Purple-coloured castor (*Ricinus communis* L.) – A rare multiple resistant morphotype

The genus *Ricinus* is monospecific, but its evolution under natural selection in a wide range of agro-climatic areas has resulted in numerous wild and semi-wild types with wide genotypic and phenotypic diversity. India is one of the centers of origin. Castor (*Ricinus communis* L.) plants either with green, red or purple-coloured stem, green leaves, green or red capsules are common. However, for the first time, two purple-coloured morphotype castor germplasm accessions namely, RG 1930 and RG 2008 were discovered in Assam and Manipur during exploration for castor germplasm in northeastern states[1]. The characteristic feature of this type is that the entire plant, including stem, leaves, leaf stalk, peduncle, pedicle, flowers, capsules and spines, are purple in colour (Figures 1 and 2). Purple-coloured morphotype is a rare and localized variant. RG 1930 and RG 2008 were growing wild at their collecting sites.

The purple-coloured morphotypes were characterized for distinctness, uniformity and stability testing (Table 1). RG 2008 matured earlier than RG 1930 and possessed high oil content (50%). Wilt caused by *Fusarium oxysporum* f.sp *ricini* is the most important soil and seed-borne disease of castor in India. It causes yield loss to the extent of 60–70%. To understand the reaction of purple colour accessions against wilt, RG 1930 and RG 2008 were planted in wilt sick plot in eight rows each with 45×95 cm spacing. Each row was of 5 m length. One row of susceptible check variety Aruna was planted after every two rows of accessions. Inoculum load in the wilt sick plot was 2046-3023 CFU g^{-1} soil. Disease incidence (number of infected plants) was monitored periodically at 30 days interval up to 150 days after planting. RG 1930 and RG 2008 showed stable resistance to wilt (< 20% wilt incidence) in wilt sick plot in all the years.

Serpentine leafminer, *Liriomyza trifolii* (Burgess) larvae cause extensive damage to leaf mesophyll tissues, which turn parchment white and lose photosynthetic activity[2]. RG 1930 and RG 2008 were screened against serpentine leafminer under heavy infestation for five years (1999–2003) at the Directorate. Both the accessions showed high stable resistance to leafminer. Number of mines/leaf and per cent infested leaves/plant (3 plants/entry) were used as criteria for evaluating the accessions. Leaf infestation was 0% and number of larval mines/plant was zero in these accessions in the first crucial plant growth period of 40 days after sowing, whereas in susceptible checks the infestation was 52–71% and larval mines/leaf were 52–74. The incidence continued to be low on the purple colour morphotypes (2–4 mines/leaf) even at 85 days after sowing while the susceptible checks were heavily infested (74–88%) with larval mines ranging from 65 to 108 mines/leaf. Two–three fold higher total phenol content was recorded in the leaves of RG 1930 and RG 2008 compared to the most susceptible check, Sowbhagya[3].

So far these are the lone and the first reported sources of multiple resistance to *Fusarium* wilt and leafminer in castor. No effective controlling measures are available to control wilt and leafminer; breeding of resistant cultivars by introgressing resistant genes from the resistant sources is the only effective way to control them. The purple colour of the plant did not dilute, as it grew older. Expressivity of purple

Figure 1. Purple colour castor morphotype.

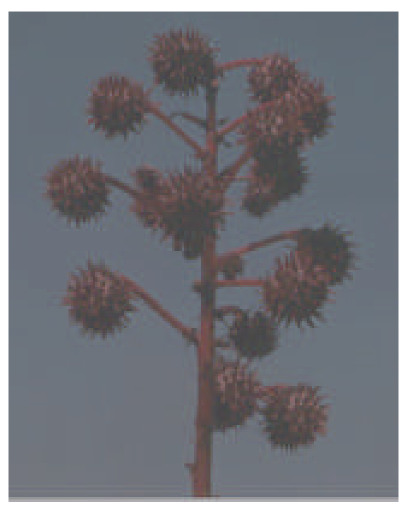

Figure 2. Purple raceme where peduncle, pedicle, capsules and spines on capsules are purple in colour.

Table 1. Morphological description of purple colour accessions

Descriptors	RG 2008	RG 1930
Stem colour and bloom	Purple, zero bloom	Purple, zero bloom
Number of nodes on main stem	12	16
Plant height (cm)	38	56
Leaf shape	Semi-cup	Flat
Leaf colour	Purple	Purple
Primary raceme length (cm)	32	18
Shape and compactness of raceme	Conical, loose	Umbrella, loose
Capsule colour and nature	Purple, spiny	Purple, spiny
Seed shape	Oval	Oval
Seed colour	Dark brown	Brown
Mottling on seed coat	Conspicuous	Less conspicuous
100-seed weight (g)	8	13
Days to 50% flowering	40	47
Days to 50% maturity	105	117
Seed yield (g/plant)	48	30
Oil content (%)	50	45

colour was uniform in all the progenies. The inheritance studies being conducted at the Directorate showed that this character is easily heritable. The hybrid between purple colour type female and other colour type male was purple while when the purple-coloured morphotype was a male parent the F_1 was intermediate. This indicates that this morphotype could also be used as a genetic marker in hybrid development programme. As purple-coloured castor looks ornamental and attractive, it could also be promoted as an ornamental plant.

Mahalanobis's D^2-statistics and canonical analysis[4] were used to assess the magnitude of divergence between the purple colour accessions along with other 89 castor accessions collected from north-eastern India. The analysis of dispersion for the test of significance of differences in the mean values based on Wilk's criterion[5] revealed highly significant differences between the genotypes ($v = 961$) for the aggregation of eight characters studied. Interestingly the two purple-coloured genotypes were placed in two diverse clusters, RG 1930 in cluster II and RG 2008 in cluster VI. The highest intra-cluster distance (5.1) between cluster II and VI indicates high genetic divergence between these two accessions. These purple-coloured morphotypes could serve as diverse resistant sources for leafminer and wilt disease with a distinct genetic marker, in castor improvement programmes in order to breed diverse resistant breeding cultivars.

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Identification of hybrids in black pepper (*Piper nigrum* L.) using male parent-specific RAPD markers

Black pepper (*Piper nigrum* L.) ($2n = 52$) belongs to the family Piperaceae, and is one of the oldest and most widely used spices in the world. Having originated in the humid, tropical evergreen forest of the Western Ghats in India, it has characteristic pungency and flavour. It is an important ingredient in cooking and has medicinal properties. India is a major producer, consumer and exporter of black pepper in the world. Over 1000 species are reported in genus *Piper* among which about 110 are of Indian origin[1].

The development of improved cultivars through hybridization has made a major contribution to increased productivity and quality of plants in different crop plants. Hybridization of genetically different parents is followed for hybrid cultivar (F1) development and molecular marker techniques are often used for fastening plant improvement[2].

Majority of the black pepper fields are now cultivated with land races or with the most popular hybrid variety, 'Panniyur-1'. Most of the varieties released for cultivation are clonal selections from the existing land races. F_1 hybrids with new gene combinations will probably replace the traditional low-yielding senile plants in a cultivators' gardens in the near future, but will depend on many factors, including availability of tools to speed up the improvement programmes. One of the problems faced by pepper breeders is the difficulty in identifying true hybrids from the crossed progenies before planting. The traditional method of hybrid identification based on morphological characters is influenced by environmental factors and frequently lacks the resolving power to identify hybrids at the juvenile stage. Therefore, black pepper plants are to be grown to maturity (i.e. 3 to 4 years) to confirm hybridity. A reliable method for identification of hybrid pepper at the early stage of the plants is thus essential. Molecular markers used to detect DNA polymorphism are the most direct answer to the problem. Sasikumar *et al*.[3] reported the use of isozyme technology in the identification of two interspecific hybrids of *Piper*. However, the level of polymorphism obtained using isozymes is often insufficient to distinguish cultivars[4]. Markers like RFLP have been used in other crops for marker-assisted selection and to guide the introgression of target genes from related species during the past several years[5]. However, RFLP is labour-intensive and costly.