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Variability of morphological characters in the hybrid progenies of dragon fruit

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Abstract
The Morphological variability in 210 hybrid progenies of dragon fruit (*Hylocereus* sp.) from Red and White cultivars of dragon fruit. The study aimed to assess the range of variability for the different morphological characters in hybrid progenies. The characters recorded were: days taken for vegetative bud formation, number of primary branches, number of secondary branches, distance between the areoles and spines per areole. The existence of continuous and overlapping variation for all the characters indicates the quantitative nature for all the studied morphological characters. The results revealed that the F_1 clones for yield and other attributes would provide a large gene pool for the recombination to generate the promising variety of considerable value.

Keywords: Dragon fruit, hybridization, morphology, variability

Introduction
Dragon fruit (*Hylocereus undatus* (Haw.) is a perennial, climbing vine attained its popularity for due to its ornamental purpose then as fruit crops across worldwide. Dragon fruit belongs to cactaceae family. Its flower is most beautiful in the cactaceae family with bright red skin stubbed with green scales and white or red flesh with tiny black seeds distributed across the flesh of the dragon fruit are edible and nutritious (Mizrahi *et al*., 1997) [7]. Owing to its beautiful flower, it is nicknamed as "Queen of the night" or "Noblewoman". Fruit contains juicy flesh which is very delicious in taste. Dragon fruit offers the very least amount of calories but full of several health benefits when consumed in moderate amount. It has been estimated that 100-gram of white-fleshed dragon fruit gives an average 21 milligrams of vitamin C, which is equivalent to 34% of the daily value (DV) (Yen, 2002) [10].
The biological diversity of *Hylocereus* is little known, even those types cultivated in home gardens and recently initiated plantations. Only in Nicaragua have some materials been selected, the most frequently cultivated in that country (Maltez, 1994) [6]. In México, studies are incipient (Grimaldo, 2001) [2]. In different species the causes of the reduced number of fruits produced relative to the total number of flowers developed have been studied (Ganders, 1976; Sutherland, 1986; Weiss *et al*., 1994; Lichtenzveig *et al*., 2000) [1, 8, 9, 5]. In pitahaya the main cause is sexual self-incompatibility (Weiss *et al*., 1994; Lichtenzveig *et al*., 2000) [9, 5]. The objective of this study was to evaluate the diversity of pitahaya F_1 progenies through the morphological characterization and study of aspects related to the production of fruits, in order to begin selection of the most promising varieties and their future cultivation in the region.

Material and Methods
The investigation was conducted in the Central Horticultural Experimental Station, Hirehalli, Karnataka, India (Latitude: 28◦38′ N, Longitude: 77◦11′ E and Altitude: 845 m above mean sea level). The progenies under examination were created manually through inter and intra specific cross-pollination. carried out manually in 2022. Crossing was carried between red and white cultivars, the treatments were; 1. MK-W X C-W (D 22 /10) 2. C-W X KK-R (D 22 /11) 3. A-R X H-R (D 22/ 12) 4. R-A X R-K (D 22/ 13) 5. R-A X R-KK (D 22 /14) 6. R-H X R-K (D 22 15) 7. R-H X W-H (D 22 16). The denomination in brackets denotes the crop, the year of hybridization carried and accession number.

Raising of F_1 population

The crossed fruits were harvested from the plant when they attain full maturity. Seeds were extracted manually by crushing the pulp between the fingers. Extracted seeds were immersed in water immediately. Floating seeds were discarded, while those that sunk were used for propagation. Seeds were washed and allowed to shade drying for three days then sown in potray filled with sterilized pot mixture medium of sand: red soil: farmyard manure at a ratio of (2:1:1). Potrays were kept in a polyhouse and observed for germination for 7 to 10 days. At five leaf stage, the seedlings were removed and transplanted separately in larger pots containing sterile pot mixture. A total of 300 seedlings of F_1 population was raised. The eleven-month-old F_1 seedling morphological characters were observed *viz.*, days taken for vegetative bud formation, number of primary branches, number of secondary branches, distance between the areoles and spines per areole.

Statistical design

Experimental design used was Random Block Design [RBD] with seven treatments and three replications was subjected to analysis of variance (ANOVA) to analyze the variability of dragon fruit F_1 progeny

Results

The results of analysis of variance for five traits revealed that the F1 population from the variable crosses showed significant differences for all the traits, indicating the existence of enormous amount of genetic variability for these traits.

Morphological characteristics of hybrid progeny growth parameters

Days taken for vegetative bud formation

Results revealed that among F_1 crosses, D 22/15 recorded significantly lesser number of days (17.93) followed by D 22/ 12) (19.87) and more number of days has taken D 22/ 10 (31.67). (Table 1, fig.1).

Primary branches/cladode

Data pertaining to the number of primary branches per cladode (table 1, fig 2) showed significantly highest primary branches per cladode by D 22/14 (4.33) followed by D 22/ 10 (4.27) and lowest in D 22/ 11 (2.07).

Secondary branches/cladode

The perusal data (table 1, fig 3) showed that the secondary branches per cladode significantly varied among the F_1 crosses D 22/ 12) showed the highest number of secondary branches (5.73) per cladode followed by D 22/ 10 (5.20) and lowest number of secondary branches was observed in D 22/ 14 (2.60).

Areole distance (cm)

The analysis of variance of distance between areoles (table 1, fig 4) was highly significant in D 22/ 12) 2.17 cm among the F_1 crosses, followed by D 22/ 11 was recorded (1.31 cm) and lowest distance between areoles was observed in D 22/ 15 (0.87 cm).

Number of spines / Areole

Results revealed that the (Table 1, fig 5) higher spines per areole was recorded in D 22/ 13 (15.53) followed by D 22/ 10 (8.07) and lower number was recorded in (3.07) (D 22 /1).

Table 1: Morphological characterization of F_1 crosses in dragon fruit

Crosses	Days taken for vegetative bud	No of primary branches	No of secondary branches	Distance b/w areoles	Spines/areole
D 22/10	31.67	4.27	5.20	1.13	11.80
D 22/11	30.67	2.07	4.73	1.31	7.53
D 22/12	19.87	3.33	5.73	2.17	9.93
D 22/13	20.80	2.60	3.13	1.17	15.53
D 22/14	22.53	4.33	2.60	1.21	8.80
D 22/15	17.93	4.00	4.53	0.87	7.87
D 22/16	20.00	3.93	4.60	1.47	5.87
S.Em±	0.29	0.16	0.27	0.05	0.42
CD@5%	0.91	0.51	0.85	0.17	1.31

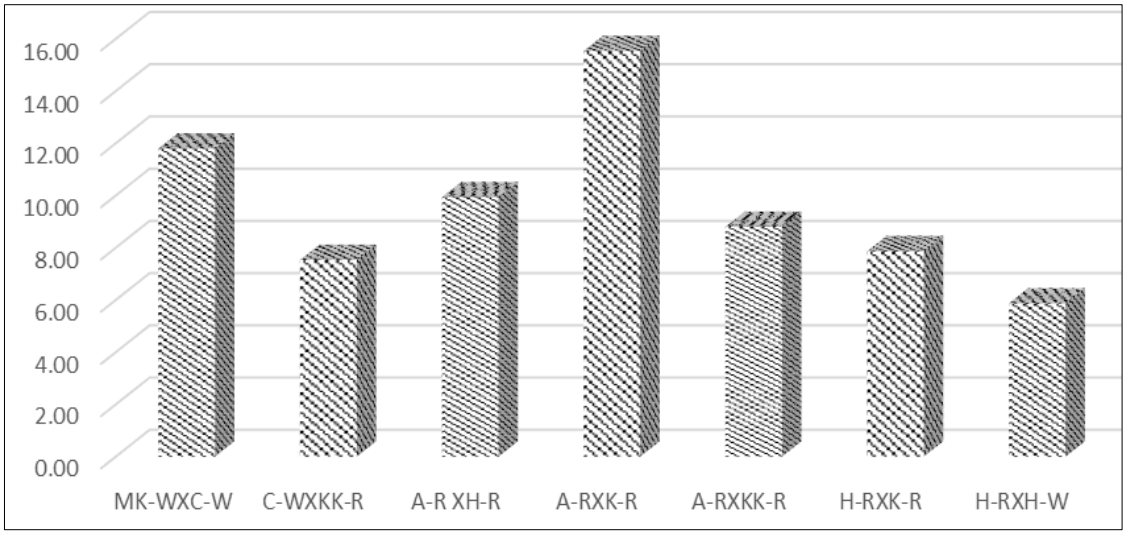

Fig 1: Spine number/areole

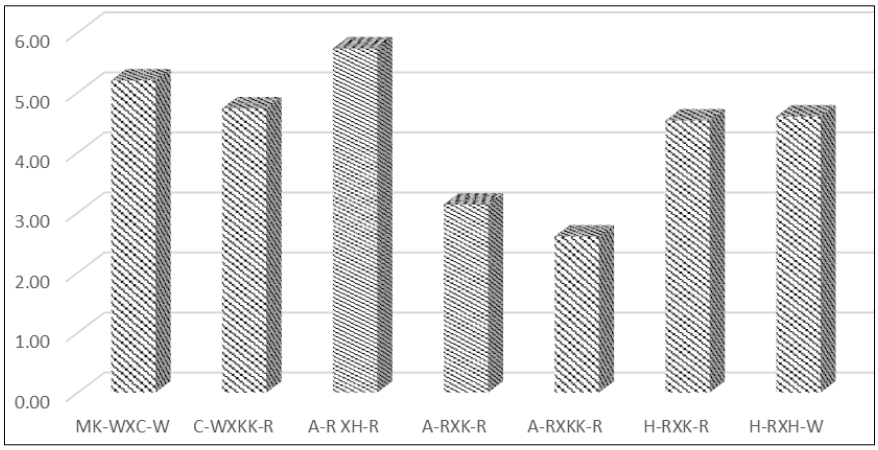

Fig 2: Secondary branches/cladode

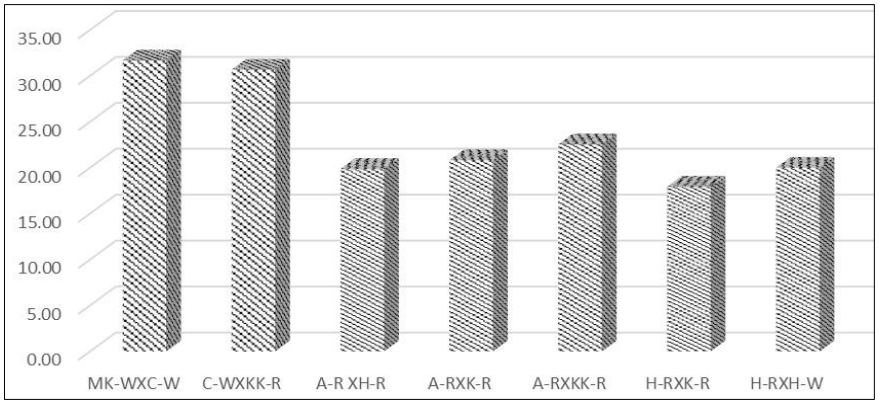

Fig 3: Days taken to vegetative bud formation

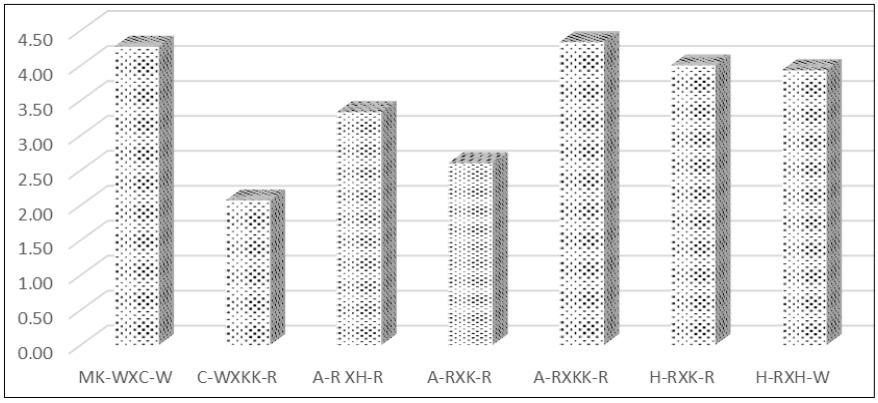

Fig 4: Primary branches/cladode

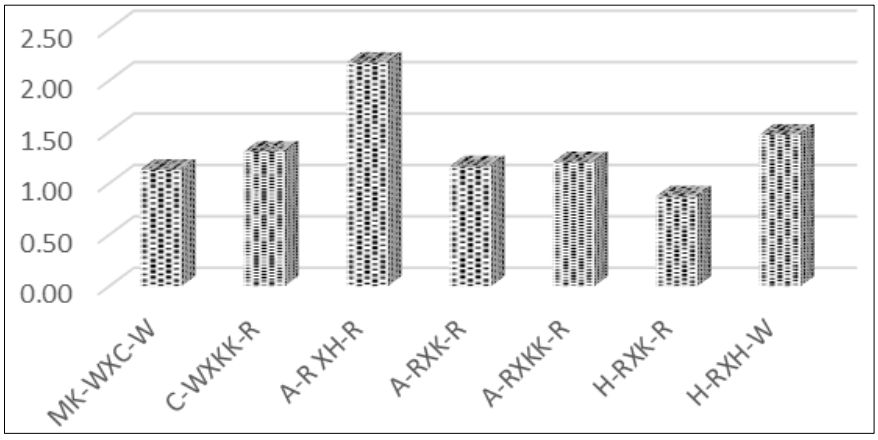

Fig 5: Areole distance

Discussion

As for the contribution of each variable analyzed for the divergence between pitaya hybrids evaluated, it was observed that the days taken for vegetative bud formation had a greater influence whereas the number of primary branches was the variable that exerted the least influence (Table 1). Juárez Sandoval *et al.* (2007) [4] state that the spines number and length characteristics, besides their arrangement in the areola, are reliable characteristics for the description of pitaya types of the genus *Hylocereus*. Grimaldo Juárez *et al.* (2007) [3] found five morphological characters related to the days taken for vegetative bud formation, number of primary branches, number of secondary branches, distance between areoles and spine number per areole as more important for genotype separation. Although many authors find positive results, it is known that morphological and agronomic characters used to measure genetic diversity in certain populations of individuals often do not allow the identification of discrete taxonomic groups, since most of the plant characters are influenced by environmental factors, exhibiting continuous variation and high degree of phenotypic plasticity (FLÁVIO, 2010). This plasticity can be considered a form of plant adaptation to environmental conditions in which they are. Also, according to Tel-Zur *et al.* (2004) [5], the separation of species and varieties in the genus *Hylocereus* is difficult due to the high intra and interspecific hybridization that occurs in this species.

Conclusions

The evaluated hybrids presented showing great variability. The hybrids D 22/11, D 22/13 and D 22/15 showed to have potential to be evaluated in a breeding program. These F1 crosses may be recommended for multilocational trials for commercialization of the crop.

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