



NATURAL CHESTNUT TANNINS USE IN TOBACCO CROP



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THE SOURCE



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CHESTNUT TANNINS : A PHYTOCOMPOSITION



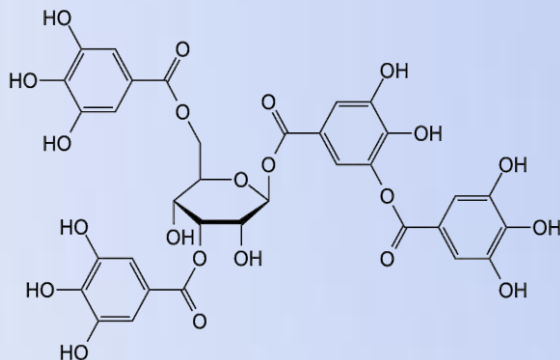
IT'S THE COMBINATION OF ALL THE SUBSTANCES PRESENT IN A PLANT-BASED EXTRACT: IN THIS CASE “TANNINS” AND SO-CALLED “NON TANNINS”:

- ❑ TANNINS: HYDROLYSABLE TANNINS (HTs) MOSTLY GALLOTANNINS & RELATED MOLECULES, WHICH ARE ANTIOXIDANT, ANTIMICROBIAL, AND CROP PROTECTION AGENTS
- ❑ NON TANNINS: ACIDS, SUGARS, SOLUBLE HEMICELLULOSE FRACTIONS, MINERALS, ETC., WHICH CONTRIBUTE TO THE OVERALL EFFECT AS PLANT BIOSTIMULANT AND NUTRIENT COMPLEXING AGENTS

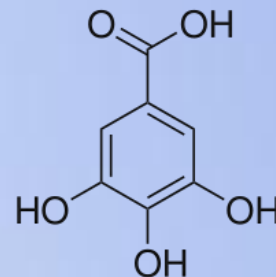
HYDROLYSABLE TANNINS (HTs)

- IN **HTs**, A CARBOHYDRATE MOLECULE (USUALLY *D*-GLUCOSE) IS PARTIALLY OR TOTALLY ESTERIFIED WITH PHENOLIC GROUPS, SUCH AS **GALLIC** OR **ELLAGIC ACIDS** (GALLOTANNINS, **GTs**; OR ELLAGITANNINS, **ETs**)
- **HTs** ARE HYDROLYZED BY WEAK ACIDS OR BASES, AND ARE MORE EASILY OXIDIZED THAN CONDENSED TANNINS (**CTs**) WHICH ARE PRESENT IN GRAPESEED EXTRACTS

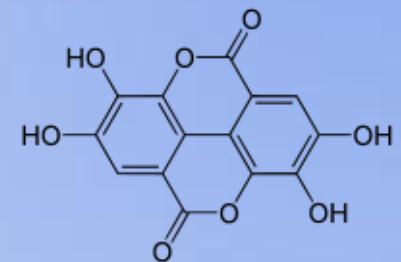
TETRA-GALLOYL-GLUCOSE



GALLIC ACID



ELLAGIC ACID



CHESTNUT TANNINS : ANTIOXIDANT AGENT

Antioxidant
Antimicrobial
Crop protectant
Plant biostimulant
Nutrient enhancer

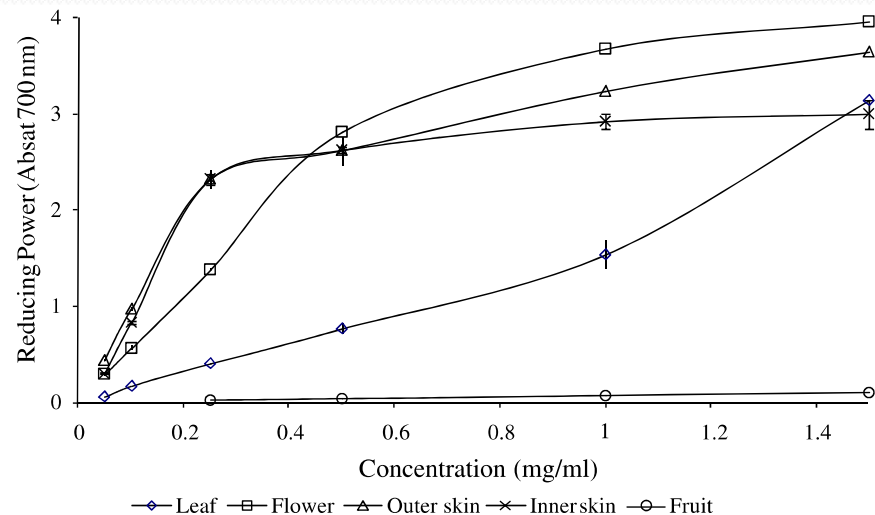
ANTIOXIDANT ACTIVITY OF THE WATER EXTRACT,
DETERMINED BY FRAP TEST * IS >3500 nmol
ASCORBIC ACID EQUIVALENTS /mg EXTRACT.

* reduction of the complex tripyridiltriazine/Fe(III) to blue Ferrous Fe(II) with
absorbance increase @ 593 nm wavelength

DIFFERENT CHESTNUT PLANT
EXTRACTS DIFFER FOR THEIR
ANTIOXIDANT ACTIVITY



Barreira et al., 2008



CHESTNUT TANNINS : ANTIOXIDANT AGENT ON VEG CROPS & TOBACCO ?

Antioxidant
Antimicrobial
Crop protectant
Plant biostimulant
Nutrient enhancer

1. ASSESSMENT OF ABSORPTION,
DISTRIBUTION & METABOLISM PATHWAY(S)
2. EFFECT ON COMPOSITION, QUALITY,
SAFETY & SHELF LIFE: + / - / =
3. BEST OPTIONS FOR APPLICATIONS

WE ARE PRESENTLY UNDER PATENT FOR
SELECTED APPLICATIONS / USES

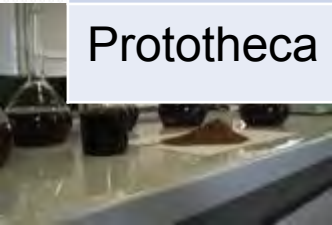


CHESTNUT TANNINS : BIOMEDICAL ANTIMICROBIAL AGENT @ extract concentr. 9.8 mg/mL polyphenols

Antioxidant
Antimicrobial
Crop protectant
Plant biostimulant
Nutrient enhancer

SELECTED SPECIES	STRAIN	Ø INHIBITION AREA mm
Candida albicans	6157	18
Candida glabrata	7212	25
Clavispora lusitaniae	6148	14
Kluyveromyces marxianus	6141	16
Saccharomyces cerevisiae	6497	24
Cryptococcus laurentii	4272	36
Filobasidiella neoformans	6981	34
Prototheca wickerhamii	8879	24

Romani et al., 2011, mod.



ANY EFFECT ON CROP FUNGI?

NO INVESTIGATION SO FAR ON TOBACCO,
BUT FOR OTHER PLANTS ...

Antioxidant
Antimicrobial
Crop protectant
Plant biostimulant
Nutrient enhancer

+ ANSWER FOR ENDOGENOUS TANNINS

e.g. HIGH-TANNIN POPULUS TREMULOIDES
GENOTYPES ARE MORE RESISTANT TO VENTURIA

LEAF BLIGHT

(Holeoleski et Al., 2009)

+ ANSWER FOR EXOGENOUS CHESTNUT TANNINS

e.g. SEED TREATMENT TO CONTROL SOYBEAN STEM
CANKER AGENT *Diaporthe phaseolorum* var. *sojae* and var.
culivora

(Bargiacchi et Al., 2011)

EP 2345628 (A1) JP2011 144175 (A)

ANTIMICROBIAL ACTION OF TANNINS ACCOUNTS FOR PART OF THEIR SLOW-RELEASE EFFECT ON NITROGEN

(Bargiacchi et Al., 2004 EP1464635, publ. 24-03-2010)

(Barbehenn et Al., 2011)

ANY EFFECT ON INSECTS? + ANSWER FOR ENDOGENOUS TANNINS ? ANSWER FOR EXOGENOUS TANNINS

Antioxidant
Antimicrobial
Crop protectant
Plant biostimulant
Nutrient enhancer

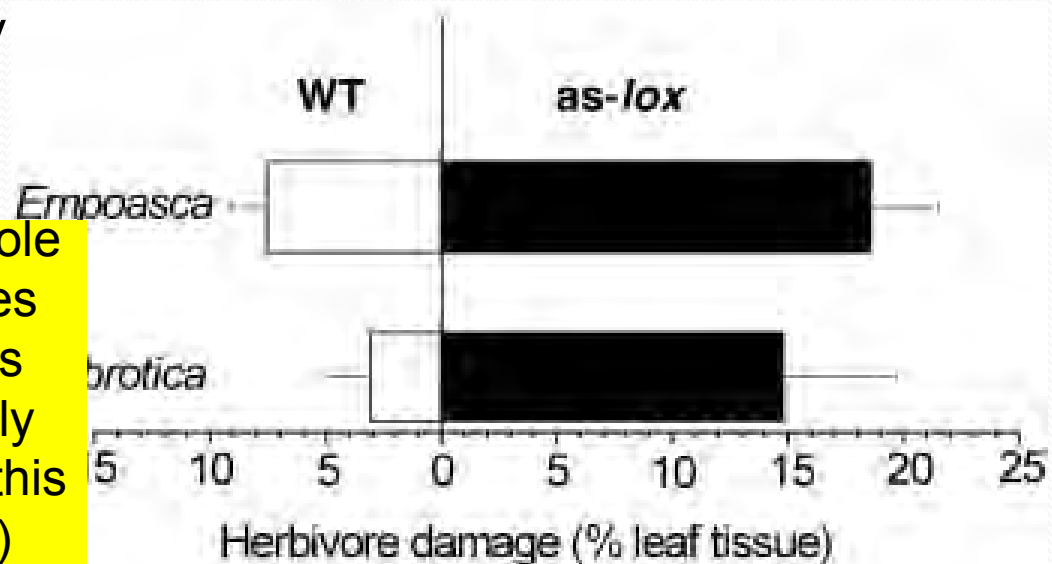
Nicotiana attenuata

WT = wild type

As-lox = transgenically
silenced plants for
endogeneous tannins

“Presumably, tannins play a central role in preventing numerous insect species from feeding on the tannin-rich leaves of many woody plants, but surprisingly little work has been done to support this assumption” (Barbehenn et Al., 2011)

AND ON COMMERCIAL
CROPS & TOBACCO?



(Kessler et Al., 2004)

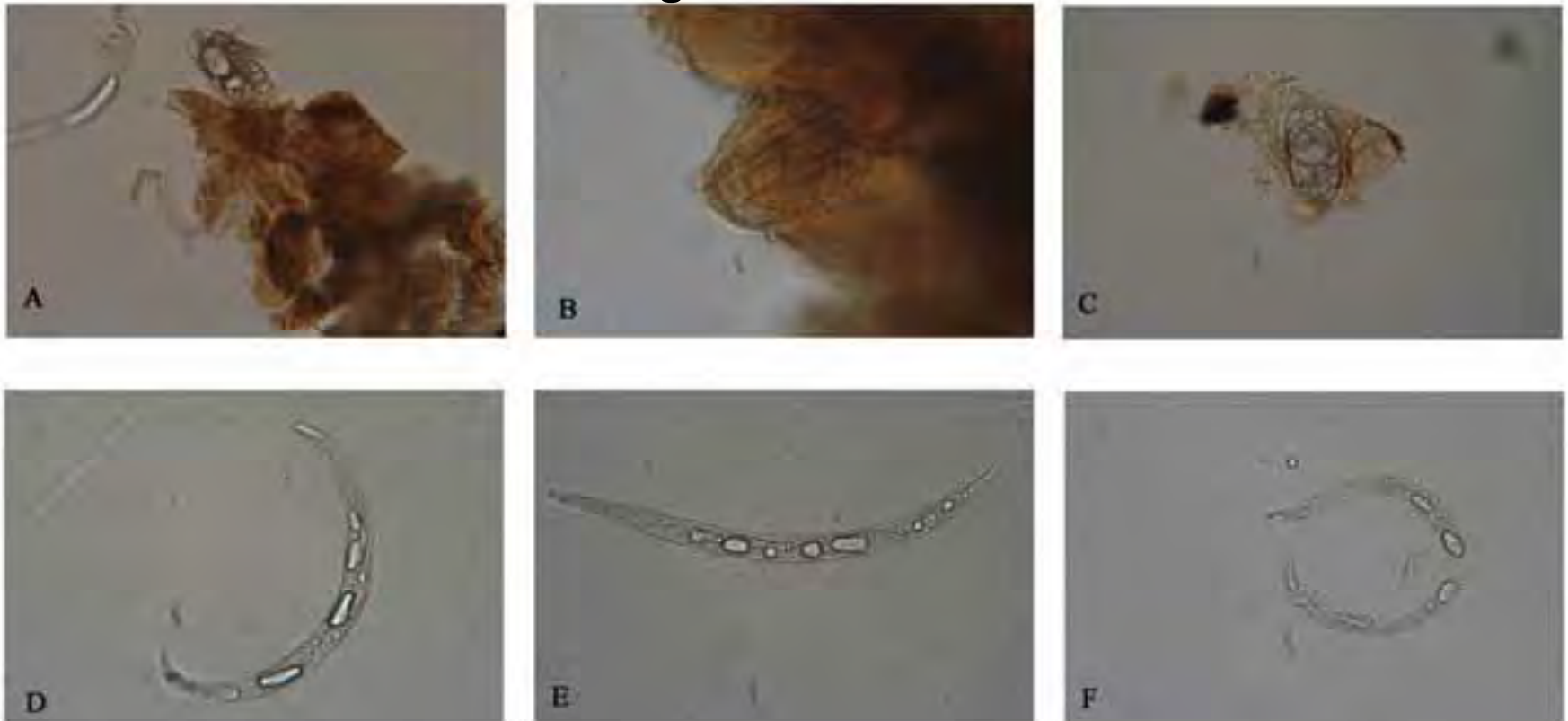
con o senza l'aggiunta di bisolfito. Infatti a tale concentrazione SAVIOTAN, oltre a bloccare e/o a rallentare l'embriogenesi, ha agito come nematostatico ma essenzialmente come nematocida nei confronti delle larve infestanti di II stadio. La sua azione si è rilevata anche principalmente nei confronti di uova e larve all'interno dell'ovisacco bloccando sia l'embriogenesi della uova che la schiusa delle larve, manifestando anche uno spiccato potenziale nematocida.

Antioxidant
Antimicrobial
Crop protectant
Plant biostimulant
Nutrient enhancer

CHESTNUT TANNINS: ACTION ON NEMATODES

Meloidogyne incognita (Kofoid et White) Chitwood

IN VITRO EFFECT OF 5 g/L CHESTNUT TANNIN EXTRACTS



A,B, C: EGGS AND OVISACKS
D, E, F: II STAGE LARVAE

(Ambrogioni et Al., 2008)

di larve mobili.

CHESTNUT TANNINS: ACTION ON J2 FORMS (IN VITRO) Meloidogyne incognita (Kofoid et White) Chitwood

Tesi	Dosi	Tempo di immersione										Lettere	
		1 gg	2 gg	3 gg	4 gg	5 gg	6 gg	7 gg	8 gg	9 gg	10 gg		11 gg
1	0,0 g/l	95,13	92,64	92,64	91,55	90,64	89,13	88,52	88,52	86,31	83,49	82,40	D
2	2,5 g/l	90,01	88,46	88,46	87,98	87,71	85,36	79,46	68,52	66,46	62,53	62,53	C
3	2,5 g/l + bisolf.	88,60	86,66	84,99	80,55	78,94	72,12	67,19	66,18	60,92	54,10	52,40	BC
4	5,0 g/l	84,39	87,11	79,12	68,61	61,38	43,38	34,23	34,47	31,45	31,45	31,45	A
5	5,0 g/l + bisolf.	82,02	81,97	76,18	71,45	68,51	65,94	59,54	56,75	51,54	48,09	47,06	B

I dati sono medie di 4 repliche.

Nella colonna le medie seguite da lettere maiuscole diverse risultano significativamente differenti per P = 0,01 (Anova e test di Fisher).

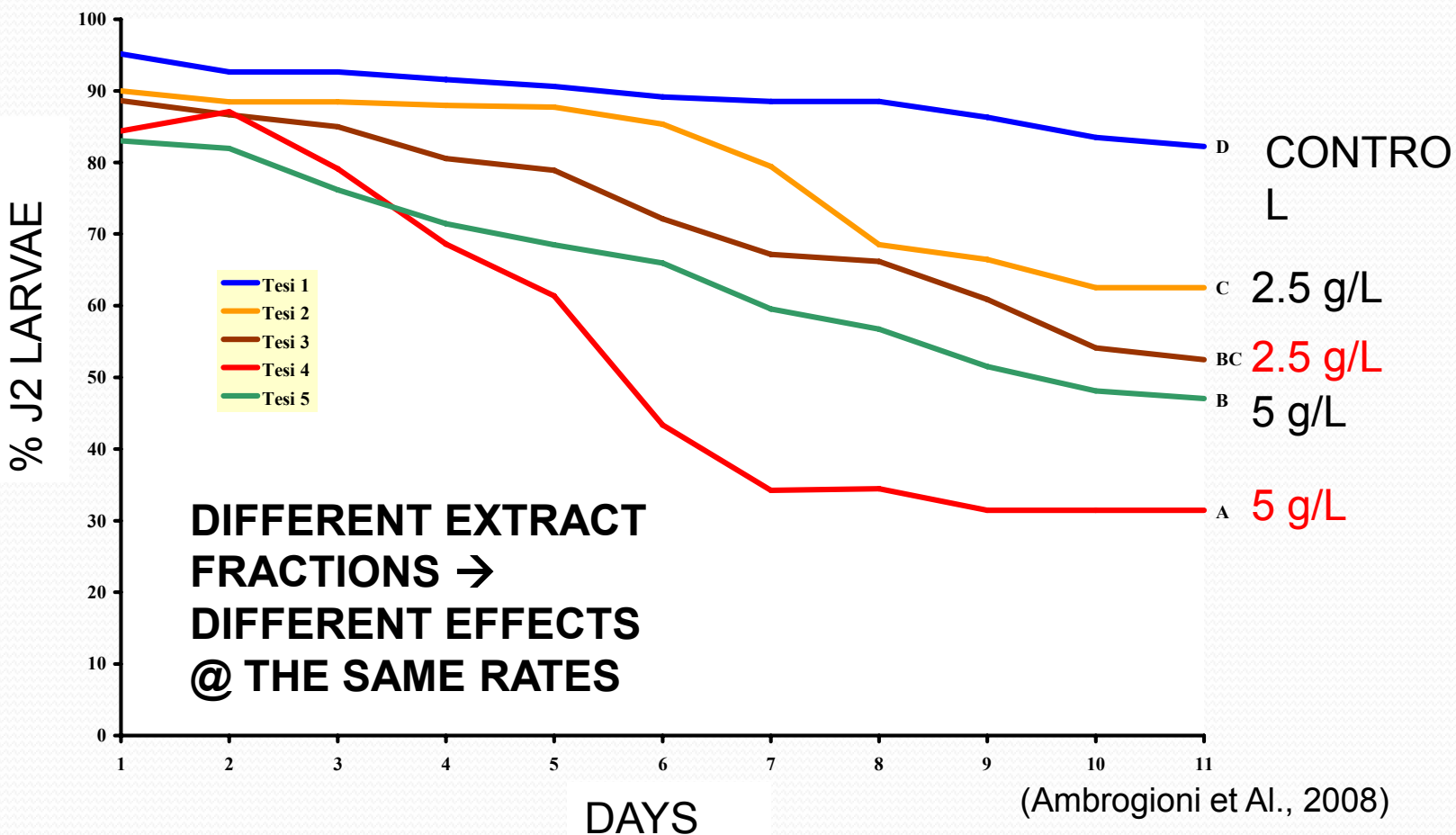


Fig. 31. Percentuale di larve di II stadio mobili di *M. incognita* uauate con due diverse concentrazioni di tannino con e

Antioxidant
Antimicrobial
Crop protectant
Plant biostimulant
Nutrient enhancer

CHESTNUT TANNINS:

ACTION ON NEMATODES

ON TOBACCO (GREENHOUSE TESTS Univ. Pisa)

Meloidogyne incognita (Kofoid et White) Chitwood

4000 J2 inoculum in 10 ml water, steam-sterilized soil, ITB 678

Antioxidant
Antimicrobial
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Plant biostimulant
Nutrient enhancer

TREATMENTS	ROOT GALL INDEX *	J2 POPULAT. No. 250g ⁻¹ SOIL**	ROOT GALL INDEX *	J2 POPULAT. No. 250g ⁻¹ SOIL**
	AT 30 DAT		AT 50 DAT	
NEMATODE+TANNINS	0,8 b	1110 b	1,2 b	1311 b
INFESTED CONTROL	4,3 a	2620 a	4,8 a	3863 a
NON-INFESTED CONTROL	NI	NI	NI	NI

* Barker (1985)

0=0-10%; 1=11-20%; 2=21-50%; 3=51-80%; 4=81-90%; 5=91-100%

** Goodey (1963)

2011 FIELD TEST ACCORDING TO THE PROTOCOL OF TANNIN EXTRACT USE IN NEMATODE INFESTED SOILS, BASED ON 2009-2010 RESEARCH RESULTS

Antioxidant
Antimicrobial
Crop protectant
Plant biostimulant
Nutrient enhancer



25 DAT



CONTROL

2% v/v TANNIN EXTRACT 13%
a.i. IN DRENCH WATER

AFTER:
25 L/ha x 3-4 times:→
(commercial product 13% a.i.)

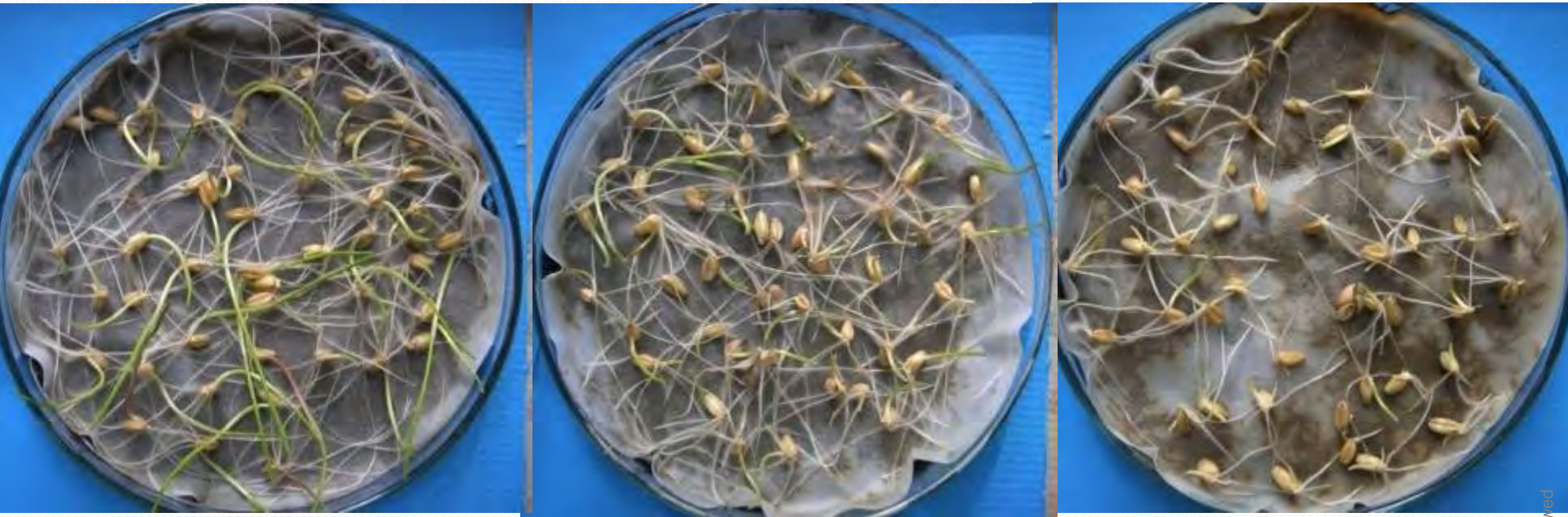


TOTAL TANNINS RATE: 25-27 kg/ha a.i.

CHESTNUT TANNINS: BIOSTIMULANT

(EARLY GROWTH ENHANCER e.g. on WHEAT)

Antioxidant
Antimicrobial
Crop protectant
Plant biostimulant
Nutrient enhancer



20 ppm

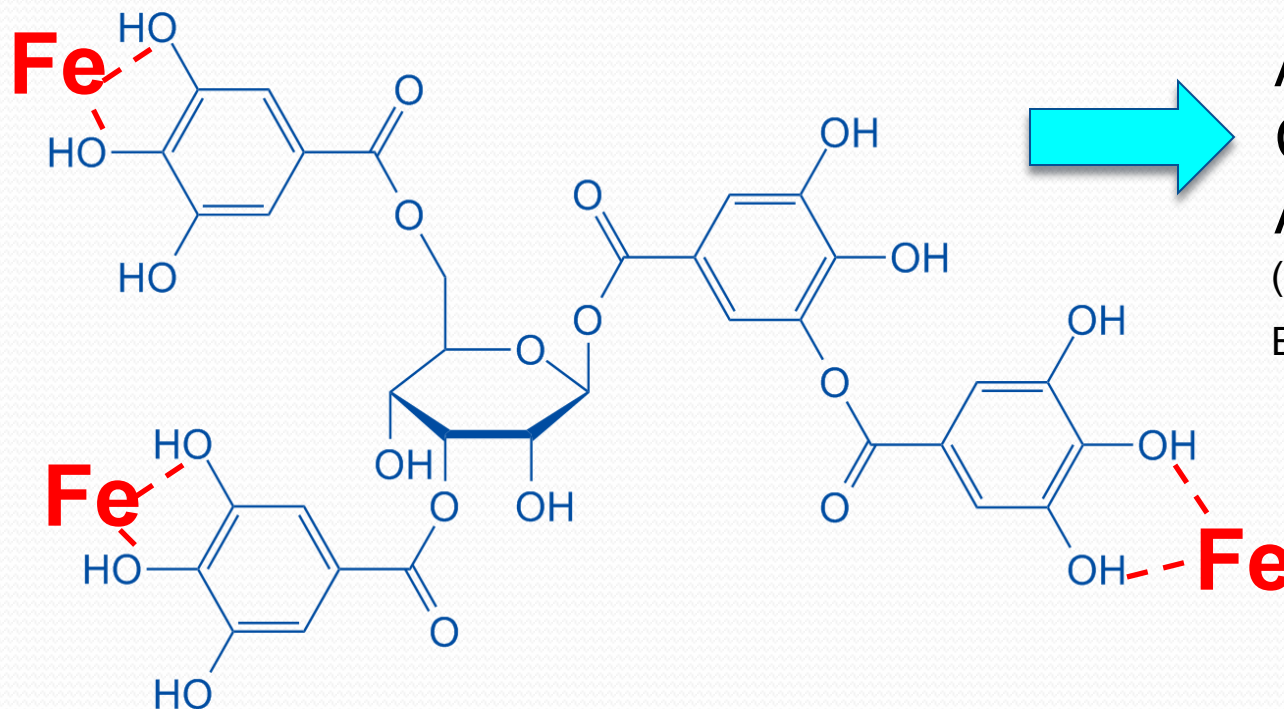
5 ppm

CONTROL

PHYSIOLOGICAL MECHANISMS INVOLVED
ARE PRESENTLY BEING INVESTIGATED

CHESTNUT TANNINS: COMPLEXING ACTION ON IRON

Antioxidant
Antimicrobial
Crop protectant
Plant biostimulant
Nutrient enhancer



A NEW IRON
COMPLEXING
AGENT

(Bargiacchi et Al., 2004

EP1464635, publ. 24-03-2010)

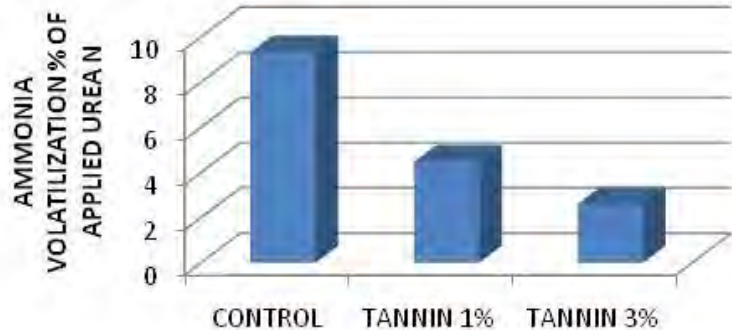
COMPLEXING STRUCTURES UNDER INVESTIGATION

ORGANIC ACIDS ALSO PARTICIPATE TO THE OVERALL
COMPLEXING EFFECT

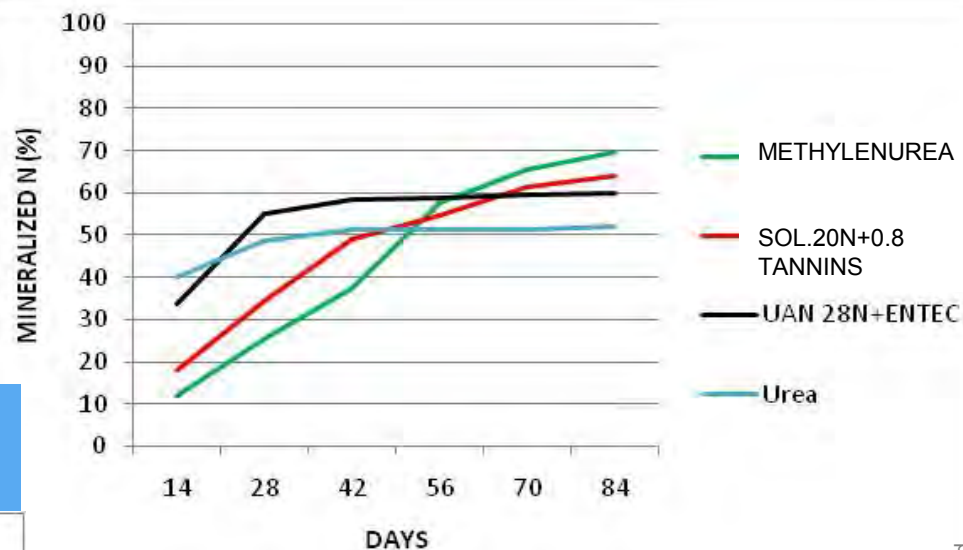
Antioxidant
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EFFECTS ON NITROGEN AND PHOSPHATE

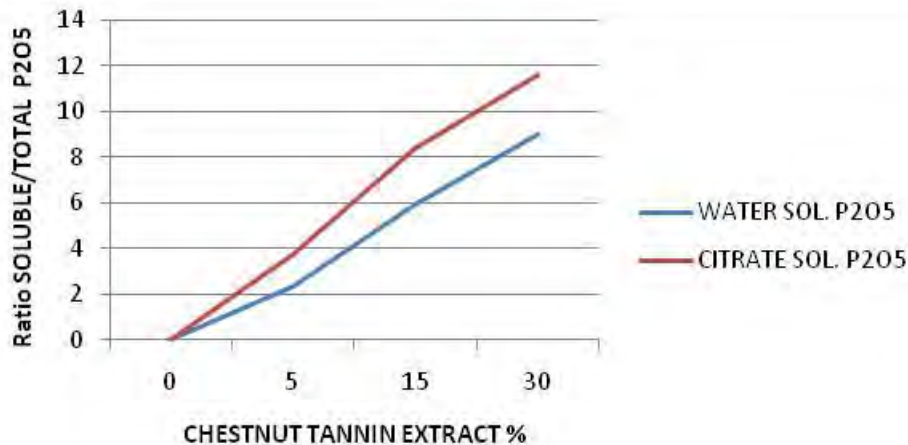
EFFECT ON AMMONIA VOLATILIZATION FROM UREA



EFFECT ON N MINERALIZATION (Stanford & Smith method, mod.)



ROCK PHOSPHATE AVAILABILITY AS AFFECTED BY CHESTNUT HTs



PATENTED FERTILIZERS
 ALREADY AVAILABLE AT
 FARM LEVEL

2010 FIELD PLOT TEST

EFFECT ON TOBACCO P UPTAKE

CHARACTER	DAT			
	21	35	49	63
Aerial DM (g/m²)				
Control	5,1 b	57,3 b	171,6 b	322,1 b
TANNIN EXTRACT 13%	5,8 a	75,5 a	246,3 a	371,4 a
10.34.0	6,1 a	78,6 a	225,6 a	381,6 a
P uptake, Aerial DM (g/m²)				
Control	0,012 b	0,235 b	0,406 b	0,597 b
TANNIN EXTRACT 13%	0,023 a	0,325 a	0,595 a	0,821 a
10.34.0	0,026 a	0,358 a	0,582 a	0,875 a

TANNIN EXTRACT = 2% v/v in drench water = 120 L/ha

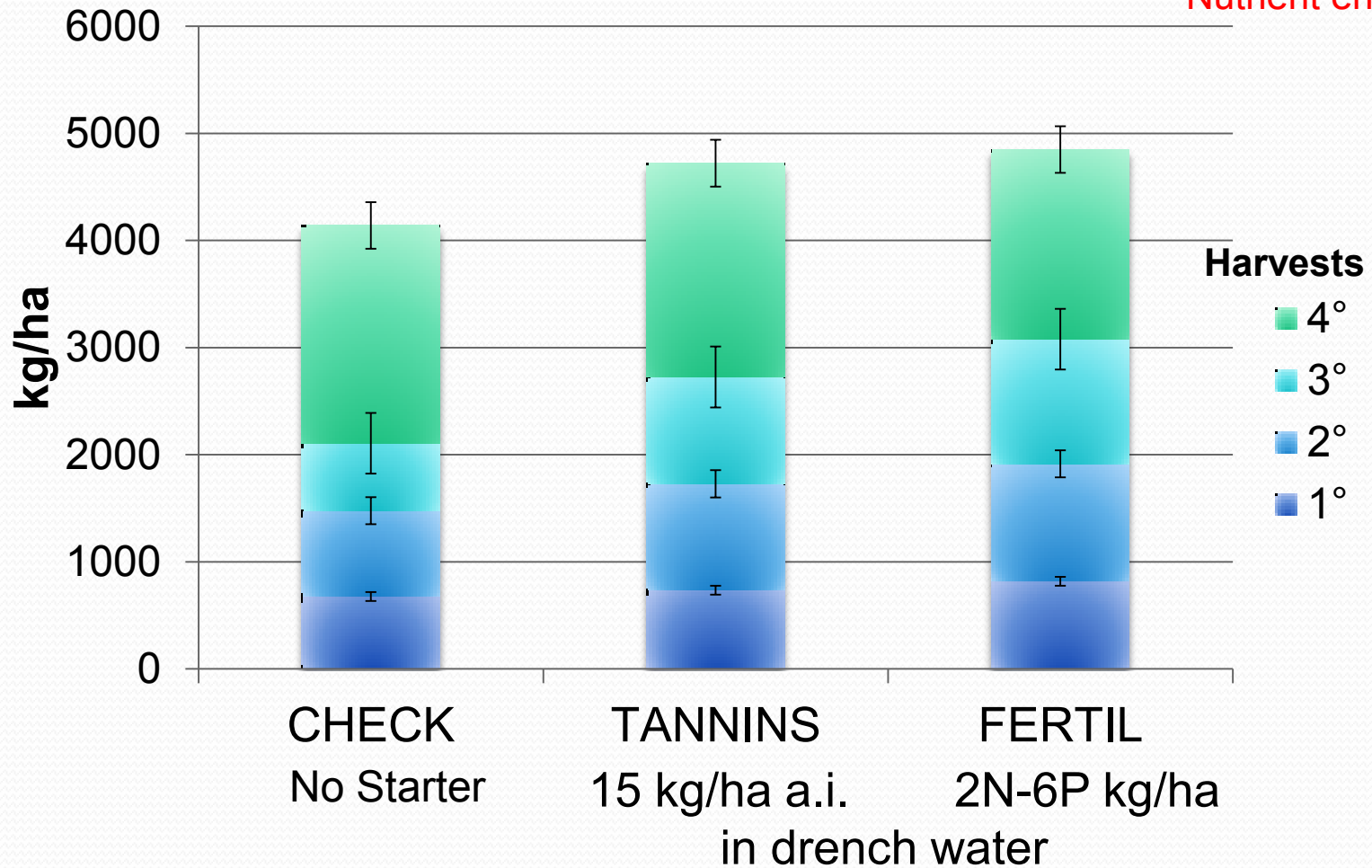
10.34.0 = 0.75% v/v in drench water = 45 L/ha = 5 kg/ha N + 22 kg/ha P₂O₅

PT fertilization for control and treatments: 28-64-84-8 kg/ha N-P₂O₅-K₂O-MgO

Significance P ≤ 0.05

2011 PLOT TEST-TOBACCO YIELD

Antioxidant
Antimicrobial
Crop protectant
Plant biostimulant
Nutrient enhancer



SAME Pre PostT FERTILIZATION EXCEPT EXPERIMENTAL TREATMENTS

CHESTNUT TANNINS: AS A STARTER TREATM. on TOBACCO

Antioxidant
Antimicrobial
Crop protectant
Plant biostimulant
Nutrient enhancer

**NOT ONLY A STARTER EFFECT:
TOPPING TIME 1 WEEK EARLIER &
8% YIELD INCREASE OF MATURE LEAF**

**2% v/v IN
DRENCH WATER**

CONTROL

**2% v/v IN
DRENCH WATER**

CONCLUSIONS (1)

Antioxidant
Antimicrobial
Crop protectant
Plant biostimulant
Nutrient enhancer

- CHESTNUT TANNINS HAVE SOME POSITIVE EFFECTS ON CROP PLANTS AND THEIR PRODUCTS, AS WELL AS SEVERAL ESTABLISHED POSITIVE ACTIONS IN LIFE SCIENCES (MEDICAL & VET)
- SOIL MEDIATED PLANT APPLICATIONS HAVE RECEIVED CONSIDERABLE ATTENTION OVER THE LAST 7 YRS. AS:
 - CROP PROTECTANT
 - PLANT BIOSIMULANT
 - NUTRIENT ENHANCER

AND PRESENTLY SOME TREATMENTS ON CROPS, AND TOBACCO, CAN BE PROPOSED AT FARM LEVEL: IN PARTICULAR, AS A NUTRIENT STARTER TREATMENT, AND TO COUNTERACT GALL NEMATODES (*M. incognita*) ESPECIALLY WHERE NO CHEMICALS ARE PERMITTED OR THEY ARE TOO EXPENSIVE.

CONCLUSIONS (2)

Antioxidant
Antimicrobial
Crop protectant
Plant biostimulant
Nutrient enhancer

- DIRECT PLANT APPLICATIONS OPEN NEW OPPORTUNITIES, BUT CONSIDERABLE RESEARCH IS STILL REQUIRED TO ACHIEVE CONSISTENT EFFECTS AS:
 - ANTIOXIDANT/ANTIMICROBIAL
 - CROP PROTECTANT
 - PLANT BIOSTIMULANT
- FRACTIONATION OF THE RAW EXTRACT IS HELPING TO EXPAND CHESTNUT TANNINS APPLICATION POTENTIALS BY OPTIMIZING THE USE OF SELECTED STANDARDIZED FRACTIONS, ESPECIALLY FOR THEIR ANTIMICROBIAL, BIOSTIMULANT & ANTIOXIDANT USES

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THANK YOU



Santa Croce Church in Firenze (Italy)
Truss of the ceiling in chestnut wood
built in Medioeval Ages

