AMADEPA

Association Martiniquaise pour le Développement des Plantes Alimentaires

29ème
CONGRES ANNUEL
ANNUAL MEETING
REUNION ANNUAL

Agriculture Intensive dans les Iles de la Caraibe : enjeux, contraintes et perspectives
Intensive Agriculture in the Caribbean Islands : stakes, constraints and prospects
Agricultura Intensiva en la Islas del Caribe : posturas, coacciones y perspectivas

THE PERFORMANCE OF SELECTED HIGH YIELDING PASSION FRUIT LINES IN DOMINICA.

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ABSTRACT

Self-incompatibility in yellow passion fruit (*Passiflora edulis f. flavicarpa*) hinders the selection of a single high yielding variety (HYV). Selection and evaluation efforts, initiated in 1989; for 3 years in Dominica by MOA-IICA-CARDI (M-I-C) on 28 farms have identified 9 lines which show consistent desirable characteristics in terms of fruit size, yield, juice content and quality, number of seeds, and freedom from pest and disease. This paper presents a model used in the selection and evaluation of the HYV fruits, and the maintenance of a germplasm bank using selections propagated vegetatively and by F_1 seedlings. Physiological and phenological characteristics, yield and yield components of selected lines are highlighted. A program to produce, distribute and monitor a composite (M-I-C selection) with high yield seed and juice quality to farmers is also discussed.

INTRODUCTION

Passion fruit (*Passiflora edulis f. flavicarpa* Degener) continues to be one of the major fruit crop in Dominica's Agricultural Diversfication Programme. The crop is grown by a large number of small farmers. At present, some 200 ha is estimated to be under cultivation with the hope of expanding to 400 (Oldham 1991). Some of the limiting barrier to the expansion are the lack of high yielding and high quality lines adapted to the varied agro-ecological environment of Dominica, and an absence of a verifiable source of quality seed material which is uniform and exhibit some level of tolerance to pest and disease (O.Grell, Pers. comm., 1992).

The Ministry of Agriculture (MOA), IICA and CARDI (M-I-C) in 1989, embarked on a programme to alleviate this problem and conducted a three year selection and evaluation exercise to identify a pool of superior yielding lines. The model is presented in Table 1. The objective of this paper is to evaluate the performance of Parent as well as F_1 generation of the selected high yielding lines.

MATERIALS AND METHODS

The mass selection phase of the programme was initiated in 1989 and continued for three years on farms within the Carib Territory on the east coast of Dominica. Twenty - eight farmers were grouped in into four categories based on altitude of farm (below and above 130m), and by age of planting material (less than or over 10 months). A rapid evaluation and screening for high yielding plants was conducted on each category of farmer. From the selected vines self-compatibility and self-incompability tests were conducted as described by Allard (1960), and vines exhibiting more than 40% of these traits were selected for re-confirmation.

The progeny testing phase is being conducted over a three year period at a remote site on the Portsmouth Agricultural Station. Nine lines which performed consistently well with desirable characteristics were further selected and established in the progeny plot / museum bank, propagated by seeds and cutting. The recommended agronomic practices described by Rajkumar (1987) and Robin (1992) were followed. No hand pollination was conducted.

The selection criteria were based on crop vigor; vegetative growth patterns; earliness to flowering and length of flowering period; flower and fruit retention, and number of fruit.vine^{-1}. The yield components of fresh weight, fruit length and diameter, pulp and juice content, seed number and weight, brix, and percent acid were assessed. These tests were conducted on both the selected Parents (P) and the F_1 seedlings (F_1).

RESULTS AND DISCUSSION

The results indicate that all the desirable lines based on the selection criteria were cross-pollinated or self-incompatible. The various selected high yielding lines of Parents and F_1 showed very little differences in crop vigor, vegetative growth patterns and earliness to flowering and fruiting. However, there were significant variations in crop growth in the vegetatively propagated lines compared to the Parents and the F_1 generations.

All the F_1 lines showed a significant increase in the total fruit yield over the Parent (Table 1). There were significant differences in fruit and pulp weight between the parents and F_1 lines, and a significant increase in both yield components as well as juice content from Parents to F_1 generation (Table 2).

A similar trend for seed number and weight per fruit was observed. In all the F_1 lines there was a minimum of a two-fold increase over the Parent for all measured variables. Eight of the nine selected lines produced a minimum number of seeds in excess of 300 seeds.fruit^{-1} which is higher than the maximum reported by Hardin (1986) in the literature for improved lines. Gilmartin (1958) reported that the amount of juice produced by a fruit is largely dependent on the number of seeds developed.This was confirmed in the study and is highlighted in Table 2. All F_1 lines produced higher quantities of juice compared to the Parent.

In the mass selection of desirable passion fruit lines, selection was based on the maternal parents only, and there was no control over pollination, nor random mating of selections. This resulted in an increase in the proportion of superior genotypes within the population (Allard, 1960). Mass selection is effective in increasing gene frequencies which are easily observed or measured by the improved components as evidenced in Tables 1 and 2 compared to the unselected vines (Table 4). Generally mass selection has not been effective in modifying yield characteristics which are governed by multiple genes (Allard, 1960). However with improved crop management, through enhanced plant nutrition (Marte,?) and wider spacing (Gurnah and Gachanja, 1983) higher yields are anticipated. It is suggested that improved F_1 hybrids may be due to a combination of the above, hybrid

vigour and improved cross-pollination ability of the lines.

In the Parents, little variation was observed for fruit weight within lines over the 3 years, but variability between lines was consistent, and a few lines improved in the F_1 indicating some form of hybrid vigour. It is suggested that due to uncontrolled (random) pollination some lines may either be superior or inferior pollen producers. The converse may also be true for the ovary. The increase in seed number, pulp weight and juice content in the F_1 lines indicate that all the selected lines are superior selections and that seed number may be a heritable character.

Through the technique of line breeding (Allard, 1960) the seeds from the superior lines will be composited and established in an isolated plot at Grand Bay Agricultural Station where it will be allowed to cross at random. Seeds harvested from this plot then become the foundation of a new variety. Further, the need for hand pollination is eliminated.

Excessive inbreeding will be avoided as an adequate number of new high yielding lines with other desirable characteristics eg. Soufriere Selection, enter the composite. Between each stage of the selection process, on farm validation and evaluation of the composite population will be conducted both for desirable agronomic and post-harvest characteristics.

CONCLUSION

The Selection process tested in this study is an effective way of advancing the development of desirable traits in passion fruit. The composite selection will form the basis of foundation seed material for a new variety. While it may be too early to conclude that there exists superior high yielding lines in Dominica, evidence indicate that in the near future farmers will have access to lines which are superior to presently cultivated ones and source of verifiable seeds called the M-I-C high yielding passion fruit selection.

ACKNOWLEDGEMENT

The Author recognises Art Wilton, formerly attached to IICA, Dominica, who was responsible for identifying the selected lines in the study. This is the basis of the continuity of this research project. Further the collaborative and colleagial efforts by Urban Martin (IICA), Oliver Grell (MOA) and assistance by the CARDI Dominica Representation are greatly appreciated.

Table 1. Passion fruit yield (number fruits.vine^{-1}) for selected high yielding lines.

Selection	Fruit yield.	Vine^{-1+}
	P^{++}	$F_1$$^{+++}$
JHLA 9	70	109
JHLA 10	71	105
JHLA 11	72	90
ALDU 23	36	135
ALDU 30	38	101
ALDU 45	41	96
AECH 5	82	89
AECH 9	68	123
CSRA 28	34	66
x	57	102
SE	2.21	2.23

\+ represents 6m^2 vines - ++ mean over 3 years (P=Parents)

+++ mean over 1 year (F_1 = first generation)

Table 2. Fruit and pulp weight, (g.fruit^{-1}) and Juice content (ml.fruit^{-1}) for selected high yielding passion fruit lines.

Selection	Fresh wt(g)		Pulp wt (g)		Juice (ml)	
	P+	F_1++	P	F_1	P	F_1
JHLA 9	90	136	42	65	11.3	45
JHLA 10	79	171	33	87	12.6	40
JHLA 11	110	125	56	62	20.6	43
ALDU 23	141	162	70	70	28.3	46
ALDU 39	95	145	52	72	22.5	42
ALDU 45	130	153	63	72	25.3	42
AECH 5	60	153	36	75	20.1	42
AECH 9	66	125	28	80	12.3	41
CSRA 28	54	131	26	74	17.0	40
x	91.6	144.5	44.4	75.2	18.9	41.8
SE	10.20	5.48	5.14	3.67	2.01	0.61

\+ mean for 3 years and >300 fruits. [Parents]

++ mean for 1 year and 108 fruits. [F_1]

Table 3. Seed weight (g.fruit^{-1}) and seed numbers.(fruit^{-1}) for selected high yield passion fruit lines

		P	F_1	
Selection	Weight+	Number ++	weight	number
JHLA 9	3.4	186	6.0	295
JHLA 10	3.1	174	9.1	463
JHLA 11	3.3	183	7.3	358
ALDU 23	5.5	308	9.1	440
ALDU 39	4.3	237	8.8	429
ALDU 45	6.3	320	7.2	357
AECH 5	2.8	163	8.6	420
AECH 9	1.8	129	8.1	397
CSRA 28	2.5	115	7.1	319
x	3.6	200	7.9	398
SE_	0.48	23.2	0.31	7.7

\+ mean for 3 years

++ fruits harvested in year 3 of Parent

F_1 = first generation

P = Parent

Table 4. Yield components of the unselected passion fruit lines in Dominica.

Yield Component +	Values
Fruit wt	75.4
Diameter	48
Length	55
Pulp wt	32
Seed wt	2.1
Juice	12.9
Seed number	108
pH	3.1
Brix	17.6
% Acid	3.52
Brix:acid	5.02

+ represent mean of 30 fruits for 2 years.

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