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ANDCP 1601: A Pistillate Line of Castor (*Ricinnus communis* L.) with Unique Morphological Characters and Resistant to Wilt (*Fusarium oxysporum* f.sp. ricini)

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ABSTRACT: Castor (*Ricinus communis* L.) is an annual or perennial flowering non-edible versatile oilseed species of Euphorbiaceae family having sexually polymorphic species with unisexual flowers, either male or female mostly arranged as monoecious and occasionally pistillate spike. Three types of pistillate mechanism are present in the castor i.e. N, S and NES types. These mechanisms are utilized for the development of new pistillate lines in castor. The development of a new pistillate line in castor is a highly tedious and changeable job. ANDCP 1601 is a new NES type pistillate line that was identified from the segregating population of cross between ANDCP 06-07 × ACP 1-06-07 during 2008-09 at Regional Research Station, AAU, Anand. The pistillate line evaluation trial was conducted at two locations *viz*., Anand and Derol during kharif 2021-22 and 2022-23. Seed yield of ANDCP 1601 was found 11.23 and 18.78 per cent higher than SKP 84 during 2021-22 and 2022-23, respectively. The proposed line has distinct morphological characters *viz*., green stem color, triple bloom, long peduncle, semi compact spike with spiny capsule, early maturing and late revertant type. At RRS, AAU, Anand tested under wilt screening plot against the wilt susceptible check i.e. JI 35 and it is found highly resistant reaction against wilt. Therefore, the newly developed promising pistillate line ANDCP 1601 can be effectively utilized in hybrid breeding program for developing high yielding, green stem hybrid in castor.

Keywords: ANDCP 1601, pistillate line, castor, morphological, Wilt.

INTRODUCTION

Castor (*Ricinus communis* L.) is an annual or perennial flowering non-edible versatile oilseed species of Euphorbiaceae family having sexually polymorphic species with unisexual flowers, either male or female mostly arranged as monoecious and occasionally pistillate spike (Patel *et al*., 2013). It is a fast-growing monotypic C_3 plant having 10 diploid set of chromosomes (Perry, 1943; Aher *et al*., 2017; Papazoglou *et al.*, 2020). Castor is domesticated 3200 years ago from Ethiopian center of origin as a non-edible vegetable oil seed crop (Patel *et al*., 2012a; Patel *et al*., 2012b; Xu *et al*., 2021). Castor oil has a unique fatty acid named "Ricinoleic acid" which has anti-inflammatory effects (Weiss, 1971; Vieira *et al*., 2000). In Asian continent, India is the largest producer and exporter of castor seed and in India, its cultivation mainly in the state *viz*., Gujarat, Andhra Pradesh, and Rajasthan. Hybrids have more yield potential than varieties. The mechanism of pistillate can be commercially exploit for hybrid seed production in castor.

Castor (*Ricinus communis* L., 2n = 2x = 20) is an industrially important non-edible oilseed crop widely cultivated in the arid and semi-arid regions of the world. Castor is a sexually polymorphic species with different sex forms *viz*., monoecious, pistillate, hermaphrodite and pistillate with interspersed staminate flowers (Delvadiya *et al.*, 2021; Reddy *et al.*, 2022). Three types of pistillate mechanism are present in the castor i.e., N, S and NES types. These mechanisms are utilized for the development of new pistillate lines in castor. The N types is governed by homozygous recessive sex switching gene and maintained by sib matting, S type pistillate line was obtained by selection within sex reversals at the Weizmann Institute, Israel and governed by dominant and epistatic effects (Shifriss, 1960) which is maintained by mating between pistillate & monoecious plant. NES type is a combination of both N and S type as it carries the homozygous recessive gene for pistillateness and environment sensitive genes for ISF (Kulkarni and Ankineedu 1966) and this type of pistillate line maintained by ISF. For Pistillate maintenance carried out by conventional as well as modified method.

MATERIAL AND METHODS

The present efforts are made at Regional Research Station, Anand Agricultural University, Anand. The trial was sown with three replications at 120 × 60 cm spacing with plot size 12.0 × 6.0 m at two locations *viz*., RRS, AAU, Anand and ARS, AAU, Derol (PMS) during kharif 2021-22 & 2022-23 for yield evaluation and three years for wilt screening purpose in wilt sick plot at RRS, AAU, Anand along with wilt susceptible check i.e., JI 35. The morphological and quantitative data were collected from each replication for seed yield,

days to flowering, days to maturity, plant height (cm), number of nodes per plant, number of effective racemes per plant, effective length of primary raceme (cm), number of capsules on primary raceme, 100 seed weight (g), wilt reaction (%).

RESULTS AND DISCUSSION

The present efforts are made at Regional Research Station, Anand Agricultural University, Anand for development of pistillate line from NES source led to identification of the genetic stock ANDCP 1601 from the segregating population of the cross between pistillate × pistillate i.e. ANDCP 06-07 × ACP 1-06-07 during 2008-09 (Aher *et al.*, 2015). The pistillate line evaluation trial was conducted at two locations *viz*., RRS, AAU, Anand and ARS, AAU, Derol (PMS) during kharif 2021-22 and 2022-23. ANDCP 1601 was compared with the most popular pistillate line SKP 84. Seed yield of ANDCP 1601 was found 11.23 and 18.78 per cent higher than SKP 84 during 2021-22 and 2022-23, respectively (Table 1 and 2). Pistillate line SKP 84 was late maturing one as compared to ANDCP 16-01 and SKP 84 was not a good general combiner in respect to earliness (Patel *et al.*, 2012a). Morphophysiological observations (Fig. 1 and 2) were taken as per Table 3-6. The proposed line has distinct morphological characters *viz*., green stem color, triple bloom, long peduncle, semi compact spike with spiny capsule, early maturing and late revertant type (Table 7). The pistillate ANDCP 1601 were also tested for reaction against Fusarium wilt (*Fusarium oxysporum* f.sp. ricini) in wilt screening plot at Regional Research Station, Anand Agricultural University, Anand during year 2019-20 to 2021-22 against the wilt susceptible check i.e JI 35 and it is found highly resistant reaction against wilt (Table 8). This line is early maturing as well as late reverent so this can be helpful in maintaining genetic purity of hybrid seeds as well as produce higher quantity of commercial hybrid seed. In future, the newly developed promising pistillate line can be effectively utilized in hybrid breeding program for developing high yielding, green stem hybrid in castor.

Table 1: Seed yield (g/plant) and ancillary observations of Anand and Derol center (2021-22).

Sr. No.	Name of Entry	Anand (g/plant)	% inc. over SKP 84	Derol (g/plant)	% inc. over SKP 84	Pooled (g/plant)	% inc. over SKP 84
1.	ANDCP 1601	170	6.92	245	14.49	208	11.23
2.	SKP 84	159	-	214	-	187	-

Table 2: Seed yield (g/plant) and ancillary observations of Anand and Derol center (2022-23).

Sr. No.	Name of Entry	Anand (g/plant)	% inc. over SKP 84	Derol (g/plant)	% inc. over SKP 84	Pooled (g/plant)	% inc. over SKP 84
1.	ANDCP 1601	167	14.38	224	22.40	196	18.78
2.	SKP 84	146	-	183	-	165	-

Table 3: Seed yield (g/plant) and ancillary observations of Anand center (2021-22).

Sr. No.	Name of Entry	SY (g/plant)	DF	DM	PH	NNP	NERP	ELPR	NCPR	SW	WR
1.	ANDCP 1601	170	60	108	43	18	19.3	74.1	69.2	30.7	R
2.	SKP 84	159	68	120	59	22	12.9	75.7	72.0	29.2	R

Table 4: Seed yield (g/plant) and ancillary observations of Anand center (2022-23).

Sr. No.	Name of Entry	SY (g/plant)	DF	DM	PH	NNP	NERP	ELPR	NCPR	SW	WR
1.	ANDCP 1601	167	64	109	71	17	12.8	83.1	97	30.4	R
2.	SKP 84	146	69	124	75	18	8.7	89.9	108	28.9	R

Table 5: Seed yield (g/plant) and ancillary observations of Derol center (2021-22).

Sr. No.	Name of Entry	SY (g/plant)	DF	DM	PH	NNP	NERP	ELPR	NCPR	SW	WR
1.	ANDCP 1601	245	54	92	49	20	11.8	68.5	64.2	30.8	R
2.	SKP 84	214	63	110	58	20	10.1	66.9	61.8	29.2	R

Table 6: Seed yield (g/plant) and ancillary observations of Derol center (2022-23).

Sr. No.	Name of Entry	SY (g/plant)	DF	DM	PH	NNP	NERP	ELPR	NCPR	SW	WR
1.	ANDCP 1601	224	54	92	46	19	10.9	79.4	65	31.1	R
2.	SKP 84	183	65	111	46	18	9.1	75.1	61	29.5	R

Note: SY=seed yield, DF=Days to flowering, DM=days to maturity, PH=plant height (cm), NNP= number of nodes per plant, NERP= number of effective racemes per plant, ELPR= Effective length of primary raceme (cm), NCPR=Number of capsules on primary raceme, SW= 100 Seed weight (g), WR=Wilt reaction (%)

Table 7: DUS characters and chief morphological traits of ANDCP 16-01.

Sr. No.	Characters	ANDCP 16-01
1.	Hypocotyl: Anthocynin pigmentation	Present
2.	Leaf: Anthocynin pigmentation of young emerging leaves	Absent
3.	Leaf: Waxi bloom on upper side	**Present**
4.	Leaf: Waxi bloom on lower side	**Present**
5.	Steam: Waxi bloom	**Present**
6.	Stem: Colour (after removal of bloom)	**Green**
7.	Stem: Types of internodes	**Condensed**
8.	Leaf: Length of 4th leaf from top (cm)	Short
9.	Plant: Time of 50 % flowering (days)	**Medium (60 days)**
10.	Stem: Number of nodes on main stem	**Medium (16-18)**
11.	Leaf: Shape	Deep Cup
12.	Leaf: Number of lobes	Few (8-9 lobe)
13.	Leaf: Lascination	Shallow
14.	Petiole: Length (cm)	Medium (29 cm)
15.	Petiole: Surface	Smooth
16.	Inflorescence: Types of flowers on primary spike	**Pistillate**
17.	Inflorescence: Spike shape	**Cylindrical**
18.	Inflorescence: Spike compactness	**Semi compact**
19.	Inflorescence: Length of primary spike (cm)	**Very long (74.07 cm)**
20.	Capsule: Spininess	**Dense**
21.	Capsule: Length (cm) (central part of the spike)	Short
22.	Plant: Location of branches	**Basal/all over**
23.	Plant: Branching pattern	**Convergent**
24.	Plant: Height up to the base of primary spike (cm)	**Medium (42.80 cm)**
25.	Seed: Weight of 100 seeds (g)	**High (30.67)**
26.	Seed: Shape	**Oval**
27.	Seed: Coat colour	**Light brown**
28.	Seed: Mottling	Low
29.	Seed: Caruncle	Small
30.	Seed: Oil content (%)	**Medium (46.50)**

Table 8: Reaction of Fusarium wilt (*Fusarium oxysporum* f.sp. ricini) in ANDCP 1601 against susceptible check JI 35 in wilt sick plot.

Year of screening	Wilt incidence in ANDCP 16-01 (%)	Wilt incidence in susceptiblecheck JI 35 (%)
2019-20	0	100
2020-21	5	100
2021-22	0	100
2022-23	0	100

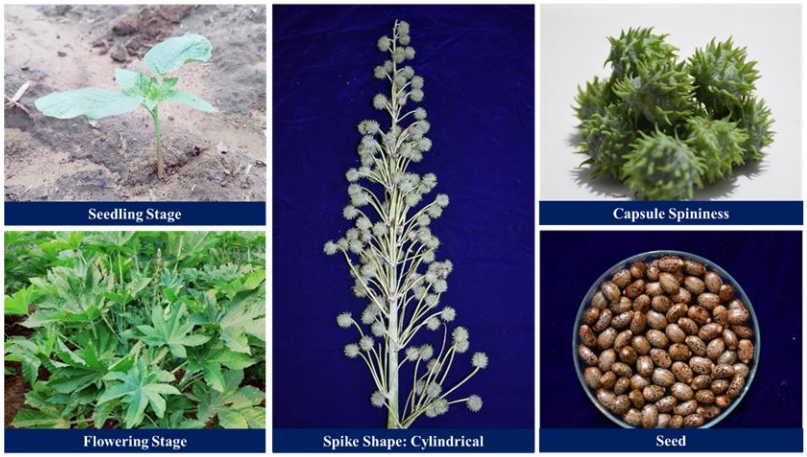

Fig. 1. Distinct morphological features of pistillate line ANDCP 1601.

Fig. 2. Comparative performance of ANDCP 1601 with susceptible check JI 35 for wilt resistance under Wilt Sick.

Fig. 3. Field view of castor pistillate line ANDCP 1601.

CONCLUSIONS

The newly developed line ANDCP 1601 is having NES type pistillate mechanism with distinct morphological characters like green stem, triple bloom, semi compact spike, early maturing, late revertant and highly wilt resistant reaction.

FUTURE SCOPE

The newly developed line ANDCP 1601 can be utilized as a NES type late revertant pistillate line for development of green stem segment hybrid, which is highly demanded by farming community. Due to late revertant type, hybrid seed production became more convenient in comparison to the existing NES type pistillate lines.

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Conflict of Interest. None.

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