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Evaluation of potato clones for agronomic and processing traits in conventional and organic crop systems

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ABSTRACT

This work aimed to evaluate the performance of potato genotypes for tuber yield, processing quality traits, and plant vigor, under conventional and organic crop systems. The experiments in conventional system were carried out during the springs of 2018 and 2019 in Canoinhas-SC, while both conventional and organic crop systems were performed in 2020's winter in Brasília-DF, Brazil. Fourteen advanced clones, five of them selected in organic system (OS), and check cultivars Atlantic (chipping), Markies, and Asterix (french fry) were evaluated. A randomized complete block design with four replications was used. Clones F63-10-13A and EP121 performed well for tuber yield in all experiments. F129-12-08 presented a good frying quality, and F63-12-04 had a tuber yield and frying quality similar to 'Asterix'. OD38-06 had a tuber yield similar to 'Asterix' and 'Markies', and frying quality similar to 'Markies'. In general, the clones developed in the OS had better performance in that system, however some of them also performed well in the conventional system, while some developed in conventional system also performed well in the OS, such as F63-10-13A.

Keywords: *Solanum tuberosum*, tuber yield, plant vigor, frying color, specific gravity.

RESUMO

Avaliação de clones de batata para caracteres agronômicos e de processamento em sistemas de cultivo convencional e orgânico

Este trabalho teve como objetivo avaliar o desempenho de genótipos de batata para produtividade de tubérculos, características de qualidade de processamento e vigor de plantas, em sistemas de produção convencional e orgânico (OS). Experimentos em sistema convencional foram conduzidos na primavera de 2018 e 2019 em Canoinhas-SC, enquanto que ambos sistemas convencional e orgânico foram conduzidos no inverno de 2020 em Brasília-DF, Brasil. Quatorze clones avançados, cinco deles desenvolvidos em OS, e as cultivares testemunhas Atlantic (para chips), Markies e Asterix (para fritas em palitos) foram avaliados. O delineamento experimental foi blocos completos casualizados com quatro repetições. Os clones F63-10-13A e EP121 apresentaram bom desempenho para rendimento de tubérculos em todos os experimentos. F129-12-08 apresentou qualidade de fritura muito boa e F63-12-04 obteve rendimento de tubérculos e qualidade de fritura similares à 'Asterix'. OD38-06 obteve rendimento de tubérculos semelhante à 'Asterix' e 'Markies', e qualidade de fritura similar à 'Markies'. Em geral os clones desenvolvidos em OS tiveram melhor desempenho naquele sistema, mas alguns também se destacaram no sistema convencional, enquanto que alguns desenvolvidos em sistemas convencional também tiveram bom desempenho no OS, a exemplo do F63-10-13A.

Palavras-chave: *Solanum tuberosum*, produtividade, vigor de planta, cor de fritura, peso específico.

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Most potato cultivars planted in Brazil are from Europe, but they are poorly adapted, since they were developed under very different weather and soil conditions (Silva *et al*., 2020). The potato growing areas in Brazil have shorter photoperiods, soil with higher acidity, and higher temperature and pressure of pathogens other than those observed in Europe (Silva *et al*., 2020, Andrade *et al*., 2021). Despite having a good tuber appearance for the fresh market and elevated processing quality, these cultivars require high inputs to achieve acceptable yield in Brazil. This contrasts with the development of production systems that pursue economic and environmental sustainability, which emphasize the importance of developing bred cultivars more adapted to our production conditions and crop systems (Silva *et al*., 2020).

The potato crop responds very well to improved management factors, such as high rates of chemical fertilizers applied to the planting row and the

use of pesticides. However, it is also possible to grow potatoes using less intensive production systems, such as the organic systems of production, in which nutrients are less concentrated and few pesticides are allowed (Ragassi *et al*., 2020; Djaman *et al*., 2021). Thus, genotypes which are more rustic and efficient in nutrient uptake, or which are more tolerant to pests and diseases, are beneficial for this production system (Ragassi *et al*., 2020).

Therefore acceptable tuber production and quality can be achieved by using appropriate management techniques, such as the application of fertilizers and other inputs allowed in the organic cropping system. The tuber yield in organic is generally lower than in conventional systems, though (Ragassi *et al*., 2020; Margus *et al*., 2022). Nevertheless, the higher value paid for organic tubers, coupled with a milder requirement by the market for tuber appearance and size, can maintain the profitability of this system (Ragassi *et al*., 2020).

The demand for cultivars suitable for processing is increasing in Brazil (Santos *et al*., 2020). These cultivars must have high tuber yield, high specific gravity, low reducing sugar content, and absence of tuber physiological disorders, among other traits (Silva *et al*., 2020). The specific gravity influences the texture and flavor of the final product, as it is directly related to the dry mass content (Silva *et al*., 2020). The higher the dry mass content, the lower the fat absorption, so the texture of the final product is improved and the processing yield is increased (Silva *et al*., 2020). Lower levels of reducing sugars cause less darkening during frying, improving the appearance and flavor of the product, which can be directly assessed by the frying color (Santos *et al*., 2020).

The objective of this work was to evaluate the performance of potato genotypes for tuber yield, processing quality traits, and plant vigor, under conventional and organic production systems.

MATERIAL AND METHODS

The experiments were carried out in Canoinhas (26°10‘S, 50°23‘W, 839 m altitude), in the spring seasons of 2018 and 2019, under a conventional cropping system; and in the winter season 2020 in Brasília (15°55‘S, 48°08‘W, 999 m altitude), under conventional and organic systems.

The experiments were planted on August 09, 2018 and August 12, 2019, and harvested 106 and 105 days after planting (DAP), respectively, in Canoinhas; and planted on May 25, 2020 and on June 09, 2020, and harvested 112 and 111 DAP, respectively, under conventional and organic cropping systems, in Brasília.

A set of 14 advanced potato clones, five selected under the organic production system, codified as “ORG”, and the other nine clones selected under conventional production systems (Tables 1, 2 and 3), were evaluated and compared with check cultivars Asterix and Markies, which are widely cultivated for french fries; and Atlantic, widely used to make chips and string fries in Brazil.

In the experiment carried out in Canoinhas in 2018, type IV seed tubers (mini-tubers of 23-30 mm diameter) were used, which had been stored for eight months in a cold room (3.5±0.5°C). Type II tubers (40-50 mm diameter) obtained in the 2018 experiment were stored in a cold room and used in the experiments carried out in 2019 in Canoinhas, and in 2020 conventional and organic experiments in Brasília.

A randomized complete block design with four replications was used for all experiments. Canoinhas plots had two rows of 10 plants each, whereas in Brasília a single row of 10 plants in the conventional system experiment, and a single row of 15 plants in the organic system experiment. Plants were spaced 0.80 m between rows and 0.30 m within plants in both experiments.

In Canoinhas experiments fertilizers were applied to the planting furrow at the rate of 120 kg/ha of N, 420 kg/ha of P_2O_5 and 240 kg/ha of K_2O, using the formulae NPK 04-14-08. In Brasília, in the conventional system experiment, fertilizers were applied to the planting furrow at the rate of 190 kg/ha of N, 420 kg/ha of P_2O_5 and 350 kg/ha of K_2O, and sidedressed with 120 kg/ha of N (urea) when hilling up the plants. In the organic system experiment, 28,750 kg/ha of organic compost (Couto *et al*., 2008) and 1,250 kg/ha of thermophosphate (18% of P_2O_5) were applied. Cultural and phytosanitary treatments followed the recommendations of the respective regions and according to the production system (Silva & Lopes, 2016).

The following agronomic traits were evaluated: plant vigor and tuber yield components. The plant vigor was evaluated by assigning scores from 1 to 5 to each plot (1= higher vigor; 5= lower vigor), 70 days after planting. The tuber yield was evaluated by weighing the graded tubers of each plot. Tubers were graded according to their transverse diameter as marketable (>45 mm) and non-marketable (≤45 mm), and weighed, obtaining the total and marketable tuber mass (kg/plot), and the average tuber mass obtained by the ratio between the total tuber mass and the total number of tubers. The average tuber mass was not evaluated in the organic system.

For processing quality traits, the specific gravity and frying color were evaluated. Specific gravity was assessed in marketable-sized tuber samples, using a hydrometer from the Snack Food Association (Arlington, VA, USA), in all replications of Canoinhas experiments and one replication of Brasília experiments. The frying color was assessed as chips, using samples of three healthy tubers of marketable size per plot, in all replications in the conventional experiments and one replication in the organic system. Fifteen 2.0 mm thick slices were obtained from each sample, fried in vegetable oil, at an initial temperature of 180°C until the bubbling stopped. The fry color was evaluated visually by one evaluator, assigning scores from 1 to 9 (1= dark; 9= light), according to Silva *et al*. (2020).

The tuber mass data were converted to t/ha. After cheking the presuppositions of normality and the rate lower than 7 among the higher and lower error square mean, the data were subjected to individual and joint analysis of

variance and analysis of grouping of means by the Scott & Knott test. The environment factor was used as fixed effect. Statistical analyzes were performed using the Genes computer software (Cruz, 2016).

RESULTS AND DISCUSSION

The joint analysis of variance showed significant differences ($p<0.05$) among genotypes for all traits. There were also significant effects of environment and genotype x environment interaction for all traits, indicating that, in general, the genotypes showed different performances in the studied environments.

Coefficients of environmental variation (CV) were lower than or close to 30% for all yield traits, in all the experiments, indicating good precision, considering that these traits are quantitative, and, therefore, they suffer a greater environmental influence than qualitative traits do (Silva *et al*., 2017). The same is true for the plant vigor trait. For processing quality traits, i.e., frying color and specific gravity, CV values were low (Tables 1, 2, and 3). These traits are more stable and less influenced by environmental variations comparing with traits related to tuber yield (Silva *et al*., 2017).

The marketable yield, which is the most important yield component, in Canoinhas, clones F53-11-05, F124-12-01, F63-10-13A, OD38-06, EP121, ORG725, ORG14599, and the check cultivar Markies, stood out, forming the top yielding group. In Brasília, in the organic cropping system, most of the same genotypes also stood out, except F53-11-05, OD38-06, and ORG4446. In the conventional cropping system, in Brasília, four groups were formed for yield. The genotypes grouped among the top two groups, "a" and "b" were clones F63-10-13A, EP121, and the check cultivar Markies. These three genotypes stood out as the most productive in all environments. In addition, in the conventional system in Brasília, the clone ORG4446, which also showed a good performance in the organic system, and the check cultivar Asterix, grouped among the best ones (Table 1). Comparing the performance

Table 1. Means of marketable and total tuber yield of 14 advanced potato clones and three cultivars, in the spring seasons of 2018 and 2019 under the conventional production system in Canoinhas, and in the winter season 2020 under conventional and organic production systems, in Brasília, Brazil. Canoinhas and Brasília, Embrapa, 2018-2020.

Genotypes	Marketable tuber yield (t/ha)				
	Canoinhas Conv. system		Brasília Conv. system	Brasília Org. system	Means
	2018	2019	2020	2020	
F53-11-05	21.14 aA	27.15 aA	26.59 cA	23.76 bA	24.66
F129-12-08	14.52 bB	23.81 aA	26.17 cA	24.36 bA	22.22
F124-12-01	22.81 aA	18.81 aA	19.00 cA	28.37 aA	22.25
F60-11-02	13.86 bB	27.14 aA	11.88 dB	13.36 bB	16.56
F63-10-13A	24.33 aB	25.96 aB	32.22 bA	35.92 aA	29.61
F63-12-04	15.48 bC	26.43 aB	39.35 aA	24.06 bB	26.33
OD38-06	18.24 aB	26.67 aB	36.22 bA	25.37 bB	26.63
EP120	11.24 bC	30.62 aA	28.94 cA	20.62 bB	22.86
EP121	19.91 aB	23.57 aB	49.58 aA	28.82 aB	30.47
ORG725	19.62 aA	21.67 aA	24.63 cA	27.98 aA	23.48
ORG2798	0.00 cB	0.24 bB	21.94 cA	25.19 bA	11.84
ORG4446	13.10 bB	6.67 bB	37.97 bA	36.81 aA	23.64
ORG14599	22.14 aA	24.76 aA	9.72 dB	29.42 aA	21.51
ORG6408	11.95 bC	5.95 bC	41.64 aA	21.30 bB	20.21
Asterix	16.38 bB	20.48 aB	30.58 bA	20.01 bB	21.86
Markies	20.29 aB	33.81 aA	34.40 bA	30.12 aA	29.66
Atlantic	15.24 bC	24.29 aB	40.85 aA	24.35 bB	26.18
Means	16.48	21.65	30.10	25.87	23.53
CV (%)	20.26	17.19	31.85	25.48	-
Genotypes	**Total tuber yield (t/ha)**				
F53-11-05	26.10 aC	47.14 aA	36.07 bB	37.61 cB	36.73
F129-12-08	24.33 aB	38.33 aA	38.56 bA	32.71 dA	33.48
F124-12-01	28.48 aA	34.76 aA	29.87 cA	39.68 cA	33.20
F60-11-02	22.86 aB	42.14 aA	17.47 dB	21.45 dB	25.98
F63-10-13A	29.81 aB	35.95 aB	43.98 bA	50.01 aA	39.94
F63-12-04	18.34 aC	38.09 aB	52.52 aA	35.45 cB	36.10
OD38-06	25.38 aB	38.81 aA	47.86 aA	39.11 cA	37.79
EP120	19.53 aB	40.52 aA	37.06 bA	26.74 dB	30.96
EP121	26.29 aC	33.81 aB	58.92 aA	38.63 cB	39.41
ORG725	22.10 aB	38.81 aA	30.28 cB	36.34 cA	31.88
ORG2798	5.48 bB	5.29 cB	40.28 bA	45.15 bA	24.05
ORG4446	20.90 aB	18.10 bB	48.89 aA	55.08 aA	35.74
ORG14599	26.38 aB	39.05 aA	15.34 dC	35.04 cA	28.95
ORG6408	14.86 bC	12.14 bC	49.27 aA	31.75 dB	27.01
Asterix	21.95 aB	32.38 aB	41.65 bA	30.53 dB	31.63
Markies	26.33 aB	43.81 aA	45.13 bA	41.53 bA	39.20
Atlantic	21.67 aC	32.00 aB	49.78 aA	32.22 dB	33.92
Means	22.40	33.60	40.17	37.00	33.29
CV (%)	17.63	16.06	24.27	18.27	-

Means followed by the same lowercase letter in the column and uppercase in the row belong to the same group by the Scott & Knott test at 5% probability. CV (%): coefficient of environmental variation.

of each genotype in all environments, clones F53-11-05, F124-12-01, and ORG725, despite not being superior in each environment, were stable, and not significantly different among the four experiments.

Considering the experiments of Brasília, that were carried out in the two crop systems on the same farm, the tuber yield was generally higher in the conventional than in the organic system, 40.17 and 37.00 t/ha for total tuber yield, and 30.10 and 25.87 t/ha for marketable tuber yield, respectively, indicating the possibility of having a good yield in the organic system. The marketable tuber yield gap between the conventional and the organic systems is higher, almost 30%, for the imported check cultivars. This observation denotes the importance of developing potato genotypes adapted to the Brazilian potato crop and environmental conditions, with the marketable tuber yield reaching potentially 35 to 36 t/ha, as observed in the organic experiment. In this study, no problems were observed with diseases such as late blight (*Phytophthora infestans*), which could magnify the yield gap between foreign and locally bred varieties in the organic system.

Considering the clones developed in the organic system, which were selected basically for the same traits assessed in this study, but under a less concentrated and soluble fertilizing, ORG725 showed stability for marketable tuber yield and had no significant difference among all environments. This clone, however, was not among the best genotypes in the conventional system experiment in Brasília. Clone ORG2798 was not significantly different in the two production systems in Brasília, but it did not rank among the best genotypes. In Canoinhas, it did not perform well for total and marketable tuber yield, the plants grew higher than other genotypes and few tubers were formed. It probably occurred for this genotype not being adapted to the lower photoperiod in this environment (Silva *et al*., 2019b). Clones ORG4446 and ORG6408 also showed poor performance in Canoinhas, but the former was better in the organic cropping system and

Table 2. Average tuber yield and plant vigor of 14 advanced potato clones and three cultivars, in the spring seasons of 2018 and 2019 in Canoinhas, and in the winter season 2020 in Brasília, Brazil, under a conventional production system. Canoinhas and Brasília, Embrapa, 2018-2020.

Genotype	Average tuber mass (g)			
	Canoinhas Conv. system		Brasília Conv. system	Means
	2018	2019	2020	
F53-11-05	94.42 bB	76.21 bB	125.49 cA	98.71
F129-12-08	64.04 cB	79.92 bB	143.57 cA	95.84
F124-12-01	100.78 bB	75.83 bC	135.77 cA	104.13
F60-11-02	62.50 cA	64.58 cA	76.73 eA	67.94
F63-10-13A	104.84 aA	83.57 bB	115.67 dA	101.36
F63-12-04	121.20 aB	89.86 bC	221.07 aA	144.04
OD38-06	84.89 bB	85.19 bB	115.22 dA	95.10
EP120	59.46 cC	91.03 bB	128.74 cA	93.08
EP121	92.62 bB	86.63 bB	147.30 bA	108.85
ORG725	132.28 aA	104.90 aB	150.09 bA	129.09
ORG2798	30.51 dB	25.56 dB	132.32 cA	62.80
ORG4446	68.82 cB	51.44 cB	115.08 dA	78.45
ORG14599	112.02 aB	98.21 aB	141.26 cA	117.16
ORG6408	110.33 aB	61.66 cC	201.15 aA	124.38
Asterix	107.74 aB	91.57 bB	136.08 cA	111.80
Markies	93.52 bB	94.49 aB	155.75 bA	114.59
Atlantic	87.94 bC	110.90 aB	165.36 bA	121.40
Means	89.88	80.68	141.57	104.04
CV (%)	14.78	13.21	13.57	-
Genotype	**Plant vigor[1]**			
F53-11-05	3.00 cA	1.75 bB	3.25 aA	2.67
F129-12-08	3.00 cA	3.00 aA	3.00 aA	3.00
F124-12-01	3.25 cA	1.25 cB	3.50 aA	2.67
F60-11-02	3.25 cA	1.75 bB	2.50 bA	2.50
F63-10-13A	5.00 aA	3.50 aB	2.25 bC	3.58
F63-12-04	4.00 bA	2.00 bB	2.25 bB	2.75
OD38-06	2.50 cA	1.25 cB	2.00 bA	1.92
EP120	2.75 cA	1.00 cB	2.25 bA	2.00
EP121	2.25 cA	2.75 aA	2.25 bA	2.42
ORG725	4.00 bA	2.00 bB	4.25 aA	3.42
ORG2798	5.00 aA	3.25 aB	2.75 bB	3.67
ORG4446	3.00 cA	2.75 aA	3.25 aA	3.00
ORG14599	4.75 aA	3.50 aB	3.75 aB	4.00
ORG6408	3.75 bA	1.50 cB	3.50 aA	2.92
Asterix	2.75 cA	2.25 bA	3.00 aA	2.67
Markies	2.75 cA	1.75 bB	2.50 bA	2.33
Atlantic	2.75 cA	2.25 bA	2.50 bA	2.50
Means	3.40	2.21	2.87	2.83
CV (%)	14.16	29.24	20.24	-

[1]Plant vigor 1= high; 5= low; Means followed by the same lowercase letter in the column and uppercase in the row belong to the same group by the Scott & Knott test at 5% probability. CV (%): coefficient of environmental variation.

the latter in the conventional system in Brasilia. ORG14599 performed well in Canoinhas in the conventional system as well in the organic system in Brasilia, but not in the conventional system in Brasilia. Comparing the two crop systems in Brasília, clones ORG725, ORG2798 and ORG4446 did not differ statistically for marketable tuber yield. ORG14599 was better in the organic system and ORG 6408 in the conventional system. This indicates a non-prevalence of specific and exclusive adaptability of these clones to the organic system. However, on average, these clones had a marketable tuber yield 13% higher than other genotypes in the organic system, and 15% lower than the others in the conventional system, indicating a tendency for better performance in the system they were developed.

Evaluating potato clones developed in the conventional cropping system, Silva *et al*. (2017) and Ragasssi *et al*. (2020) observed that, although most genotypes had higher marketable yield in the conventional system, some clones performed very similarly (not significantly different) in the organic system and much better than two check cultivars. It also indicates that the development of more adapted genotypes and the evaluation of the most adapted to this system could help to increase the viability of the organic production of potatoes in Brazil.

The average tuber mass was higher in Brasília than in Canoinhas (Table 2). In general, the higher values were achieved by the genotypes with a higher marketable tuber yield, as the tuber mass is positively correlated to and an important component of the tuber yield (Silva *et al*., 2021).

The clone ORG14599 had less vigorous plants in Canoinhas and Brasília (Table 2). The clones OD38-06 and EP120 tended to present vigorous plants in all experiments. Some studies correlate a higher plant vigor with a higher tuber yield (Bertin *et al*., 2013; Pereira *et al*., 2017; Silva *et al*., 2019). Nevertheless, in general, the growers prefer cultivars with lower vegetative growth, because there exists

Table 3. Means of specific gravity and chip color of 14 advanced potato clones and 3 cultivars, in the spring seasons of 2018 and 2019 in Canoinhas, and in the winter season 2020 under conventional and organic production systems, in Brasília, Brazil. Canoinhas and Brasília, Embrapa, 2018-2020.

Genotype	Specific gravity				
	Canoinhas Conv. system		Brasília Conv. system	Brasília Org. system	Means
	2018	2019	2020[1]	2020[1]	
F53-11-05	1.083 bB	1.087 dA	1.091	1.084	1.086
F129-12-08	1.079 cB	1.087 dA	1.087	1.075	1.082
F124-12-01	1.082 bB	1.085 eA	1.090	1.077	1.084
F60-11-02	1.086 aB	1.088 cA	1.090	1.084	1.087
F63-10-13A	1.086 aB	1.090 bA	1.105	1.083	1.091
F63-12-04	1.080 cB	1.090 bA	1.088	1.077	1.084
OD38-06	1.076 dB	1.084 fA	1.079	1.075	1.079
EP120	1.083 bB	1.095 aA	1.094	1.084	1.089
EP121	1.074 eB	1.084 fA	1.084	1.075	1.079
ORG725	1.079 cA	1.078 hB	1.083	1.069	1.077
ORG2798	1.079 cA	1.079 hA	1.082	1.077	1.079
ORG4446	1.076 dA	1.079 gA	1.085	1.073	1.078
ORG14599	1.074 eB	1.075 iA	1.080	1.068	1.074
ORG6408	1.071 fA	1.084 fA	1.096	1.087	1.085
Asterix	1.071 fB	1.080 gA	1.071	1.076	1.075
Markies	1.075 dB	1.083 fA	1.083	1.070	1.078
Atlantic	1.082 bB	1.088 cA	1.095	1.083	1.087
Means	1.079	1.084	1.087	1.078	1.082
CV (%)	0.16	0.15	-	-	-

Genotype	Chip color[2]			
	Canoinhas Conv. system		Brasília Conv. system	Means
	2018	2019	2020[1]	
F53-11-05	5.00 bA	4.25 bA	7.00	5.42
F129-12-08	7.00 aA	6.75 aA	9.00	7.58
F124-12-01	7.25 aA	4.50 bA	7.00	6.25
F60-11-02	8.00 aA	5.50 bA	9.00	7.50
F63-10-13A	5.25 bA	5.75 bA	7.00	6.00
F63-12-04	4.25 bA	6.25 aA	7.00	5.83
OD38-06	9.00 aA	8.25 aA	7.00	8.08
EP120	8.00 aA	8.00 aA	7.00	7.67
EP121	8.25 aA	6.00 bA	9.00	7.75
ORG725	5.00 bA	5.75 bA	7.00	5.92
ORG2798	4.50 bA	4.25 bA	9.00	5.92
ORG4446	8.00 aA	7.00 aA	7.00	7.33
ORG14599	6.00 bA	4.00 bA	5.00	5.00
ORG6408	4.75 bA	4.00 bA	7.00	5.25
Asterix	6.25 bA	6.75 aA	7.00	6.67
Markies	8.00 aA	7.75 aA	7.00	7.58
Atlantic	8.75 aA	7.75 aA	9.00	8.50
Means	5.00	4.25	7.47	5.57
CV (%)	8.66	8.78	-	-

Means followed by the same lowercase letter in the column and uppercase in the row belong to the same group by the Scott & Knott test at 5% probability. CV (%): coefficient of environmental variation. [1]There was only one replication and the anova was not performed. [2]Chip color: 1= dark; 9= light.

a relation between vigorous plants and late maturity (Lamboro *et al*., 2014; Silva *et al*., 2019a). Early cultivars allow higher number of harvests throughout the year, additionally to a shorter time of plant exposure to biotic and abiotic stresses as well as lower demand for irrigation.

Observing the frying quality traits (Table 3), the classification of check cultivars for french fries, 'Asterix' and 'Markies', and check for chips, 'Atlantic', the specific gravity and chip color was as expected, with a better frying quality for 'Atlantic' and also good quality for 'Asterix', and mainly for 'Markies' indicating that the environments were favorable for the expression of these traits. Concerning the processing requirements, dry matter content, or specific gravity, it depends on the type of product. For french fry production, it ranges from 18 to 24% (specific gravity of 1.070 to 1.097), whereas for chip production, a higher content is required, between 20 and 24% (specific gravity of 1.077 to 1.097), due to its higher surface/volume ratio, which increases absorption and superficial oil retention (Pádua *et al*., 2010). Clones F60-11-02, F63-10-13A, and EP120 had a specific gravity comparable with 'Atlantic'. Most genotypes presented the specific gravity standards for french fries in all experiments, but not ORG725, ORG2798, and ORG14599.

For chip color, the clone F129-12-08 had a performance similar to 'Atlantic', and 'OD38-06', EP120 and ORG6408 were similar to 'Markies'. In addition, clone F63-12-04 performed similarly to 'Asterix'. Identifying genotypes with good tuber yield and exceptional frying quality is not easy, especially concerning frying color (Bradshaw *et al*., 2000; Luthra *et al*., 2018; Silva *et al*., 2018, 2021).

It was observed that clones F63-10-13A and EP121 performed well for tuber yield in all experiments. F129-12-08 presented a good frying quality, and F63-12-04 had a tuber yield and frying quality similar to 'Asterix'. 'OD38-06' had a tuber yield similar to 'Asterix' and 'Markies', and frying quality similar to 'Markies'. The clones selected in the organic system had a better performance in this system, but not a prevalence of specific and exclusive adaptability of these clones to the organic system. The difference in marketable tuber yield between the two systems was higher for the foreign cultivars than for the clones, with the potential marketable tuber yield reaching at least 35 to 36 t/ha even in the organic system, and with clones not developed in the conventional system, such as the 'F63-10-13A'.

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