

Innovative fully biodegradable mulching films & fruit protection bags for sustainable agricultural practices

Agronomical and postharvest validation trials in field crops and commodities



**Final Conference LIFE Multibiosol, 29th May
2019, Zaragoza, Spain.**

Aula Dei Campus



Fundación Aula Dei
PARQUE CIENTÍFICO TECNOLÓGICO

PCTAD works in collaboration with regional, national and international institutions located in the Aula Dei Campus (Zaragoza) to support agri-food research and favor the transfer of its results to the business sector.

ACTION B.4:
Post-harvest validation tests



The Estación Experimental de Aula Dei (EEAD) is a Research Institute of the Consejo Superior de Investigaciones Científicas (CSIC) devoted to the research in Agricultural and Environmental Sciences.

The CSIC is the largest public research institution of the Ministry of Science and Innovation.

ACTION B.3:
Pre-harvesting field tests



The NCF Group is working in applied and basic research, to extend self life and quality of horticultural products, with special emphasis on the mitigation of physiological alterations. We develop new foliar fertilization strategies, characterizing the influence of the treatments on the morphology of tissues and foliar surfaces (SEM, TEM, histology) and their physical-chemical and biochemical properties. The group has strong links with crop production and fertilizer companies and this collaboration with the chemical and agricultural sectors has allowed the implementation of sustainable agronomic strategies related with calcium metabolism.

Group objectives are:

- Develop **agronomic techniques** to improve fruit quality, especially through **public-private partnerships**.
- Study **calcium metabolism in fruit trees and vegetables** to develop foliar fertilization strategies
- Apply the **postharvest physical treatments** developed by the group to reduce the incidence of physiopathies (apple and peach)
- Study fruit **proteomics** and the affected areas by disorders and its relationship with the **fruit allergens**.
- Contribute to the **implementation of new biobased and biodegradable plastic materials in fruit and vegetable** production (mulching and bagging of fruit).
- **Optimize cherry production** by preventing alterations due to rain, manipulation and other abiotic stresses.
- **Optimize peach production** by combining Controlled Deficit Irrigation, calcium treatments and monitoring by sensors in soil and plant and multispectral aerial images.



Multidisciplinary and Pluri-institutional Research Group:
Alimentos de Origen Vegetal. To7_17R (Grupo DGA 2017-2019). CSIC, UNIZAR, Gob Aragón, PCTAD

Plan Nacional de Investigación

- Mejora de la calidad de fruto en especies frutales a través de prácticas culturales, con especial referencia a los tratamientos de calcio exógeno. 201740E054.
- Reducción de fisiopatías en manzana mediante la aplicación de Tratamientos Postcosecha Combinados de Bajo Impacto (CDTI (subcontratación)).
- Mejora genética de patrones Prunus y variedades de melocotonero (MINECO AGL2014-52063-R).
- Actividades permanentes del Banco de Germoplasma de Manzano, Melocotonero y Patrones Prunus de la Estación Experimental de Aula Dei-CSIC (INIA RFP2015-00019-00-00).

Retos de Colaboración

- Fertilizantes foliares para potenciar la fijación biológica de nitrógeno en la filosfera (Retos-Colaboración con Fertinagor-Biotech S.L.). RTC-2017-59112.

Plan de Desarrollo Rural de Aragón

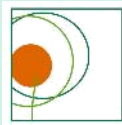
- Grupo Operativo para la mejora de la calidad de la manzana *Golden* de Valdejalón (GO-GOLDJALÓN).
- Grupo de Cooperación MELOCOTÓN 4.0: “Geomática, sensórica y prácticas agronómicas innovadoras para adaptar el cultivo de melocotón al cambio climático en el Bajo Aragón”.

Plan Nacional de Desarrollo Rural

- Grupo operativo para la reducción de fisiopatías en cereza: CHERRY CARE. Grupo Operativo Supra-Autonómico.
- Mejora de la calidad de frutas y hortalizas mediante una producción sostenible a través del uso de materiales biobasados y biodegradables. Grupo Operativo Supra-Autonómico AGROBIOSOL.

Proyectos Europeos

- Innovative fully biodegradable mulching films & fruit protection bags for sustainable agricultural practices. LIFE14 ENV/ES/000486- Multibiosol.
- Innovative Options for Water Resources Management in the Mediterranean (ERA-NET cofound Water Resources). (UE. PCIN-2017-020).



FOUNDING ENTITIES



CSIC
CONSEJO SUPERIOR DE INVESTIGACIONES CIENTÍFICAS



GOBIERNO DE ARAGON

PATRONS



Universidad Zaragoza



A powerful public-private partnership for innovation in the agri-food sector
"Instrument suitable to promote research in the agri-food sector and carry out the transfer of its results to the business sector" (article 1 Statutes of the Foundation).

- Technical support to entrepreneurs
- Specialized training
- Marketing strategies

Competitiveness and business development

Sustainable production

- Smart fertilization
- Agriculture 4.0
- Control of pathogens and pests
- Food security

WHAT DO WE DO?



Promoviendo la innovación en el sector agroalimentario aragonés

Quality and shelf life of products of plant origin

- New formats and varieties
- Fresh cut & sous-vide
- Optimization of packaging and transport conditions

Valorization of products and waste

- Validation for co-products and by-products market
- Treatment and reuse of slurry

Ecological production

- Zero waste production
- Access to markets
- New crops

Postharvest quality determinations

Phytosanitary use reduction

Development of new products

Services on demand

Integral advisory and R&D projects



R&D PROJECTS

(international, national and regional calls)



FundaciónAulaDei
PARQUE CIENTÍFICO TECNOLÓGICO

RETOS-COLABORACIÓN



Proyecto ECOPLUS: "Conversión a producción ecoeficiente de una explotación de fruta de hueso"



Proyecto PATBIOCONTROL: "Biocontrol de patógenos en campo: desarrollo de sistemas de detección precoz y herramientas de lucha integrada"

ESTADO FENOLÓGICO	Gemeche	Marabou
1. BOUTON FLORAL (H)	05/04/16	03/04/16
2. INICIO FLORACIÓN (S12)	10/04/16	10/04/16
3. CERRAMIENTO DE BACIMO (S)	11/07/16	11/07/16
4. INICIO ENVERO (M1)	15/08/16	22/08/16
5. PLENO ENVERO (M2)		

Proyecto TRENDY FRUIT:

"Nuevas variedades y formatos de fruta para tendencias emergentes de consumo"



Aprobados convocatoria 2017

Proyecto S.O.S. GREENHOUSE: ARPA

"Sistemas de cultivo nutritivos intensivos adaptados para emergencias"



Proyecto FERTILIGENCIA:

"Fertilizantes innovadores para reducir el impacto ambiental de la agricultura y desarrollo de un estándar para evaluar la sostenibilidad de agroecosistemas"



MINISTERIO DE AGRICULTURA Y PESCA, ALIMENTACIÓN Y MEDIO AMBIENTE



AGROBIOSOL

TICS 4 FRUIT

fruit CARE



GOLDJALON



UNIÓN EUROPEA "Una manera de hacer Europa"

Nafarroako Gobernua
Garapen Ekonomikorako
Departamentua

Gobierno de Navarra
Departamento de
Desarrollo Económico



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B.3: Pre-harvest field trials

1. Foliar chlorophyll
2. Potential photosynthetic activity
3. Set up of plastic materials: mulching & biobags
4. Soil sampling, processing and analysis
(Ionomics by ICP; pH; conductivity; carbonates; gypsum)

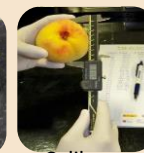


B4: Post-harvest validation tests

1. Physical-Chemical parameters
2. Nutritional Compounds (antioxidants, pigments)
3. Mineral analysis (B, Fe, Mn, Zn...)
4. Postharvest diseases and disorders
5. Pesticide residues analysis



Weight



Caliber



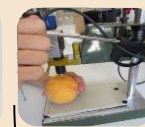
Color



Acidity



°Brix



Texture (destructive & non-destructive)

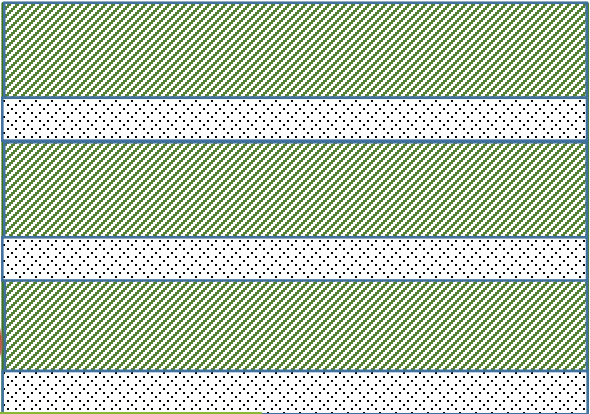


MULCHING: Field tests/ experimental design

Table 1. Acolchado Mulching	2016 Pequeña escala Small scale	2017 Pequeña y Gran escala Small & Large scale	2018 Gran escala Large scale
Nº ensayo + control Nº trials + control	9 + 1	6 + 1	1 + 1
Oligoelemento Oligoelements	Mn; Zn	Mn; Zn; Fe; B	B
Vegetal Vegetable			

2017:
small & large scale

2016: small scale



2018:
large scale

plastic	additive	batch
Control		CONTROL
A	X% Zn y Mn	Ax
	Y% Zn y Mn	Ay
	Z% Zn y Mn	Az
B	X% Zn y Mn	Bx
	Y% Zn y Mn	By
	Z% Zn y Mn	Bz
C	X% Zn y Mn	Cx
	Y% Zn y Mn	Cy
	Z% Zn y Mn	Cz



B

CONTROL



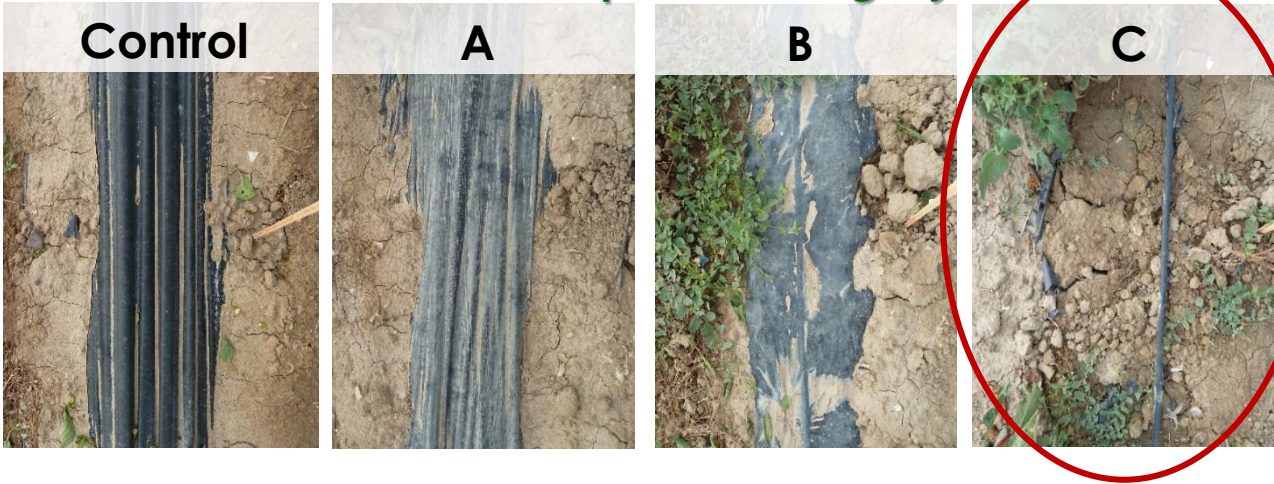
X>Y>Z

[Zn.Mn]



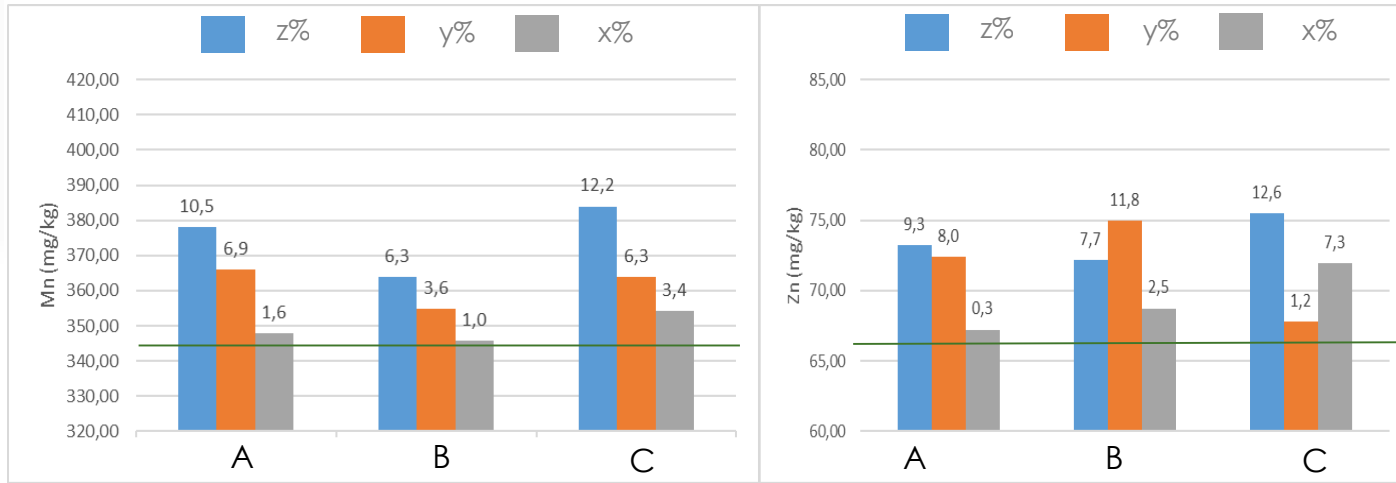
Tipo de Bioplástico	Concentración de oligoelementos en el suelo	Control de malas hierbas	Fisiología del cultivo	Estado del bioplástico después de la cosecha	Biodegradabilidad en el suelo	Parámetros de calidad	Producción y fisiopatías
Type of Bioplastic	Oligoelement concentration increase in soil	Weed control	Physiological state of crops	Bioplastic integrity at harvest	Soil biodegradability	Quality parameters	Production and physiopathies
Control	●	●	●	●	●	●	●
A	●	●	●	●	●	●	●
B	●	●	●	●	●	●	●
C	●	●	●	●	●	●	●

Weed control & Bioplastic integrity at harvest



Incorporation plastics into the soil

Oligoelement concentration increase in soil



control —



Tipo de Bioplástico	Concentración de oligoelementos en el suelo	Control de malas hierbas	Fisiología del cultivo	Estado del bioplástico después de la cosecha	Biodegradabilidad en el suelo	Parámetros de calidad	Producción y fisiopatías
Type of Bioplastic	Oligoelement concentration increase in soil	Weed control	Physiological state of crops	Bioplastic integrity at harvest	Soil biodegradability	Quality parameters	Production and physiopathies
Control Control	●	●	●	●	●	●	●
A	●	●	●	●	●	●	●
B	●	●	●	●	●	●	●
C	●	●	●	●	●	●	●

- Verde: Efecto positivo
Green: Positive effect
- Naranja: Sin beneficio
Orange: Without benefits
- Rojo: Efecto negativo
Red: Negative effect

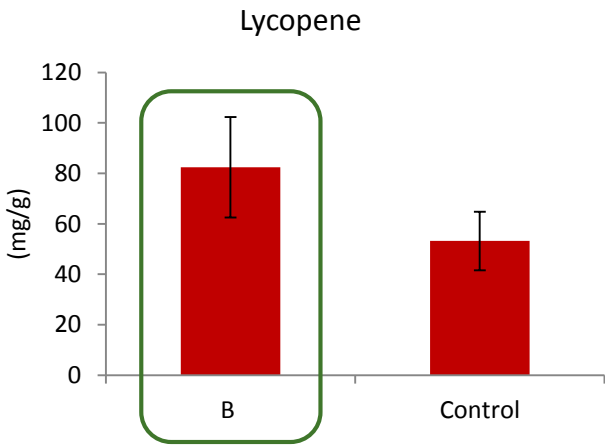
BATCH	weight (g)		caliber (mm)		coordinate a*		coordinate b*	
	mean	s.d.	mean	s.d.	mean	s.d.	mean	s.d.
Control	74,17	16,83	39,05	3,19	29,48	4,48	30,12	4,53
B	101,05	15,44	43,96	3,22	31,91	2,55	27,55	2,20
	0,00		0,00		0,01		0,01	



Quality parameters
Harvest 2017

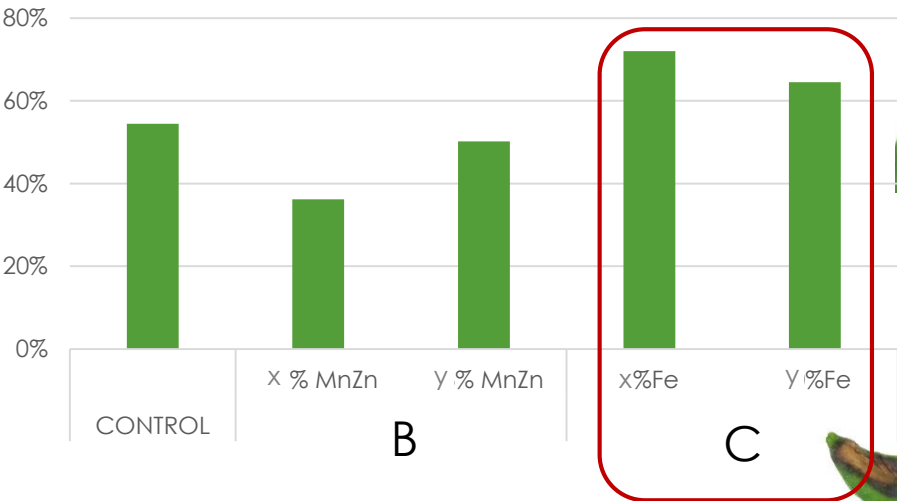
BATCH		weight (g)		ecuat caliber (mm)		Length (cm)		Texture (kg)	
material	additive	mean	s.d.	mean	s.d.	mean	s.d.	mean	s.d.
B	X % MnZn	59,2 d	19,50	36,84 b	7,33	14,68 c	2,30	1,34 c	0,35
	Y % MnZn	52,8 cd	16,37	35,50 ab	6,87	14,36 bc	2,64	0,89 b	0,37
C	X % Fe	39,27 a	11,85	33,46 a	7,24	12,01 a	2,14	0,65 a	0,20
	Y % Fe	42,92 ab	13,28	33,15 a	7,19	12,47 a	2,02	0,62 a	0,25
control		47,92 bc	14,90	34,71 ab	6,05	13,24 ab	2,20	1,18 c	0,31
sign.		0,00		0,00		0,00		0,00	

Harvest 2018



Tipo de Bioplástico	Concentración de oligoelementos en el suelo	Control de malas hierbas	Fisiología del cultivo	Estado del bioplástico después de la cosecha	Biodegradabilidad en el suelo	Parámetros de calidad	Producción y fisiopatías
Type of Bioplastic	Oligoelement concentration increase in soil	Weed control	Physiological state of crops	Bioplastic integrity at harvest	Soil biodegradability	Quality parameters	Production and physiopathies
Control	●	●	●	●	●	●	●
A	●	●	●	●	●	●	●
B	●	●	●	●	●	●	●
C	●	●	●	●	●	●	●

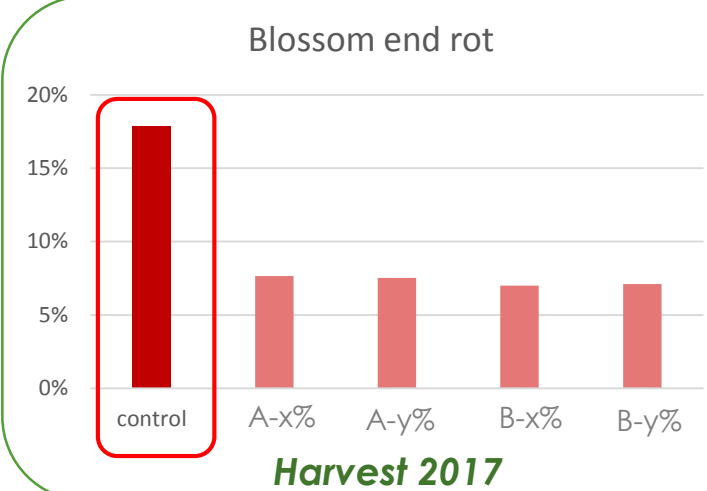
Damaged fruit



Harvest 2017



Disorders & diseases



Blossom end rot

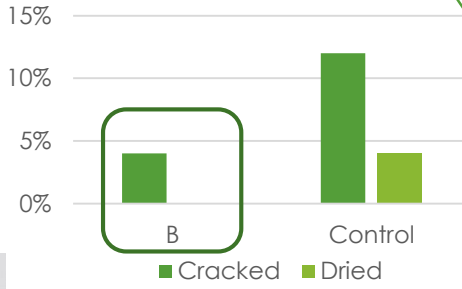


cracked

dried



Damaged fruits



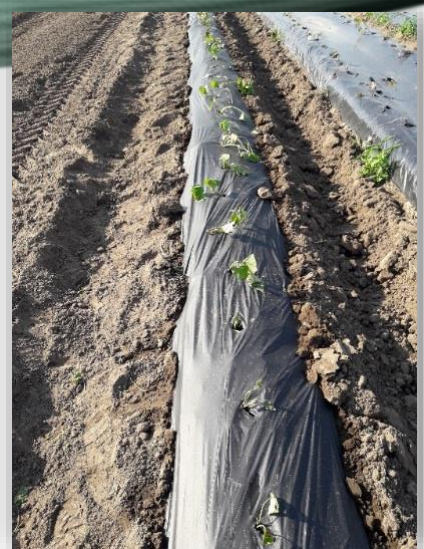
trips

B

Control

Harvest 2018

“Groencreatie tests”



France



Belgium

BIOVIDA
Organic farmer
Alfonso Castellón

Winter Vegetables
(cauliflower)
around **5 ha**



biovida

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BIOBAGS: Field tests/ experimental design



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Bioclips - Bioclips



% opacity

Control



Bolsas Biobags	2016 Pequeña escala Small scale		2017 Pequeña y Gran escala Small & Large scale		2018 Gran escala Large scale	
	Nº ensayo + control Nº trials + control					
Color Colours	Blanco - White Rojo - Red Azul - Blue	0-5% opacidad 0-5% opacity	Blanco - White Rojo - Red	0-5% opacidad 0-5% opacity	Blanco - White Rojo - Red	0-2% opacidad 0-2% opacity
Fruta Fruit	 		 		  	



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Effects of BIOBAGS in APPLES



Quality parameters

Tipo de Bioplástico Type of Bioplastic	Color Colour	Producción y fisiopatías Production and physiopathies	Parámetros de calidad Quality parameters	Compuestos nutricionales Nutritional compounds	Disminución de presencia de pesticidas Reduction in pesticide content
Sin bolsa Without bag		●	●	●	●
A	Blanco - White	●	●	●	●
	Rojo - Red	●	●	●	●
	Azul - Blue	●	●	●	●
B	Blanco - White	●	●	●	●
	Rojo - Red	●	●	●	●
C	Blanco - White	●	●	●	●
	Rojo - Red	●	●	●	●



discarded

Fuji 2016



Golden 2017



Golden 2018

Pesticide residues

	batch	Lambda cihalotrina (mg/kg) (LMR 0,1)		Tebuconazol (mg/kg) (LMR 0,3)	
		media	d.s.	media	d.s.
Whole fruit	control	0,02	0,01	0,012	0,00
	Biodeg				

Fuji 2018

C



LOTE		Caliber (mm)		Weight (g)		coord a*		refl 680 nm	
BIOMATERIAL	color	media	s.d.	media	s.d.	media	s.d.	media	s.d.
CONTROL		69,15b	3,70	162,1ab	18,76	-9,38a	0,48	20,42a	1,67
BIOMATERIAL	White	67,01a	3,09	146,95a	16,11	-8,35b	1,22	22,82b	2,83
	Red	69,29b	4,51	173,4b	26,79	-8,9ab	0,62	20,65a	1,82
sign.		0,02		0,00		0,00		0,00	



C

< size
< green color (riper fruit)

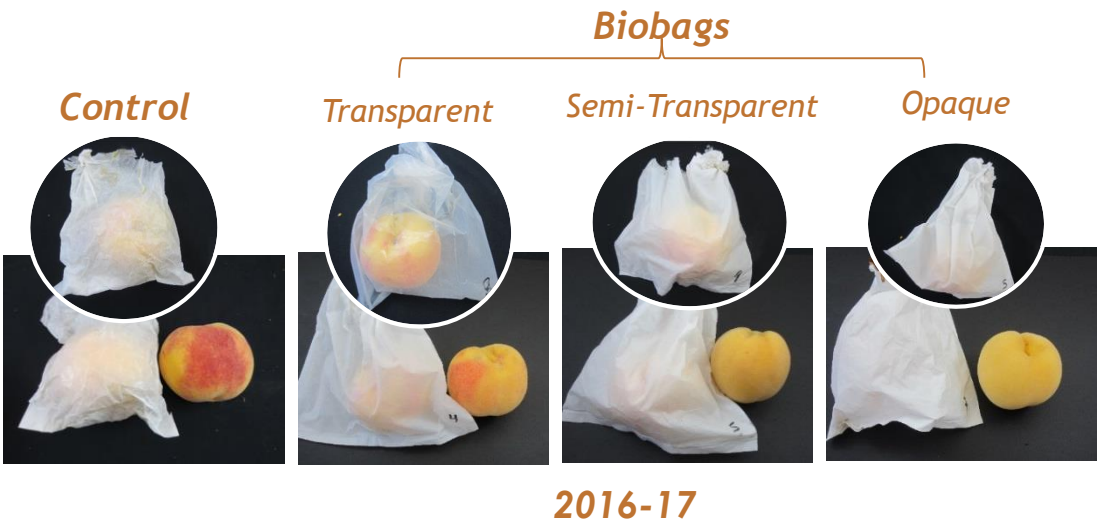
Multibiosol

Effects of BIOBAGS in PEACHES



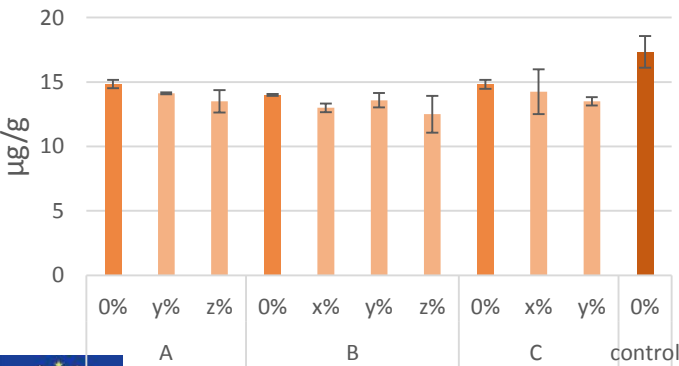
Tipo de Bioplástico <i>Type of Bioplastic</i>	Color blanco <i>Colour white</i>	Producción y fisiopatías <i>Production and physiopathies</i>	Parámetros de calidad <i>Quality parameters</i>	Compuestos nutricionales <i>Nutritional compounds</i>	Disminución de presencia de pesticidas <i>Reduction in pesticide content</i>
Control <i>Control</i>	Papel deparafina Opaco <i>Opaque paraffin paper</i>				
A	Transparente <i>Transparent</i>				
	Opaco <i>Opaque</i>				
B	Transparente <i>Transparent</i>				
	Opaco <i>Opaque</i>				
C	Transparente <i>Transparent</i>				
	Opaco <i>Opaque</i>				

Quality parameters



2017

Carotenoids



Nutritional compounds

2018

BAG	phenols (mg/100g)	
Material	media	s.d.
Control	60,83	4,89
biodeg.	33,73	4,41
sign.	0,002	



2018

MULCHING

Multibiosol mulching shows excellent results as a substitute for traditional mulching (non-biodegradable).

- It maintains the **performance** throughout the crop cycle.
- The **production** of the crop is equivalent to that of traditional mulching. In some cases, even the **quality** is improved (size, maturation ...) and the incidence of **diseases** and **physiological disorders** significantly decreases compared with traditional plastic materials

BIOBAGS

Multibiosol biobags show excellent performance as to replace traditional bags (paraffined paper).

- BioBags **effectively protects** against pesticide residues.
- Multibiosol biobags maintain the required mechanical **performance** throughout the fruit crop cycle.



Biobags (opaque) reduce reddish tones in peaches, producing a homogeneous fruit external surface.



Red bags, are the suitable for apples, since they produce homogeneous "sunburn" free fruits.

