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UFV-M7: mutant yellow passionfruit genotype with photoperiod insensitivity for flowering

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Abstract – *The development and characteristics of UFV-M7, a mutant with photoperiod insensitivity to beginning of flowering, are described. This genotype was fortuitously obtained by regeneration of nodal segments, exposed to gamma radiation. The possibility of incorporating photoperiod insensitivity into cultivars for producing regions is discussed for latitudes where the photoperiod determines the seasonality of harvest.*

Key words: Passiflora edulis*, mutation, flowering, photoperiod.*

INTRODUCTION

Yellow passionfruit (*Passiflora edulis* Sims., Passifloraceae) is a species typical of tropical climates. It belongs to a group of plants requiring long days, demanding in photoperiod and temperature (Nave et al. 2010). The plant needs a minimum of 11 h light day^{-1} and monthly average temperatures around 20 °C, to ensure floral induction and fruit development (Junqueira et al. 1999, Borges and Lima 2009).

In general, the climatic conditions for year-round production of yellow passionfruit are ideal in low-latitude regions near the equator (Cavichioli et al. 2006). Major passionfruit-producing regions are located at latitudes above 15° South. In these regions, the reduction in photoperiod and temperature in the winter adversely affects the passionfruit harvest, which is seasonal.

Mutant plants that can flower when days are short were identified in the yellow passionfruit breeding program of the Federal University of Viçosa (UFV), Minas Gerais, Brazil. Understanding the genetic control of photoperiod insensitivity would facilitate the incorporation of this phenotype in hybrids or cultivars (Bruckner et al. 2005). Genotypes with photoperiod insensitivity to flowering can be used to develop cultivars recommendable for higher-latitude regions, increasing the harvest period.

DEVELOPMENT OF THE MUTANT GENOTYPE

The genotype UFV-M7 was obtained from micropropagated plants from nodal segments explants exposed to gamma radiation. The plant material, derived from superior genotypes identified by the UFV yellow passionfruit breeding program, was initially irradiated with a view to the establishment of varieties resistant to *Fusarium oxysporum* f.sp. Passiflorae (Flores et al. 2011). The nodal segments in petri dishes containing MS medium were exposed to gamma irradiation (20 Gya) from a ^{60}Co Gammacell source (0.709 to 0.711 kGy h^{-1}) at the center for nuclear energy in agriculture (CENA), in Piracicaba, São Paulo (Flores 2011). After four subcultures, the plants were subjected to two selection cycles in liquid MS medium supplemented with culture filtrate of a *F. oxysporum* f. sp. Passiflorae isolate, according to the methodology developed by Flores et al. (2012). The selected plants were acclimatized and transferred to an area of historical occurrence of Fusarium in an experimental field of UFV (lat 20° 45' 14" S, long 42° 52' 54" W and alt 648 m asl), Viçosa, Minas Gerais, Brazil. The climate is Cwb (tropical highland climate), with dry/cold winters and hot/humid summers. The average annual rainfall is 1,200 mm. Among the surviving plants, it was found that the plant UFV-M7 flowered early and grew flower buds even at photoperiods of less than 11 h light

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day^{-1}, demonstrating insensitivity to short photoperiod for flowering of this mutant.

CONFIRMATION OF INSENSITIVITY TO SHORT PHOTOPERIOD FOR FLOWERING

To confirm the insensitivity of UFV-M7 to flower under a photoperiod of less than 11 h light.day^{-1}, this genotype was compared with N9 in an experiment. This plant material is unirradiated and normal in terms of photoperiod requirement for flowering (over 11 h light day^{-1}). Genotype N9 was derived from a progeny developed by the UFV yellow passionfruit breeding program, based on recurrent selection cycles for fruit yield and quality, with flowering between September and October.

Location

The experiment was carried out in a greenhouse of the Plant Science Department of UFV. The monthly distribution of photoperiod and temperature in the evaluation period is shown in Figure 1. Photoperiod data were obtained by subtracting the hours from sunset to sunrise from 24, by the forecast Center CPTEC/INPE. Temperatures were recorded by a Datalogger Impact IP-747RH, maintained in a greenhouse with hourly data collection.

Propagation of genotypes

The genotypes UFV-M7 and N9, initially present in the field, were propagated by cuttings and grown in a greenhouse. The cuttings were collected with three buds, cut between the middle part and the apex of branches of annual growth. After removing the leaves, the cuttings were planted in dibble tubes (6 x 20 cm) containing commercial substrate, at a depth of 4 cm. They were kept under spray irrigation for 5 min, triggered every 1 hour by a timer, from 6 to 18 o'clock.

Test installation and performance

In May/2011, 60 days after planting the cuttings, seedlings were transplanted to 30 L pots containing a substrate of soil and washed sand (ratio 2:1). Fertilization was applied according to the results of fertility analysis of this substrate. The substrate was maintained near field capacity by trickle irrigation, using one dripper per pot (microjet spray heads) at a flow rate of 14 L/h at 1 kgf cm^{-2}. Thirty-two plants per genotype were evaluated, with one plant per pot, totaling 64 plants. The seedlings were grown from a single stem (Figure 2A), clipping the lateral branches. When these main stems crossed a wire at a height of 20 cm, they were bent downward, forming a loop. Secondary and tertiary branches were left to grow from this loop, to assess the flowering period (Figure 2B).

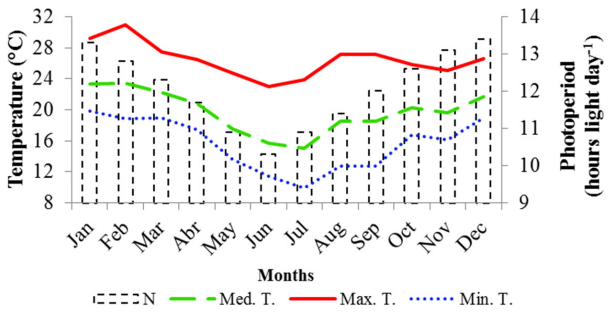

Figure 1. Monthly distribution of photoperiod (N) to the latitude of 20 ° and maximum temperatures (Max. T.), medium (Med. T.) and minimum (Min. T.). Experimental duration (DEA/UFV).

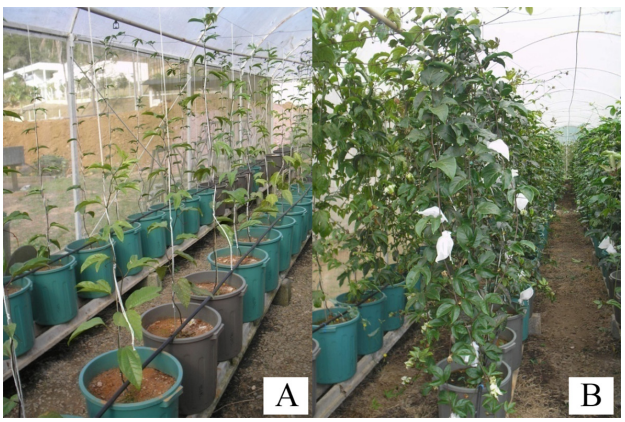

Figure 2. General view of the experiment thirty days (A) and six months (B) after planting; UFV/Viçosa-Minas Gerais, Brazil. Photos: Lira Júnior JS

Figure 3. Flower bud stage to assess beginning of flowering, UFV/Viçosa-MG, Brazil. Foto: Lira Júnior JS.

Evaluation flowering periods

Two evaluation periods were previously established, considering the variations in photoperiod and temperature throughout the year (Figure 1): Period 1 - May 2011 to August 2011, a cold/dry season with short photoperiod, less than 11 h light day^{-1}; Period 2 – September 2011 to December 2012, a warm/humid season with long photoperiod, more than 11 h light day^{-1}.

The evaluated characteristics

The number of flowering plants in the two pre-established periods was evaluated. The beginning of flowering was

Table 1. Morphological traits of two genotypes of yellow passionfruit (*Passiflora edulis* Sims.), contrasting for beginning of flowering at latitude 20° 45´ 14´´ S, propagated by cuttings and grown in a greenhouse

Characteristic	Description	Genotype UFV-M7 (unsensitive)	Genotype N9 (normal)
1. Branch: color	light green (1); dark green (2); purplish light green(3); purple (4)	3	2
2. Leaf blade: length	short< 12cm (3); medium 12-15cm (5); long> 15cm (7)	7	7
3. Leaf blade: greatest width	narrow< 12cm (3); medium 12-15cm (5); wide> 15cm (7)	7	7
4. Leaf blade: cavity depth	shallow (3); medium (5); deep (7)	7	7
5. Petiole: length	short< 3cm (3); medium 3-3.5cm (5); long> 3.5cm (7)	7	7
6. Petiole: nectary position	Adjacent to the leaf blade (1); Distant from the leaf blade (2)	1	1
7. Flower: bract length	short< 2 cm (3); medium 2-3cm (5); long> 3cm (7)	5	5
8. Flower: sepal length	short< 3.5cm (3); medium 3.5-4cm (5); long> 4cm (7)	5	5
9. Flower: sepal width	narrow<1.5cm (3); medium 1.5-2cm (5); wide> 2cm (7)	3	3
10. Flower: corona diameter	small< 7cm(3); medium 7-8cm(5); large> 8cm(7)	7	5
11. Flower: banding in the corona filaments	absent (1); present (2)	2	2
12. Flower: ring color (except white) of the corona	pink (1); purple (2)	2	2
13. Flower: width of the colored rings in the corona filaments	narrow<1cm (3); medium 1-1.5cm (5); wide>1.5cm (7)	5	7
14. Flower: corona filaments	straight (1); wavy (2)	1	1
15. Fruit: longitudinal diameter	short< 10cm (3); medium 10-13cm (5); long> 13cm (7)	3	3
16. Fruit: transversal diameter	small< 8cm (3); medium 8-10cm (5); large> 10cm (7)	3	3
17. Fruit: ratio Longitudinal diameter/transversal diameter	very small < 0.9 (1); small 0.9-1.2 (3); medium 1.2–1.5 (5); large 1.5-1.8 (7); very large >1.8 (9)	3	3
18. Fruit: shape	oval (1); oblong (2); rounded (3); oblata (4); ellipsoid (5); oboval (6)	3	3
19. Fruit: shell color (epidermis)	yellow (1); red (2); purple (3)	1	1
20. Fruit: lenticels	inconspicuous (invisible or little visible) (1); conspicuous (visible) (2)	2	2
21. Fruit: mean weight (UFV-M7 x N9 and N9 x UFV-M7, hand-pollinated)	low< 150g (3); medium 150-250g (5); high> 250g (7)	5	5
22. Fruit: skin thickness	thin< 6mm (3); medium 6-10mm(5); thick> 10mm (7)	5	7
23. Fruit: pulp color	greenish yellow (1); yellow (2); orange (3); dark orange (4)	3	2
24. Fruit: soluble solids content	low< 10ºbrix (3); medium 10º-13ºbrix(5); high> 13ºbrix (7)	5	5
25. Fruit: number of seeds per mature fruit (UFV-M7xN9 and N9xUFV-M7, with hand-pollination)	small< 200 (3); medium 200-400 (5); large> 400 (7)	5	5

Source: Descriptors established by the National Plant Variety Protection (SNPC) of the Ministry for Agriculture, Livestock and Supply (MAPA)

computed when the flower buds in the leaf axil became visible (Figure 3). The evaluation was performed weekly until all plants flowered. Morphological descriptors were also evaluated according to the instructions of the National Plant Variety Protection (SNPC) of the Ministry of Agriculture, Livestock and Supply (MAPA). The fruit-related characteristics were evaluated based on samples of at least three fruits per plant.

RESPONSE TO VARIATIONS IN PHOTOPERIOD

The genotypes UFV-M7 (mutant) and N9 (unirradiated), propagated by cuttings, began flowering in periods with different photoperiod and temperature (Figures 4A and 4B). The beginning of flowering of UFV-M7 occurred in July 2011, three months after transplanting, at photoperiods of less than 11 h light day^{-1}.and an average air temperature of around 16 °C (Figure 1), confirmed its insensitivity, in contrast to genotype N9. Genotype N9 initiated flowering between October and November/2011, six months after transplantation, i.e., upon the establishment of the period of higher temperature (average day temperature 20 °C) and favorable photoperiod (over 11 h light day^{-1}) (Junqueira et al. 1999, Borges and Lima 2009).

MORPHOLOGICAL CHARACTERISTICS

Twenty-five morphological descriptors of two yellow passionfruit (*Passiflora edulis* Sims.) genotypes, contrasting in the beginning of flowering, at latitude 20° 45´ 14´´S,

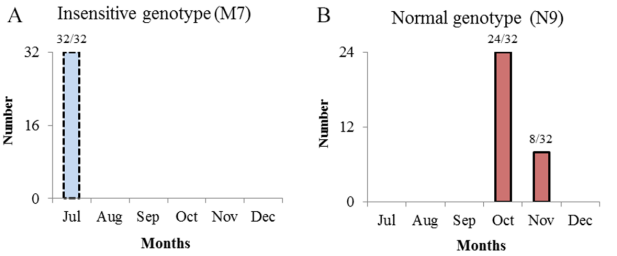

Figure 4. Number of plants observed at the beginning of flowering of the yellow passionfruit genotypes UFV-M7 (A) and N9 (B).

are shown in Table 1. The fruits were obtained by hand-pollinated crosses of UFV - M7 x N9 and N9 x UFV - M7.

PROPAGATIVE PRODUCTION MATERIAL

The Federal University of Viçosa (UFV) is responsible for the maintenance of genotype UFV-M7 and for experiments for the incorporation of this phenotype in yellow passionfruit cultivars or hybrids.

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