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Integrated production of grapes for juice in southern Brazil

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Abstract: New concepts of agricultural production should be introduced in Brazilian agriculture to become competitive. The integrated system is an agricultural technology that should be also applied to grape production. The purpose of this work was to evaluate two systems of agriculture production. Two plots (Plot IP), *Vitis labrusca* grapes and Hybrid, were chosen in fields conducted within the integrated production system (IPS) for juice production. All practices adopted in the plots were documented in a field book to ensure the traceability. The results were compared with Conventional System (CS) production of the same cultivars situated in two neighboring areas. The IPS plots provided a decrease in the amount of fungicides by 36.46% (fungicide g/ha). In Conventional System, 3,000 ml herbicide/ha were used. In IPS, herbicide was not applied due to the maintenance of the ground cover. Grapes produced in this system resulted in a yield 32.08% higher than in CS. There was no insecticide application in any of the two systems. The IPS provided a reduction in pesticide application without affecting yields and the biological assays revealed no presence of metabolism inhibitors. With the IPS, it is possible to product high-quality grapes that are safe for both consumers and farmers.

Key words: *Vitis labrusca*, monitoring of pests and diseases, integrated management

Introduction

To introduce new concepts in a traditional agriculture management is not an easy task. To find effective methodologies to analyses integrated systems is hard task either. In a partnership involving Embrapa Uva e Vinho and Brazilian public and private institutions, a project of Standards Integrated Production of Grape Processing began in 2010. Two plots, cv. Concord (*Vitis labrusca*) and cv. Isabel (Hybrid), were selected in fields conducted within the integrated production system (IPS) of grape for juice in the State of Rio Grande do Sul, which the main grape producing region in Brazil. This work focuses on the results obtained adopting integrated production of grapes for juice in comparison with conventional production of the same cultivars grown in two neighboring areas.

Material and methods

Pests and diseases

The monitoring of pests was carried out in each plot by: a) McPhail Trap model to capture the adult fruit fly [*Anastrepha fraterculus* (Wiedemann)] b) Delta trap model for capturing adult moth-of-clusters [*Cryptoblabes gnidiella* (Millière)] c) Visual monitoring of damage in leaves, branches and bunches for other pests of importance to the region, such as the beetle defoliator [*Maecolaspis aenea* (F.)]. Pesticide was only applied when the pest incidence reaches its respective infestation level. For disease control, it was considered the phenological stage of the plant, period of the year of occurrence of the disease and weather, to prevent the occurrence of diseases such as anthracnose [*Elsinoe ampelina* (deBary)], mildew [*Plasmopara viticola* (Berk. and Curt.) Berl. and de Toni] and powdery mildew [*Uncinula necator* (Schwein.)]. Attractive ingredients applied were registered for use on grapes, following the instructions of the manufacturer.

Soil fertilization and ground cover

The soil corrective fertilization was made according to soil and leaf tissues analysis and no herbicide was applied to plots of IPS.

Biological assay for chemical residue detection

Microorganisms

The strain *Saccharomyces cerevisiae* Embrapa 1vvt/97 was used to evaluate the presence of inhibitors of the must from IPS grapes. The yeasts were maintained in G7 (Silva *et al*., 2006) and must agar (Silva, 1996).

Grapes

The grapes of the cultivars Concord (Garibaldi-RS) and Isabel (Caxias do Sul-RS) were collected from vineyards in sterile plastics bags and macerated in the same plastic bags. The must samples were then decanted for sugar analysis by sulfuric acid and Fehling as described by Dubois *et al.* (1956) and Ribéreau-Gayon *et al.* (1982), respectively.

Fermentation of serial diluted must

The fermentation procedure was based on Silva *et al.* (2007) with modification. It was used the Concord, Isabel and Lorena (control) musts. The G7 medium (pH 4.0) containing 150 g/l sucrose was used to perform the dilution of the musts. An aliquot of 1 ml of cell suspension containing 107 cells/ml of *Saccharomyces cerevisiae*, diluted in the respective must was transferred to screw-capped test tubes with 9 ml of respective medium with following must composition:

1. Must 9 ml - G7 0 ml-Inoculum 1 ml = 10 ml → 100% Must
2. Must 8 ml - G7 1 ml-Inoculum 1 ml = 10 ml → 90% Must
3. Must 7 ml - G7 2 ml-Inoculum 1 ml = 10 ml → 80% Must
4. Must 6 ml - G7 3 ml-Inoculum 1 ml = 10 ml → 70% Must
5. Must 5 ml - G7 4 ml-Inoculum 1 ml = 10 ml → 60% Must
6. Must 4 ml - G7 5 ml-Inoculum 1 ml = 10 ml → 50% Must
7. Must 3 ml - G7 6 ml-Inoculum 1 ml = 10 ml → 40% Must
8. Must 2 ml - G7 7 ml-Inoculum 1 ml = 10 ml → 30% Must
9. Must 1 ml - G7 8 ml-Inoculum 1 ml = 10 ml → 20% Must
10. Must 0 ml - G7 9 ml-Inoculum 1 ml = 10 ml → 10% Must
11. Lorena 9 ml + G7 0 ml + Inoculum 1 ml = 10 ml → 100% Must (Control)

The metabolic activity based on CO_2 evolution was measured by gravimetry according to Giudici and Zambonelli (1992). The experimental design was entirely randomized with three repetitions.

The analysis of variance (one-way Anova) the difference between means by Tukey test, and regression analysis were performed using the R program (Version 2.6.2) (Venables *et al.*, 2004). The difference was considered significant and highly significant at $P < 0.05$ and $P < 0.01$, respectively.

Chemical analysis of residue

The Brazilian government has an official program of integrated production (Brasil, 2010). For auditing purposes, periodically the government publishes an updated list of chemical molecules to be analyzed in each type of food and the list of laboratories accredited by government official institutes to perform these analyses. The last published list for grapes was I.N. 25 (Brasil, 2011). Based on the list of molecules allowed for use in grapes, IPS juices were analyzed using three methods:

1. Liquid chromatography applied mass spectrometry sequentially (LC-MS/MS) (Anastassiades *et al.*, 2003), to: Acephate; Acetamiprid; Aldicarb; Aldicarb sulphone; Aldrin; Allethrin; Ametryn; Amicarbazone; Azinphos ethyl; Azinphos methyl; Azoxystrobin; Bifenthrin; Bioallethrin 1 and 2; Bitertanol; Boscalid; Buprofezin; Cadusafos; Carbaryl; Carbendazin (Benomyl, thiophanate methyl); Parâmetro; Carbofuran; Carbophenothion; Carbosulfan; Carpropamid; Chlorfenvinphos I, II; Chlormephos; Chlorpyrifos; Chlorpyrifos methyl; Chlorthiophos; Clofentezine; Clothianidin; Coumaphos; Cyanofenphos; Cyazofamid; Cyfluthrin (1,2,3,4); Cymoxanil; Cyphenothrin; Cyproconazole; Cyprodinil; DDT (SUM); Deltamethrin; Diazinon; Dichlofluanid; Dichlorvos; Dicofol; Dicrotophos; Difenoconazole 1, 2; Dimethoate; Dimethomorph (SUM); Diniconazole; Disulfoton; Diuron; Dodemorph; EPN; Epoxiconazole; Esfenvarelate; Ethiofencarb-sulfone; Ethiofencarb-sulfoxide; Ethion; Ethiprole; Ethoprophos; Etofenprox; Etrimfos; Famoxadone; Fenamidone; Fenamiphos; Fenarimol; Fenazaquim; Fenhexamid; Fenitrothion; Fenpropathrin; Fenpropimorph; Fenpyroximate; Fenthion; Fenvalerate (SUM); Fipronil; Flazasulforon; Fluazifop-p-buthyl; Flusilazol; Flutriafol; Fostiazate; Furathiocarb; Glyphosate; Heptenophos; Hexaconazole; Hexythiazox; Imazalil; Imazapic; Imazapyr; Imidacloprid; Indoxacarb; Iprovalicarb; Isocarbofos; Isoxaflutole; Kresoxim methyl; Lambda cyhalothrin; Linuron; Malathion; Mesotrione; Metalaxyl-M; Metconazole; Methamidophos; Methidathion; Methiocarb; Methomyl; Methoxyfenozide; Metribuzin; Metsulfuron methyl; Mevinphos (SUM); Monocrotophos; Myclobutanil; Nuarimol; Omethoate; Oxadixyl; Oxamyl; Oxicarboxin; Oxyfluorfen; Paclobutrazol; Paraoxon ethyl; Paraoxon methyl; Parathion ethyl; Parathion methyl; Penconazole; Pencycuron; Permethrin cis, trans; Phenthoate; Phorate; Phosalone; Phosmet; Phosphamidon (SUM); Picoxystrobin; Pirimicarb; Pirimiphos ethyl; Pirimiphos methyl; Prochloraz; Profenophos; Promecarb; Propargite; Propiconazole I, II; Propoxur; Prothiophos; Pyraclostrobin; Pyrazophos; Pyridaben; Pyridaphenthion; Pyrifenox; Pyrimethanil; Pyriproxyfen; Spinosad; Spiroxamine; Sulfometuron-methyl; Sulfotep; Tebuconazole; Tebufenozide; Tebufenpyrad; Terbufos; Tetraconazole; Tetradifon; Thiabendazole; Thiacloprid; Thiamethoxam; Thiobencarb; Thiodicarb; Thiophanate methyl; Tolylfluanid; Triadimefon; Triadimenol; Triazophos; Trichlorfon; Tricyclazole; Trifloxisulfuron sodium; Trifloxystrobin; Triflumizole; Trinexapac-ethyl; Triticonazole; Vamidathion

2. Gas chromatography with electron capture detection (GC/ECD), to: 4,4-DDD; 4,4-DDE; 4,4-DDT; Alachlor; Aldrin; Benfluralin; Bromophos-ethyl; Bromopropylate; Bromuconazole; Captafol; Captan; Chlordane (SUM); Chlorfenapyr; Chlorobenzilate; Chlorothalonyl; Cyfluthrin beta; Cypermethrin (alpha); Cypermethrin (beta); Cypermethrin (zeta); DDT (SUM); Dicloran; Dieldrin; Dodecachlor (mirex); Endosulfan (alpha e beta); Endrin; Fenchlorphos; Folpet; Heptachlor; Heptachlor epoxide (cis + trans); Hexachlorobenzene (HCB); Hexachlorocyclohexane (HCH) (alpha)'; Hexachlorocyclohexane (HCH)

(beta)'; Hexachlorocyclohexane (HCH) (delta)'; Hexachlorocyclohexane (Lindane); Iprodione; Isodrin; Methoxichlor; Nonachlor cis; Nonachlor trans; Procymidone; Quintozene; Trifluralin; Vinclozolin; Zoxamide, and

3. Gas chromatography-mass spectrometry (GC-MS) (The Netherlands, 1996), to: Dithiocarbamates in CS2.

Traceability

All practices adopted in the plots were documented in a 35 page field notebook, including: identification of the property; plot; technician; cultural practices; irrigation; fertilization; pest and disease monitoring; application of agrochemicals; weather conditions; use of hand labor and tractor; harvest conditions and checklist for auditing purposes. A copy of this book is sent to the grape processing plant, to ensure traceability.

Results and discussion

In the plots IPS, the honey dew moth was not detected, as well as the presence of insects. Few adults of the fruit fly *A. fraterculus* (4 adults/week/ha) were found only in the first three weeks of December and in only one IP field, where no control was required. In conventional areas, there was no presence of the honey dew moth or fruit fly. These results confirm that the honey dew moth is not a problem for varieties with compact clusters (Silva *et al.*, 2010), such as Concord and Isabel. In Southern Brazil, *Vitis labrusca* is not seriously affected by the fruit flies (Zart *et al.*, 2010).

In comparison with conventional system, the Plots IP provided a decrease in the amount of fungicides by 36.46% (fungicide g/ha). In Conventional System, 3,000 ml of herbicide/ha were used against 0.0% in IP system, due to the maintenance of the ground cover used in this system. There was no insecticide application in any of the two systems. The IP System has provided a reduction in pesticide application without affecting yields**,** resulting in a safer product for both the consumer and farmer, in addition it promoted environmental sustainability.

Table 1. Comparative data on productivity and agrochemicals applications between a CS and an IP System, 2011/2012 harvest, cvs. Isabel (Hybrid) and Concord (*Vitis labrusca*).

Plots/Cvs.	Productivity	Fungicide		Insecticide	Herbicide	Fertilization (kg/ha)		
	kg/ha	g/ha	ml/ha	ml/ha	ml/ha	N	P_2O_5	K_2O
cv. Isabel CS	26384.6	33150	2900	0	2500	2	77	8
Isabel Prod. IPS	36285.0	31850	6025	0	0	0	0	120
Concord CS	23500.0	6970	325	0	3500	3.75	15	12.5
Concord Prod. IPS	29761.9	2160	0	0	0	0	0	55.08

CS = Conventional System; IPS = Integrated Production System

The lowest pesticide application in the IP system did not result in lower productivity. Grapes produced in this system resulted in yield 32.08% higher than the same cultivars in conventional cultivation. The biological assay did not detect any metabolic inhibitors. This method of evaluation of metabolic activity has been used by Silva *et al.* (2007) to show the presence of captan in must from vineyards treated with this fungicide. The chemical analysis did not also reveal any presence of chemical residue in IPS, which means that the IP rules applied to grape for juice production are adequate.

References

Anastassiades, M., Scherbaum, E. & Bertsch, D. 2003: Validation of a simple and rapid multiresidue method (QuEChERS) and its implementation in routine pesticide analysis. Proceedings of the MGPR Symposium, Aix en Provence (France), May 2003. [www document] URL http://www.super-lab.com/cms/mestoZaUploadFajlove/QuEChERS_new_.pdf. Cited 14 nov. 2012.

Brasil. Ministério da Agricultura, Pecuária e Abastecimento. Gabinete do Ministro. 2011: Instrução Normativa nº 27 de 30 ago. 2010. Diário Oficial [da] República Federativa do Brasil 1: 7.

Brasil. Ministério da Agricultura, Pecuária e Abastecimento. Secretaria de Defesa Vegetal. 2011: Instrução Normativa nº 25 de 9 ago. 2011. Diário Oficial [da] República Federativa do Brasil, 1: 2-11.

Dubois, M., Gilles, K. A., Hamilton, J. K., Rebers, P., & Smith, F. 1956: Colorimetric method for determiantion of sugrs and related substances. Analytical Chemistry 28(3): 350-356.

Giudici, P. & Zambonelli, C. 1992: Biometric and genetic study on acetic acid production for breeding of wine yeast. Am. J. Enol. Vitic. 43(4): 370-374.

Ribéreau-Gayon, J., Peynaud, E., Sudraud, P., and Ribéreau-Gayon, P. 1982: Traité d'Enologie: siences et techniques du vin: analyse et contrôle des vins, Vol. I. Dunod, Paris, 617 pp.

Silva, G. A. da 1996: The occurrence of killer, sensitive, and neutral yeasts in Brazilian Riesling Italico grape must and the effect of neutral strains on killing behaviour. Appl. Microbiol. Biotechnol. 46(2):112-121.

Silva, G. A. da & Almeida, E. A. de 2006: Production of yellow-green fluorescent pigment by *Pseudomonas fluorescens*. Brazilian Archives Biology and Technology 49(3):411-419.

Silva, G. A. da, Santos, H. P. dos, Poli, J. S., Chavarria, G., Gurak, P. D., & Crocoli, C. 2007: Cultivo de videira protegido com cobertura plástica e sua relação com a fermentação do mosto. Proceedings of the VI SINAFERM and XVI Simpósio Nacional de Bioprocessos, Curitiba (Brazil): 1 CD-ROM.

Silva, L. D. da, Paranhos, J. B. A., Manzoni, C. G., Pereira, S. N., Lopes & Fabiana S. C. 2010: Bioecologia e Sugestões para o Manejo da Traça-dos-Cachos em Uva de Vinho no Submédio do Vale do São Francisco, Petrolina (Brazil), Embrapa. Circular Técnica 93, 11 pp.

The Netherlands Ministry of Public Health, Welfare and Sports, General Inspectorate for Health Protection 1996: Analytical methods for pesticide residues in foodstuffs, Vol. I. 6th edition. The Hague.

Venables, W. N., Smith, D. M. & R Development Core Team 2004: An introduction to R. Bristol, Network Theory.

Zart, M., Fernandes, O. A. & Botton, M. 2010: Biology and fertility life table of the South American fruit fly *Anastrepha fraterculus* on grape. Bulletin of Insectology 63(2): 237-242.