I and AVHT-II (irrigated and rainfed) along with checks, viz. DCH 177, DCH 519 and GCH 7 at different AICRP (castor) locations during 2013-14 to 2015-16. The hybrid GCH 8 (SHB 896) exhibited wider adaptability and consistent superiority in seed yield and oil yield under irrigated as well as rainfed conditions over checks during the years of evaluation. On the basis of weighted mean, GCH 8 yielded 18.95 q/ha and 35.88 q/ha over checks, viz. DCH 177, DCH 519, and GCH 7 to the tune of 16.03, 14.02, and 13.01 % & 16.19, 17.64 and 16.57 % higher under rainfed and irrigated condition, respectively. This hybrid also recorded 48.30 % and 48.60 % oil content in seed with extract on an average 9.15 q/ha and 16.37 q/ha oil yield under rainfed and irrigated condition, respectively. This hybrid has profuse branching, tolerance to lodging and resistant to shattering. It was resistant against major diseases like wilt and root rot and showed at par as well as somewhat less attack of major insect pests of castor like semilooper, *Spodoptera*, leaf hopper, white fly, capsule borer and thrips.

Key words: Castor, GCH 8, Oil yield, Seed yield, Wilt

Castor (*Ricinus communis*) is an important non-edible oil seed crop of the arid and semi-arid region of the world. India in general and Gujarat in particular holds top rank not only in the production and productivity but also in oil export. The total world production of castor seeds was 19.48 lakh tonnes during 2014-15 with an area of 14.48 lakh ha and a productivity of 1346 kg/ha (Anonymous 2015). During the year 2016-17, the area under this crop in India was 8.07 lakh ha with 13.76 lakh tonnes of production and an average productivity of 1704 kg/ha (Anonymous 2017). Gujarat is the leading castor growing state in India having maximum area (5.50 lakh ha.) and production (11.73 lakh tones) and average productivity of 2133 kg/ha in 2018-19 (Anonymous 2018). Gujarat state contributes more than 84 % of the castor production from about 68 % of the castor growing area of the country. All type of castor have the same number of chromosome ($2n = 20$). Many morphotypes of castor are recorded in wild that have unique traits of adaptation to the particular ecology, viz. variations in stem and leaf colour and pigmentation, bloom, branching habit, flowering, fruiting, seed etc. beside quality (Anjani and Jain 2004).

Castor is cultivated intensively in arid and semi-arid

region of Gujarat state. Because of intensive cultivation, castor wilt disease has become a bottle neck problem in castor production in Gujarat state. Hence, there was a need to develop high yielding, wilt resistant hybrid for castor growing area of Gujarat as well as for India. Keeping this objective in view, the efforts were made for screening pistillate lines and inbred male pollinators against wilt disease. The hybrid GCH 8 (SHB 896) developed by crossing resistant pistillate line JP 96 and male line DCS 89. It was found promising and resistant to wilt and tolerant to root rot along with higher seed yield.

MATERIALS AND METHODS

The breeding efforts were initiated from 2006-07 to 2015-16 at Castor-Mustard Research Station, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar (Gujarat) with a view to develop improved castor hybrid with high yielding, high oil content and resistant to wilt and tolerant to root rot disease under rainfed and irrigated area of the country. The crosses were attempted between wilt resistant pistillate line, JP 96 and male line DCS 89. The hybrid was tested for nine years (1 year station trial + 5 year state trial + 3 year AICRP trials). As a result, the hybrid GCH 8 was identified and evaluated for its potentiality in comparison to check GCH 7 at 16 locations of Gujarat under state trials (09 locations of Large

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Scale Varietal Hybrid Trial, 03 locations of Small Scale Varietal Hybrid Trial as well as 04 locations in Preliminary Hybrid Trial/Preliminary Yield Trial.) during 2006-07 to 2011-12. In AICRP (castor) trials, this hybrid was evaluated in 53 locations (19 locations of IVHT including 10 rainfed and 09 irrigated and 34 locations of AVHT I & II including 17 locations for irrigated and 17 locations for rainfed conditions) along with checks, viz. DCH 177, DCH 519 and GCH 7 during 2013-14 to 2015-16. The recommended packages of practices were followed to raise castor crop for conducting the trials. The data were analyzed by methods developed by Panse and Sukhatme (1985).

RESULTS AND DISCUSSION

Seed yield: Under rainfed condition, the yield performance of the hybrid GCH 8 in AICRP trials from 2013-14 to 2015-16, on the basis of weighted mean performance it yielded 18.95 q/ha, which was higher over the checks, viz. DCH 177, DCH 519, and GCH 7 to the magnitude of 16.03, 14.02, and 13.01 %, respectively (Table 1). During 2013-14 to 2015-16 the hybrid evaluated at different 27 AICRP locations and GCH 8 secured top position at 15 locations. Similarly under irrigated condition, the performance of hybrid GCH 8 in AICRP trials from 2013-14 to 2015-16 on the basis of weighted mean hybrid yielded 35.88 q/ha, which was 16.19, 17.64 and 16.57 % higher than the checks, viz. DCH 177, DCH 519, and GCH 7, respectively. These results are in close conformity with the findings of Chaudhary *et al.* (2015) and Sapovadiya *et al.* (2015). During 2013-14 to 2015-16, GCH 8 was evaluated at 24 locations under AICRP trials and secured top position at 18 locations.

Oil content and oil yield: The mean oil content of GCH

8 was recorded by 48.30 % under rainfed condition and the per cent increment over checks, viz. DCH 177, DCH 519 and GCH 7 was 3.21, 4.09 and 1.90 %, respectively (Table 1). The mean oil content was recorded 48.60 % which was 1.67, 4.29 and 3.18 % higher as compared to checks, viz. DCH 177, DCH 519 and GCH 7, respectively under irrigated condition. The oil yield performance of GCH 8 under rainfed condition yielded 9.15 q/ha which was 12.41, 12.68 and 9.06 % higher over checks, viz. DCH 177, DCH 519 and GCH 7, respectively based on weighted mean. Simultaneously, GCH 8 produced 16.37 q/ha oil yield with the margin of 24.96, 25.92 and 23.64% higher over checks, viz. DCH 177, DCH 519 and GCH 7, respectively under irrigated condition.

Pest and disease: Major insect-pest and diseases occurs in castor are semilooper, *Spodoptera*, leaf hopper, white fly, capsule borer, thrips, wilt, root rot and *Botriyotinia* gray mold. GCH 8 performed at par as well as somewhat less attack of major insect-pests as compared to the checks (Table 2). GCH 8 exhibited resistant reaction (≤ 20 % disease incidence) against wilt and root rot under irrigated condition and moderately resistant reaction (20-40 % disease incidence) to wilt under rainfed condition (Table 2). *Botriyotinia* gray mold severity was at par as well as somewhat less as compared to the checks.

DNA profiling: DNA profiling or fingerprinting and molecular characterization of the parents and hybrids is mandatory for commercialization. Therefore, DNA profiling was carried out for castor hybrid and parental lines using SSR markers. Young leaf samples were collected and DNA was isolated using CTAB method. PCR reaction and thermal cycler conditions are presented in Table 3. Forty SSR markers were tested in parental lines along with hybrid.

Table 1 Seed yield, oil content and oil yield of castor in coordinated hybrids trials under rainfed and irrigated conditions

Year of testing	No. of trials		Hybrid GCH 8		Check: DCH 177		Check: DCH 519		Check: GCH 7	
	Rainfed	Irrigated	Rainfed	Irrigated	Rainfed	Irrigated	Rainfed	Irrigated	Rainfed	Irrigated
<i>Seed yield (q/ha)</i>										
2013-14	10	07	22.17	44.48	17.58	35.09	20.01	33.25	19.11	33.98
2014-15	08	08	17.09	32.88	15.30	30.47	14.90	29.95	16.48	28.95
2015-16	09	09	17.02	31.86	15.98	27.98	16.95	28.86	16.99	29.93
	Weighted mean		18.95	35.88	16.37	30.88	17.48	30.50	17.62	30.78
	Frequency in the top group		15/27	18/24	10/27	10/24	7/27	7/24	10/27	5/24
<i>Oil content (%)</i>										
2013-14	05	04	50.4	48.6	48.5	48.1	47.6	46.2	49.2	45.5
2014-15	06	05	47.1	47.0	45.2	46.6	45.0	45.4	45.8	46.1
2015-16	04	07	47.3	49.8	47.1	48.4	46.9	47.7	47.6	48.8
	Weighted mean		48.3	48.6	46.8	47.8	46.4	46.6	47.4	47.1
<i>Oil yield (q/ha)</i>										
2013-14	05	04	12.60	18.25	10.02	13.48	10.78	12.34	10.67	11.58
2014-15	06	05	8.35	14.91	7.29	12.68	7.08	12.14	7.82	12.28
2015-16	04	07	6.03	16.33	7.08	13.19	6.36	13.98	6.39	14.88
	Weighted mean		9.15	16.37	8.14	13.10	8.12	13.00	8.39	13.24

Table 2 Reaction to insect-pests and diseases in coordinated trials during 2013-14 to 2015-16.

Name of insect-pests and diseases	Name of AICRP center	Hybrid GCH 8	Check DCH 177	Check DCH 519	Check GCH 7	Susceptible check JI 35	Resistant check 48-1
Capsule damage (%)	Yethapur	6.6	6.8	6.5	3.3	-	-
Leaf hoppers/3 leaves/plant	S K Nagar, Yethapur & Palem	15.9	19.2	16.5	14.9	-	-
Whitefly adult /plant	S K Nagar,	6.2	3.1	5.6	1.8	-	-
Hairy caterpillars/plant	Yethapur & Palem	0.8	0.4	1.4	0.6	-	-
Spodoptera/plant	Yethapur & Palem	2.5	2.6	1.4	2.2	-	-
Semilooper/plant	Yethapur & Palem	1.9	1.4	2.4	2.3	-	-
Thrips/top leaf	S K Nagar, Yethapur	6.4	6.0	6.7	6.4	-	-
Wilt incidence (%) under irrigated	S K Nagar	18.4	42.4	17.0	7.9	99.3	0.0
Wilt incidence (%) under rainfed	IIR	29.1	33.1	17.7	22.9	100.0	1.27
Root rot incidence (%)	Junagadh	16.9	26.3	19.7	33.7	51.1	25.2
<i>Botryotinia</i> Gray mold severity (%)	IIR, Yethapur & Palem	56.4	56.6	62.4	58.0	-	-

Table 3 PCR reaction mix, thermal cycler conditions and primer details

<i>PCR reaction mix</i>		
Components for 20 µl	Required stock concentration	Final concentration/reaction
10 × PCR buffer	2.0 µl	1×
dNTPs (10mM)	0.4 µl	200 µM
Primers (0.5pmol)	0.5 µl	5.0 pmol
Taq DNA Polymerase (3U/ul)	0.15 µl	0.45 unit
DNA (100 ng/ul)	0.5 µl	50 ng
Sterile water	16.45 µl	Water for final volume 20 µl
<i>Thermal cycler conditions</i>		
<i>Thermal cycler conditions</i>	<i>Time in minutes</i>	<i>Number of cycles</i>
94 °C	4.00	35
94 °C	1.00	35 repeat
55 °C	0.30	35
72 °C	0.30	1 (Final Extension)
72 °C	7.00	
4 °C	Infinite	
<i>Details of primers</i>		
<i>Name of loci</i>	<i>Primer (F)</i>	<i>Primer (R)</i>
Castor_SSR_32	CATCATGGAGGCATTGCTA	CCAATAAGACCTTTTGCAACC
Castor_SSR_33	CAGAGCCCATGGTGATTCT	CCACAAAAAGCAGCCAAATC

Out of 40 loci, two were polymorphic (castor 32 and castor 33) between parental lines and two bands were obtained in hybrid GCH 8.

Gujarat state varietal release committee released the castor hybrid SHB 896 as GCH 8 (Gujarat Castor Hybrid 8) for large scale commercial cultivation in castor growing area on the basis of its consistent superior yield performance, resistant to wilt disease and tolerance to root rot disease and insect pests, suitable for irrigated as well as rainfed conditions. GCH 8 has been registered (IC No. 0622891) and conserved under long term storage at NBPGR, New

Delhi. GCH 8 has been notified for cultivation in all castor growing states of the country in the Gazette of India, Ministry of Agriculture (Department of agricultural and Co-operation), New Delhi, after consultation with Central Sub-Committee on Crop Standards, Notification and Release of Varieties for Agricultural Crops, ICAR, Krishi Bhavan, New Delhi, wide the Notification number S.O. 1379(E), dated 27th March, 2018.

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