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WATERMELON YIELD AND FRUIT QUALITY UNDER DIFFERENT GRAFT PATTERNS AND NPK DOSES

Rendimiento y calidad de la sandía bajo diferentes patrones de injerto y dosis de NPK

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ABSTRACT. The watermelon graft on pumpkin rootstocks protects the plant from pathogens from the soil and it could increase the yield. The purpose of this work was to evaluate the effects of rootstocks and NPK (N, P_2O_5, K_2O) doses on yield and fruit quality of the Royal Charleston watermelon hybrid. The experiment was carried out in the municipality of Santa Elena, Ecuador, between October 2014 and February 2015 on Inceptisol soil with sandy loam texture. It was evaluated three rootstocks (Shintoza, RS-841 and Ercole interspecific hybrids of *Cucurbita maxima* x *Cucurbita moschata*), three doses of nitrogen (100, 150, 200 kg ha^{-1}), three of phosphorus (60, 80, 100 kg ha^{-1}) and three of potassium (150, 200, 250 kg ha^{-1}) in an orthogonal design L9 (3)^4, arranged in a completely random block design with three replicates. The variables evaluated were: stem diameter, number of fruits per plant, fruit weight, agricultural yield (t ha^{-1}); total soluble solids expressed as ^{o}Brix, flesh firmness and peel thickness. In addition, it was the "regular analysis", which includes elaboration of the response table, selection of the optimal combination and prediction of the maximum response. The Royal Charleston watermelon hybrid grafted on the pumpkin pattern RS-841, by the approach method and the application of a mineral fertilization of 150, 100 and 150 kg ha^{-1} of NPK produced the highest quantity of fruits and the yield was significantly higher than other analyzed variables.

Key words: *Citrullus lanatus*, grafting, pumpkin, fertilization, production

RESUMEN. El injerto de sandía sobre patrones de calabaza protege a la planta de patógenos del suelo y puede aumentar el rendimiento, por lo que el objetivo de este trabajo fue evaluar los efectos de patrones y dosis de NPK (N, P_2O_5, K_2O) sobre el rendimiento y calidad del fruto del híbrido de sandía Royal Charleston. El experimento se realizó en el municipio de Santa Elena, Ecuador, entre octubre 2014 y febrero de 2015 en un suelo Inceptisol de textura franco arenosa. Se evaluaron tres portainjertos (Shintoza, RS-841 y Ercole, híbridos interespecíficos de *Cucurbita maxima* x *Cucurbita moschata*), tres dosis de nitrógeno (100, 150, 200 kg ha^{-1}), tres de fósforo (60, 80, 100 kg ha^{-1}) y tres de potasio (150, 200, 250 kg ha^{-1}) en un diseño ortogonal L9 (3)^4, dispuestos en bloques completamente al azar con tres réplicas. Las variables evaluadas fueron: diámetro de tallo, frutos por planta, masa del fruto, rendimiento agrícola (t ha^{-1}); sólidos solubles totales expresados en grados Brix, firmeza de la pulpa y espesor de corteza; además se realizó el "análisis regular", que comprende elaboración de la tabla de respuesta, selección de la combinación óptima y la predicción de la máxima respuesta. El híbrido de sandía Royal Charleston injertado sobre el patrón de calabaza RS-841, mediante el método de aproximación y la aplicación de una fertilización mineral de 150, 100 y 150 kg ha^{-1} de NPK respectivamente produjo la mayor cantidad de frutos y su rendimiento fue significativamente mayor que el resto de las variantes estudiadas.

Palabras clave: *Citrullus lanatus*, injerto, calabaza, fertilización, producción

INTRODUCTION

Watermelon [*Citrullus lanatus* (Thunb.) Matsum. and Nakai] production is a very important activity for small and medium producers in the provinces of Manabí, Guayas and Santa Elena in Ecuador. Between 2010 and 2015 the planted area increased by less than 10 % with a yield of around 15 t ha^{-1} (1), due to attacks of soil fungi, especially *Fusarium oxysporum*

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f.sp. niveum which is the main causal agent, as in other regions of the world (2).

To counteract the incidence of this pathogen, it is common practice in Japan, China and Europe to graft watermelon on squash patterns (*Cucurbita maxima* or *Cucurbita maxima* x *Cucurbita moschata*) and other cucurbitaceae species but rootstock/graft combinations must be carefully determined in each case production region (3).

Watermelon grafting on pumpkin patterns is new in Ecuador, so it is necessary to investigate different phytotechnical aspects, among which fertilization occupies a very important place because nitrogen and potassium are the nutrients most used by this species (4). Nitrogen is the macronutrient essential for the growth and development of the plant (5) and absorbs it in the form of nitrate (NO_3^-) and ammonium (NH_4^+), forming part of glutamine, glutamate or glutamate dehydrogenase, which are precursors of amino acids and proteins (6).

Potassium is the most extracted nutrient between 45 and 65 days, it favors the yield and the quality of the fruits (7), while phosphorus, due to its low concentration in the soil solution, is little available for plants, reducing the photosynthetic rate and intercellular carbon concentration, which influences the final quality of the fruit (8). Therefore, the objective was to evaluate the effect of three grafting patterns and dose of NPK on the yield and quality of the watermelon fruit.

MATERIALS AND METHODS

The experiment was carried out in the municipality of Santa Elena, Ecuador, the geographic coordinates of the site are South Latitude 1º56'9 "and West Longitude 80º41'20", at a height of 47 m a.s.l flat topography.

The main climatic variables of the place are: average temperature 26.6 ºC, relative humidity between 74 and 82 % and precipitation around 100-250 mm in December-May (9).

Inceptisol soil with sandy loam texture; cation exchange capacity 29 meq 100 g^{-1} soil; 0.59 % organic matter; phosphorus 60 mg mL^{-1}; potassium 581 mg mL^{-1}; electric conductivity in the saturation paste 1.49 mS cm^{-1}. Irrigation water was obtained from an artesian well with EC of 1.837 mS cm^{-1} and pH 6.9.

In the experimental field, watermelon is planted since 1984 and left fallow every year from May to October. The experimental results reported here correspond to the period between October 2014 and February 2015. These constitute the continuity of the one reported (10) whose results were the basis of the proposed design.

The watermelon hybrid [*Citrullus lanatus* (Thunb.) Matsum was evaluated. and Nakai] Royal Charleston grafted on three patterns: Shintoza, RS-841 and Ercole (interspecific hybrids of *Cucurbita maxima* x *Cucurbita moschata*), three doses of nitrogen: 100, 150, 200 kg ha^{-1}, three of phosphorus: 60, 80 , 100 kg ha^{-1} and three of potassium: 150, 200, 250 kg ha^{-1}, determined according to the experiences of different authors (10-12) in an orthogonal design L9 (13). The treatments are ordered sets of factors and levels (compound treatments), predefined in matrices elaborated for their direct application in the experimentation (Table 1).

The different combinations of rootstock and NPK dose were arranged in a completely random block design with three replicas. The application of nitrogen and potassium was carried out with the help of three polyethylene tanks (200 L) and three Venturi tubes to inject into the irrigation lines the fertilizer doses of each treatment.

Table 1. Matrix L9 (3)4 of treatments of the experiment

Treatments	Taguchi matrix (13)				Treatments			
	Patterns	N	P	K	Patterns	N	P_2O_5 (kg ha^{-1})	K_2O
1	1	1	1	1	Shintoza	100	60	150
2	1	2	2	2	Shintoza	150	80	200
3	1	3	3	3	Shintoza	200	100	250
4	2	1	2	3	RS-841	100	80	250
5	2	2	3	1	RS-841	150	100	150
6	2	3	1	2	RS-841	200	60	200
7	3	1	3	2	Ercole	100	100	200
8	3	2	1	3	Ercole	150	60	250
9	3	3	2	1	Ercole	200	80	150

The sources used of NPK were: ammonium nitrate (35 % N); ammonium monophosphate (11 % N+52 % P_2O_5) and potassium sulfate (50% K_2O), respectively. Doses of nitrogen and potassium were divided into 36 fertigation, according to the phenological stages of the watermelon. The fertigation began after the transplant and ended before the end of the vegetative cycle (week 12). The phosphorus (ammonium monophosphate) was applied in its entirety, at the time of the transplant, at the bottom of the hole made for each plant.

The watermelon was planted on October 10th, 2014 and six days later the pumpkin in trays of 128 alveoli that contained peat bog Lambert BM 2 of Sphagnum with fine vermiculite, a load of macro and micronutrients, pH adjusted (5,4-6, 3) also composed of dolomite, calcitic limestone and a wetting agent. It was grafted by approximation (14) on October 22th and transplanted 10 days later.

Each experimental unit was composed of three lines with 17 plants (distance between lines 4 m and between plants 0.6 m) and 10 were considered from the central line, for the evaluations. The harvest was made considering the technical maturity of the fruit, whose most outstanding indicator is the intense yellowing of the part that is in contact with the soil.

The agronomic variables evaluated were: stem diameter, expressed in mm (Vernier digital caliper model Truper 14388); number of fruits per plant; average fruit mass in kg (digital scale 0-30 kg, GHS); agricultural yield (t ha^{-1}); quality variables: total soluble solids expressed in ºBrix (Ataga refractometer Master-20α model); firmness of the pulp in kg cm^{-2} (Wagner penetrometer 0-5 kg); bark thickness (mm).

With the data obtained, the variance analysis was performed and the significant effects of the treatments were determined by the Tukey test (p≤0.05) in the statistical package INFOSTAT professional version for Windows (15).

The "regular analysis" was carried out (13), which comprises: elaboration of the response table, selection of the optimal combination and prediction of the maximum response $=\bar{y}+\Sigma(Ai-\bar{y})+(Bi-\bar{y})+(Ci-)+(Di-\bar{y})$, where ȳ-Mean General; Ai-Higher value of level i of factor A; Bi - Higher value of level i of factor B; Ci-Higher value of level i of factor C; Di-Greater value of level i of factor D.

RESULTS AND DISCUSSION

In the data presented in Table 2 it can be observed that there were no significant differences (p≤0.05) between patterns, plus the different combinations of NPK in the variables stem diameter and fruit mass; however, in treatment 5 (RS-841, N_{150}, P_{100} and K_{150}) the highest number of fruits per plant was obtained and, therefore, the highest agricultural yield, being significantly higher than the rest of the variants studied.

The plants grafted on pumpkin are efficient in the absorption of N, K and Mg and, therefore, require less fertilizers (16,17), which is explained in the characteristics of the root that is thick, with very expansive branches that they weave a network of rootlets around the plant (18).

Table 2. Stem diameter, agricultural yield and performance components in the Royal Charleston hybrid grafted on standards, under different doses of NPK

	Treatments		Diameter stem (mm)	Number of fruits per plant	Average fruit mass (kg)	Agricultural yield (t ha^{-1})
	Pattern	Dose (N-P-K)				
1	Shintoza	100 60 150	11,9	2,0 cd	7,5	63,5 ab
2	Shintoza	150 80 200	11,1	2,3 ab	7,0	66,0 ab
3	Shintoza	200 100 250	11,7	1,9 cde	7,5	59,0 b
4	RS-841	100 80 250	12,1	1,8 de	7,9	60,1 b
5	RS-841	150 100 150	11,8	2,5 a	7,6	78,7 a
6	RS-841	200 60 200	11,5	1,8 de	6,9	53,3 b
7	Ercole	100 100 200	11,5	1,9 cde	7,4	57,8 b
8	Ercole	150 60 250	11,6	2,1 bc	7,4	65,8 ab
9	Ercole	200 80 150	11,4	1,7 e	7,7	54,7 b
	EE±		0,3	0,05	0,28	3,04
	C.V (%)		6,5	4,4	6,6	8,5

Mean with different letters in the same column differ according to Tukey (p≤0,05)

In Turkey, the watermelon hybrids Crimson Tide, Dumara (hybrid of characteristics similar to Royal Charleston) and Farao on the Dynamo, RS-841 and Shintosa standards with 150 kg of nitrogen, 120 kg of phosphorus and 200 kg of potassium per hectare were grafted. respectively; in all cases the grafted plants outnumbered the non-grafted plants (19), as there was an increase in the size of the fruits (20) and higher yields were obtained (11,21-23).

The superior results are due to the fact that the rootstock promotes the movement of water and nutrients towards the graft, since there is better development of the vascular bundles, which at the same time depend on the good adherence between the two parts (24); nitrogen increases the number of fruits and, therefore, the productivity up to a certain dose (25,26); excessive doses decrease the number of fruits per plant, due to the exaggerated growth of the area, hindering the pollination of female flowers (27).

In addition, grafted plants have specific physiological mechanisms to access sufficient amounts of potassium (absorption efficiency) and to use the absorbed nutrient more effectively (efficiency of use) (17).

The different combinations of NPK patterns and doses did not significantly influence any of the quality variables evaluated (Table 3). The soluble solids in this study were similar to those reported by other researchers indicating that this variable depends on the rootstock (28). The firmness of the pulp, with values around 1.5 kg cm^{-2}, corresponds to the "crunchy" watermelon that the market appreciates, but this attribute depends more on the cutting moment than on the origin of the fruit, or on grafted plants or without grafting and environmental conditions (29).

The watermelon is classified as thick-crust when measured from 10 to 20 mm (30) and it is of practical importance during harvesting, transport, packaging and distribution since it resists physical damage (31).

The regular analysis (13) determined the optimal combination of factors and levels under study, in relation to the agricultural yield (t ha^{-1}), resulting in the RS-841 standard with doses of 150 kg ha^{-1} of nitrogen, 100 kg ha^{-1} of phosphorus and 150 kg ha^{-1} of potassium, respectively (Table 4).

Table 3. Quality of the Royal Charleston watermelon fruit grafted under different patterns and doses of NPK

Treatments					Total soluble solids (°Brix)	Bark thickness (mm)	Pulp firmness
	Pattern	Dose (N-P-K)					(kg cm^{-2})
1	Shintoza	100	60	150	9,9	10,3	1,6
2	Shintoza	150	80	200	10,1	11,5	1,6
3	Shintoza	200	100	250	11,1	10,9	1,5
4	RS-841	100	80	250	11,7	11,8	1,6
5	RS-841	150	100	150	10,3	11,2	1,5
6	RS-841	200	60	200	10,1	11,5	1,4
7	Ercole	100	100	200	10,6	11,8	1,6
8	Ercole	150	60	250	8,6	12,0	1,5
9	Ercole	200	80	150	10,7	10,8	1,4
	EE±				1,03	0,58	0,27
	C.V. %				17,2	8,8	5,9

Table 4. Partial effect of the factors Patterns (A), Nitrogen (B), Phosphorus (C) and Potassium (D) on the agricultural yield of watermelon (t ha^{-1})

Levels	Factors				
	Patterns (A)	Nitrogen (B)	Phosphorus (C)	Potassium (D)	Average
1	62,8	60,5	60,9	65,7	62,5
2	64,1	70,2	60,3	59,1	63,4
3	59,5	55,7	65,2	61,6	60,5
Media	62,1	62,1	62,1	62,1	62,1
Optimal combination	A2	B2	C3	D1	
	RS-841	N_{150}	P_{100}	K_{150}	

The prediction equation is:

$\bar{y}=62.1+\Sigma(64.1-62.1)+(70.2-62.1)+(65.2-62.1)+(65.7-62.1)$

$\bar{y}=62,1+\Sigma(2,0)+(8,1)+(3,1)+(3,6)=62,1+16,8=78,9$ t ha^{-1}

According to the results of the previous equation, in the increase of 16.8 t ha^{-1}, 12.0 % corresponds to the graft pattern (2.0 t ha^{-1}), 48.2 % to the nitrogen dose (8.1 t ha^{-1}), 18.5 % at the phosphorus dose (3.1 t ha^{-1}) and 21.5 % at the potassium dose (3.6 t ha^{-1}).

CONCLUSIONS

The Royal Charleston watermelon hybrid grafted on the RS-841 pumpkin pattern, using the approach method and the application of a mineral fertilization of 150, 100 and 150 kg ha^{-1} of N, P_2O_5 and K_2O, respectively, produced the largest number of fruits and its yield was significantly higher when compared to the rest of the treatments studied. None of the three tested standards nor the NPK doses influenced the quality of the fruit.

BIBLIOGRAPHY

1. FAO Statical Pocketbook. World food and agriculture [Internet]. FAO. Food and Agriculture Organization of the United Nations, Rome; 2015. Available from: http://www.fao.org/3/a-i4691e.pdf
2. Keinath AP, Hassell RL. Suppression of Fusarium wilt caused by *Fusarium oxysporum* f. sp. *niveum* race 2 on grafted triploid watermelon. Plant Disease. 2014;98(10):1326–32. doi:10.1094/PDIS-01-14-0005-RE
3. Kurum R, Çelik İ, Eren A. Effects of rootstocks on fruit yield and some quality traits of watermelon (*Citrullus lanatus*). Derim. 2017;34(2):91–8. doi:10.16882/derim.2017.283012
4. Silva M da, Chaves SWP, Medeiros J de, Souza M de, Santos A do, Oliveira FL. Acúmulo e exportação de macronutrientes em melancieiras fertirrigada sob ótimas condições de adubação nitrogenada e fosfatada. Agropecuária Científica no Semi-Árido. 2012;8(4):55–9. doi:10.30969/acsa.v8i1.438
5. Nawaz MA, Wang L, Jiao Y, Chen C, Zhao L, Mei M, *et al*. Pumpkin rootstock improves nitrogen use efficiency of watermelon scion by enhancing nutrient uptake, cytokinin content, and expression of nitrate reductase genes. Plant Growth Regulation. 2017;82(2):233–46. doi:10.1007/s10725-017-0254-7
6. Luo J, Li H, Liu T, Polle A, Peng C, Luo Z-B. Nitrogen metabolism of two contrasting poplar species during acclimation to limiting nitrogen availability. Journal of Experimental Botany. 2013;64(14):4207–24. doi:10.1093/jxb/ert234
7. Almeida EIB, Corrêa MC de M, Nóbrega GN, Pinheiro EAR, Lima FF. Crescimento e marcha de absorção de macronutrientes para a cultivar de melancia Crimson Sweet. Revista Agro@mbiente on-Line. 2012;6(3):205. doi:10.18227/1982-8470ragro.v6i3.778
8. Meng X, Liu N, Zhang L, Yang J, Zhang M. Genotypic differences in phosphorus uptake and utilization of watermelon under low phosphorus stress. Journal of Plant Nutrition. 2014;37(2):312–26. doi:10.1080/01904167.2013.852225
9. Instituto Nacional de Meteorología e Hidrología. Anuario meteorológico [Internet]. Jácome C, editor. Quito, Ecuador: INAMHI; 2015. 153 p. Available from: http://www.serviciometeorologico.gob.ec/wp-content/uploads/anuarios/meteorologicos/Am%202012.pdf
10. Orrala N. Influencia de patrones sobre la producción y calidad del fruto de sandía en Santa Elena, Ecuador. Centro Agrícola. 2013;40(4):11–8.
11. Mascorro AG, Arellano J de JE, Sánchez DGR, Juárez IR. Efecto del injerto y uso de microtúneles más ambiente natural en el rendimiento de sandía en la región lagunera. Agrofaz: publicación semestral de investigación científica. 2012;12(4):73–8.
12. Yetisir H, Özdemir AE, Aras V, Candır E, Aslan Ö. Rootstocks effect on plant nutrition concentration in different organ of grafted watermelon. Agricultural Sciences. 2013;04(05):230–7. doi:10.4236/as.2013.45033
13. Taguchi G, Elsayed EA, Hsiang TC. Quality engineering in production systems [Internet]. U.S: McGraw-Hill Inc; 1989 [cited 2018 Jun 22]. 173 p. (The McGraw-Hill series in industrial engineering & management science). Available from: https://books.google.com.cu/books/about/Quality_engineering_in_production_system.html?id=QNtTAAAAMAAJ&redir_esc=y
14. Gómez M. Injerto de hortalizas. Generalitat Valenciana. Conselleria de Agricultura, Pesca y Alimentación, Valencia, España. 1997;88.
15. Di Rienzo J, Casanoves F, Balzarini M, González L, Tablada M, Robledo C. InfoStat, versión 2008, Grupo InfoStat, FCA, Universidad Nacional de Córdoba, Argentina. 2008.
16. Huang Y, Li J, Hua B, Liu Z, Fan M, Bie Z. Grafting onto different rootstocks as a means to improve watermelon tolerance to low potassium stress. Scientia Horticulturae. 2013;149:80–5. doi:10.1016/j.scienta.2012.02.009
17. Huang Y, Zhao L, Kong Q, Cheng F, Niu M, Xie J, *et al*. Comprehensive mineral nutrition analysis of watermelon grafted onto two different rootstocks. Horticultural Plant Journal. 2016;2(2):105–13. doi:10.1016/j.hpj.2016.06.003
18. Gaspera P. Manual del cultivo del zapallo anquito (*Cucurbita moschata* Duch.) [Internet]. Instituto Nacional de Tecnología Agropecuaria: Ediciones INTA, La Consulta - Mendoza - Argentina; 2013 [cited 2018 Jun 25]. 175 p. Available from: https://inta.gob.ar/documentos/manual-del-cultivo-del-zapello-anquito-cucurbita-moschata-duch
19. Turhan A, Ozmen N, Kuscu H, Serbeci MS, Seniz V. Influence of rootstocks on yield and fruit characteristics and quality of watermelon. Horticulture, Environment, and Biotechnology. 2012;53(4):336–41. doi:10.1007/s13580-012-0034-2
20. Lee J-M, Kubota C, Tsao SJ, Bie Z, Echevarria PH, Morra L, *et al*. Current status of vegetable grafting: Diffusion, grafting techniques, automation. Scientia Horticulturae. 2010;127(2):93–105. doi:10.1016/j.scienta.2010.08.003

21. Gama RNC de S, Dias R de CS, Alves JC da S, Damaceno LS, Teixeira FA, Barbosa G da S. Taxa de sobrevivência e desempenho agronômico de melancia sob enxertia. Horticultura Brasileira. 2013;31(1):128–32. doi:10.1590/S0102-05362013000100020
22. Santos JS dos, Dias R de CS, Grangeiro LC, Lima MAC de, Andrade KMNSS. Compatibilidade com porta-enxertos, rendimento e qualidade de frutos em cultivares de melancia triploide. Revista Caatinga, Mossoró. 2014;27(2):141–7.
23. Orrala N, Herrera L, Arzube M, Pozo L. Efecto de nematicidas biológicos y del portainjerto en la producción de sandía (*Citrullus lanatus* L.) en Ecuador. Centro Agrícola. 2016;43(4):36–41.
24. Mohamed FH, El-Hamed KEA, Elwan MWM, Hussien MNE. Evaluation of different grafting methods and rootstocks in watermelon grown in Egypt. Scientia Horticulturae. 2014;168:145–50. doi:10.1016/j.scienta.2014.01.029
25. Silva J. Desempenho agronômico e acúmulo de nutrientes em melancia submetida à enxertia e adubação nitrogenada [Tese de Doutorado]. [Estado de Rio Grande do Norte, Brasil]: Universidade Federal Rural do Semi-Árido; 2016. 101 p.
26. Filgueira F. Novo manual de olericultura: agrotecnologia moderna na produção e comercialização de hortaliças [Internet]. Universidad Federal de Vicosa, Brasil: UFV; 2008 [cited 2018 Jun 25]. 422 p. Available from: https://www.ciadoslivros.com.br/novo-manual-de-olericultura-250307-p14849
27. Bekhradi F, Kashi A, Delshad M. Effect of three cucurbits rootstocks on vegetative and yield of'Charleston Gray'watermelon. International Journal of Plant Production. 2012;5(2):105–10. doi:10.22069/ijpp.2012.724
28. Álvarez JC, Castellanos JZ, Aguirre CL, Huitrón MV, Camacho F. Influence of rootstocks on fusarium wilt, nematode infestation, yield and fruit quality in watermelon production. Ciência e Agrotecnologia. 2015;39(4):323–30. doi:10.1590/S1413-70542015000400002
29. Fernández EJ, Camacho F. El cultivo de sandia apirena injertada, bajo invernadero, en el litoral mediterraneo español [Internet]. 1ª ed. Almería, España: Caja Rural. Sociedad Cooperativa de Crédito. Cajamar; 2000 [cited 2018 Jun 25]. 316 p. Available from: https://www.agapea.com/libros/El-cultivo-de-sandia-apirena-injertada-bajo-invernadero-en-el-litoral-mediterraneo-espanol-9788492278596-i.htm
30. Reche J. Cultivo de la sandía en invernadero. Almería: Colegio Oficial de Ingenieros Técnicos Agrícolas; 1994. 244 p.
31. Dias R de CS, Resende GM de, Costa ND. Sistema de produção de melancia. colheita e pós-colheita. Embrapa Semiárido. Sistema de Produção, 6. 2010.

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