Effects of Seeding Season and Density on Yield, Proximate Composition and Total Tannins Content of Two Kabuli Chickpea Cultivars

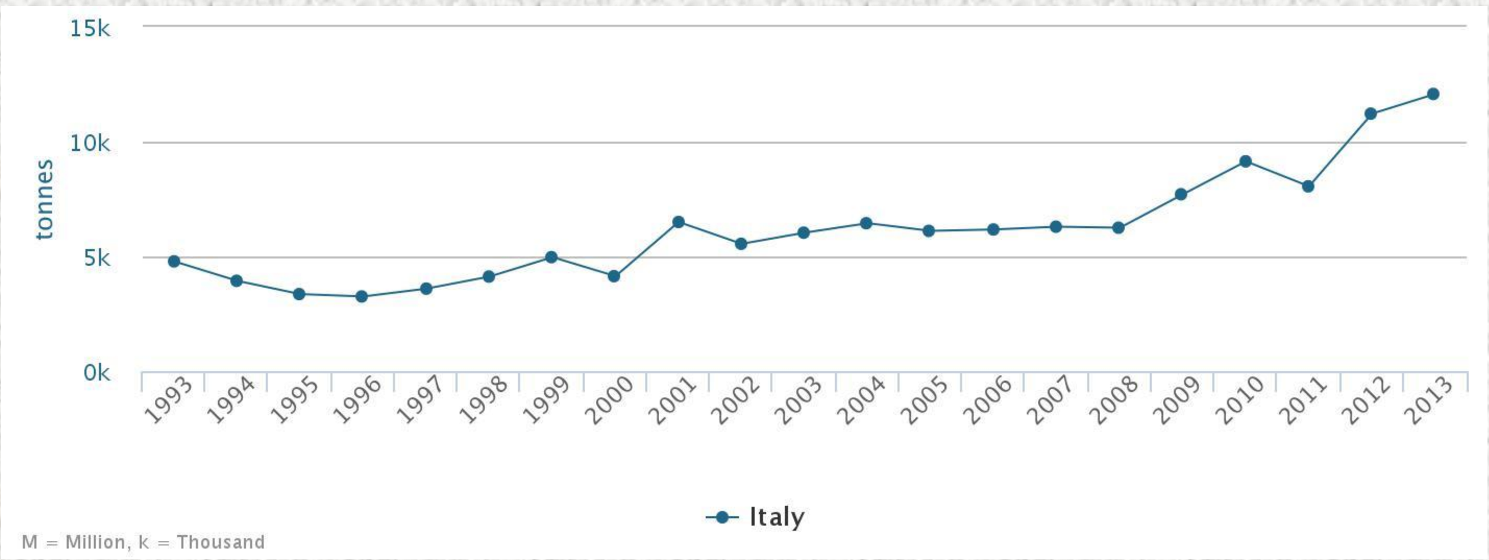
R. Ruggeri, R. Primi, P. P. Danieli, B. Ronchi, F. Rossini

Dip. di Scienze Agrarie e Forestali (DAFNE), Univ. degli Studi della Tuscia

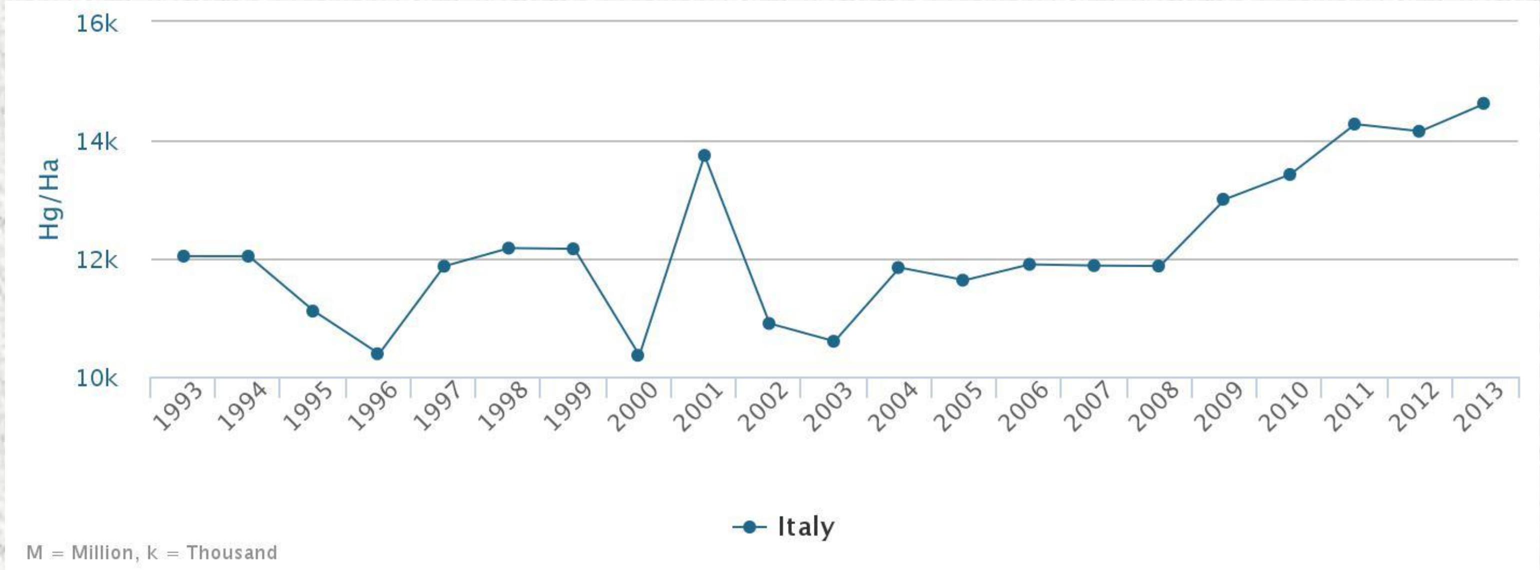
The revival of traditional pulses for human and animal feeding

- Due to animal protein sources often containing large amounts of saturated fat and cholesterol, most health organisations recommend the frequent consumption of vegetable protein;
- Pulses are generally well adapted to a wide range of agro-climatic conditions and play an important role in the traditional diets of many regions throughout the world;
- Legumes have potential of enhancing sustainable productivity in cropping and forestry systems
- Pivotal agro-ecological role especially within low input farming systems
- They can be used in different animal husbandries, but are well suited especially for organic livestock production systems.

Chickpea Total Production



Chickpea Yield



Looking for soybean alternatives

The increasing use of genetically modified (GM) feeds has aroused many concerns in Europe

The request for improving sustainability in different production systems

The need to reduce the dependency on imports

PAC 2014-2020

Constraints

- The occurrance of bioactive compounds with anti-nutritional effects, such as tannins may represents a limiting factor for chickpeas consumption.
- Especially in monogastrics, nutrient absorption from the gastrointestinal tract can be impaired, with the onset of detrimental effects on health and growth
- Agronomic technique, growth conditions and biotype can contribute to improve chickpea yield and disease resistance
- Few studies have been implemented to assess their effect on nutritional quality of chickpea seeds and total tannins content

Objectives

To gain more detailed knowledge about the effects of different growing conditions (sowing dates and seeding rate) on grain yield, nutritional composition and total tannins content of two chickpea cultivars (‘Sultano’ and ‘Pascià’) currently cultivated in the Meditrerranean basin

Materials and methods

- **Localization**: Tarquinia (VT), Central Italy, 42°11’ N, 11°45’ E, 22 meters a.s.l.,
- **Time of sowing**: winter, late December (2006 and 2007)
  spring, first decade of March (2007 and 2008)
- **Seeding rate**: low, 70 seeds m^{-2} (30 cm row spacing)
  high, 110 seeds m^{-2} (30 cm row spacing)
- **Experimental design**: randomized complete block (RCB)
- **Fertilization**: Diammonium phosphate before sowing (200 kg ha^{-1})
- **Replicates**: 3 plots (8 m x 1.5 m)
- **Weed control**: Pre-emergence herbicide (Pendimetalin + Imazetapir)
- **Pesticide**: no
- **Irrigation**: no
- **Preceding crop**: durum wheat
- **Cumulative rainfall**: winter sowing, 227mm(2007), 303 mm (2008)
  spring sowing, 134 mm(2007), 162 mm (2008)

Cultivar

Pascià

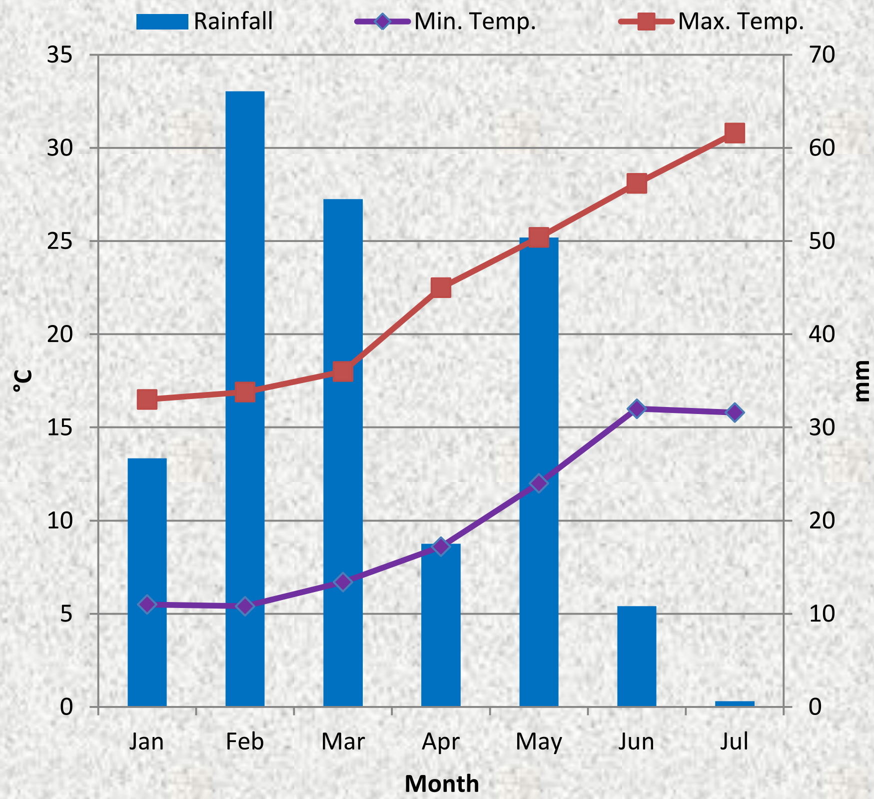
- Seed weight: 501 mg
- Seed type: rough
- Plant habit: semi-erect
- Resistance to AB: yes

Sultano

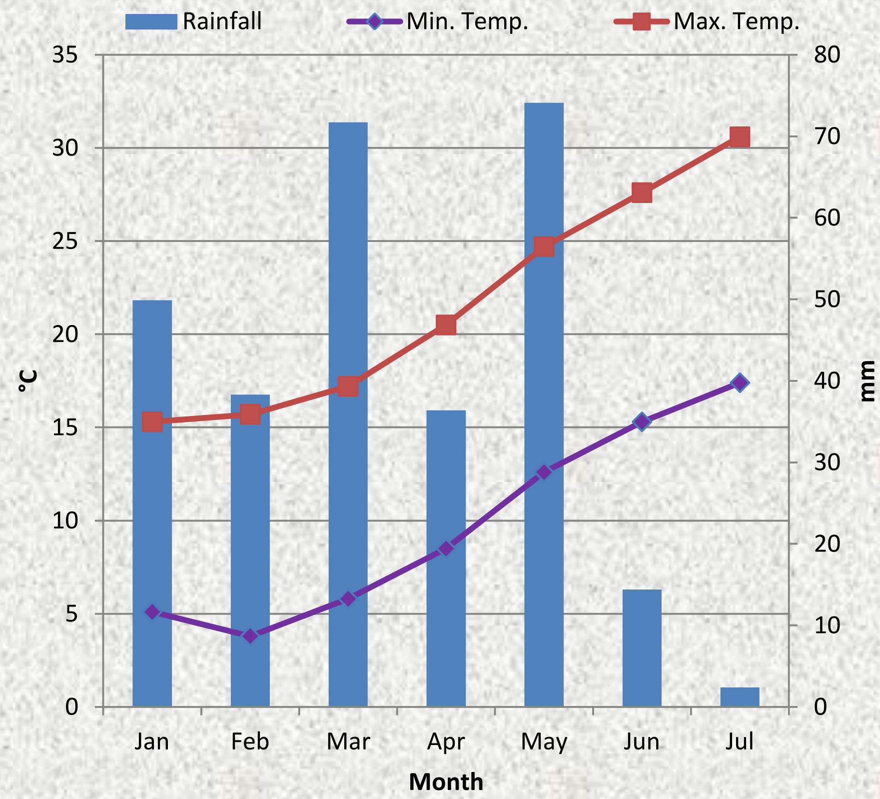
- Seed weight: 340 mg
- Seed type: smooth
- Plant habit: erect
- Resistance to AB: yes

Charts of cumulative rainfall (mm of rain), minimum and maximum temperature (°C) of chickpea growing season for the years 2007 and 2008. Weather data were collected from ‘‘Regione Lazio Assessorato Agricoltura - ARSIAL’’ agro-meteorological station, which is located 100 m away from the experimental fields.

2007



2008



The major constraint to chickpea cultivation is represented by Ascochyta blight (AB), a necrotrophic disease caused by the fungus *Ascochyta rabiei* (Pass.) Labrousse. Several epidemics of AB causing complete yield loss have been reported in Pakistan, India, European countries and Mediterranean regions (Jettner*et al*., 1999).

The reaction to disease was recorded starting from 40 days after emergence on 6 randomly selected plants per plot, using a 1-9 rating scale (Kimurto *et al*. 2013), in which the disease score(DS) was graded from no visible symptoms to aerial part (1) to 100% of plants killed (9).

Based on the DS, test genotypes were categorized for their resistance to *A. rabiei* infection according to the Pande *et al*. (2006) scale, where:

1, asymptomatic;

1.1–3.0, resistant;

3.1–5.0, moderately resistant;

5.1–7.0, susceptible;

7.1–9.0, highly susceptible.

The whole plant disease ratings were averaged across plants to generate a mean disease rating for each genotype before analysis.

Chemical analyses

- Fresh samples were dried at 65 °C for 48 h in a forced air oven before grinding through a mill (Retsch, Haan, Germany)
- Dried and grounded samples (1 mm mesh) were analyzed for:
  - Crude Proteins
  - Crude Fat
  - Crude Fiber
  - Ash

  AOAC Official Methods 984.13 (A-D), 920.39, 978.10 and 942.05 (Ass. Off. Analyt. Chem., 2006)

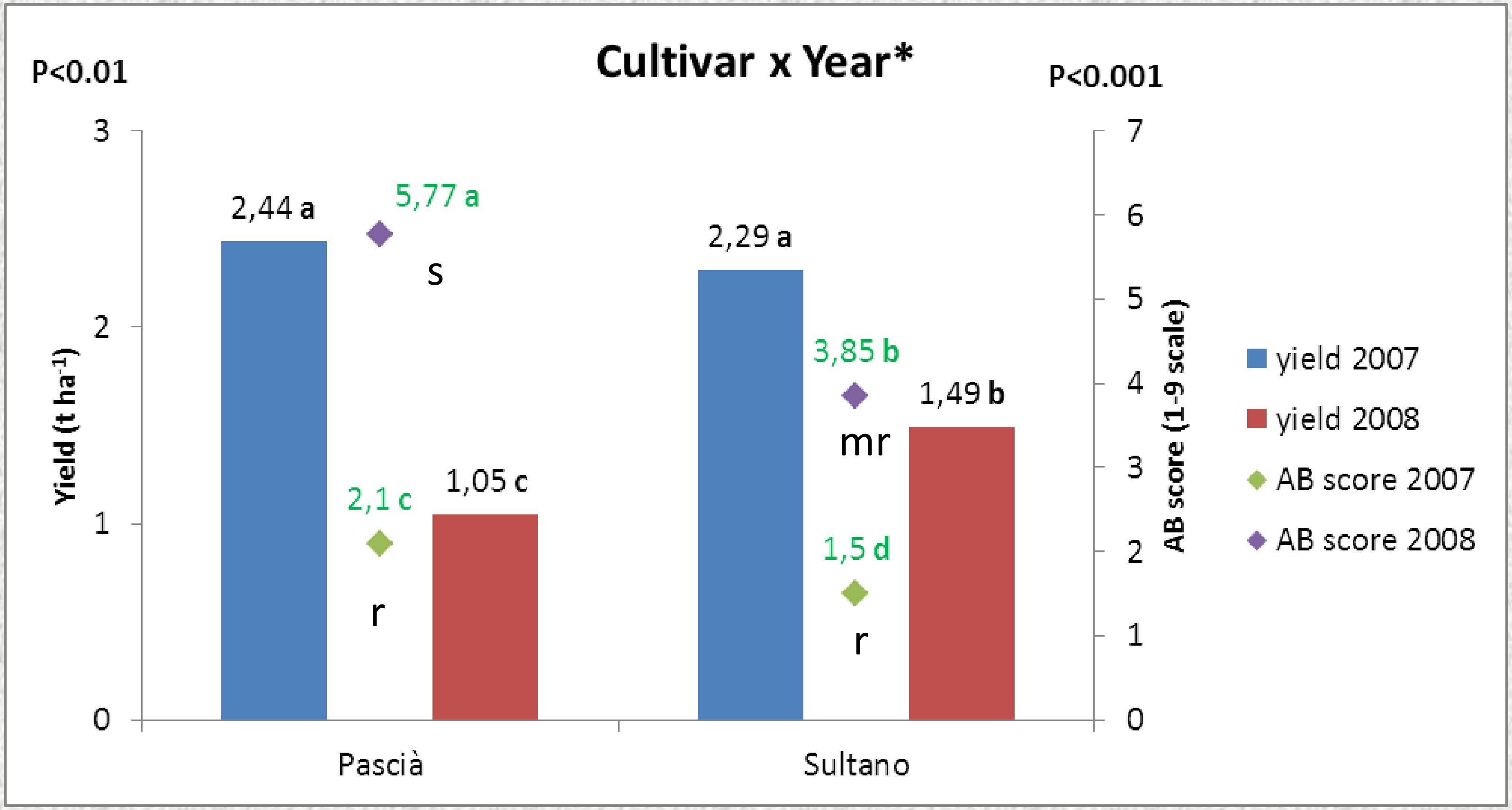
  - Total Starch → (AOAC Official Method 996.11) using a commercial kit (Total Starch, AA/AMG, Megazyme International Ireland, Wicklow, Ireland)
  - Amino-acidic profile → Reverse phase liquid chromatography(RP-HPLC) following the method developed by Cohen and De Antonis (1994), as modified by Liu *et al*. (1995).
  - Total Tannins (TT) → Folin-Ciocalteu method, according to Zielinski and Kozlowska (2000). expressed as g of Catechin-Equivalents (CE) per kg of sample (g CE/kg).

Statistical analysis

- The data were analyzed by ANOVA.
- Fischer LSD post-hoc test was also performed to assess differences between means. Significance was declared at $P<0.05$

Results

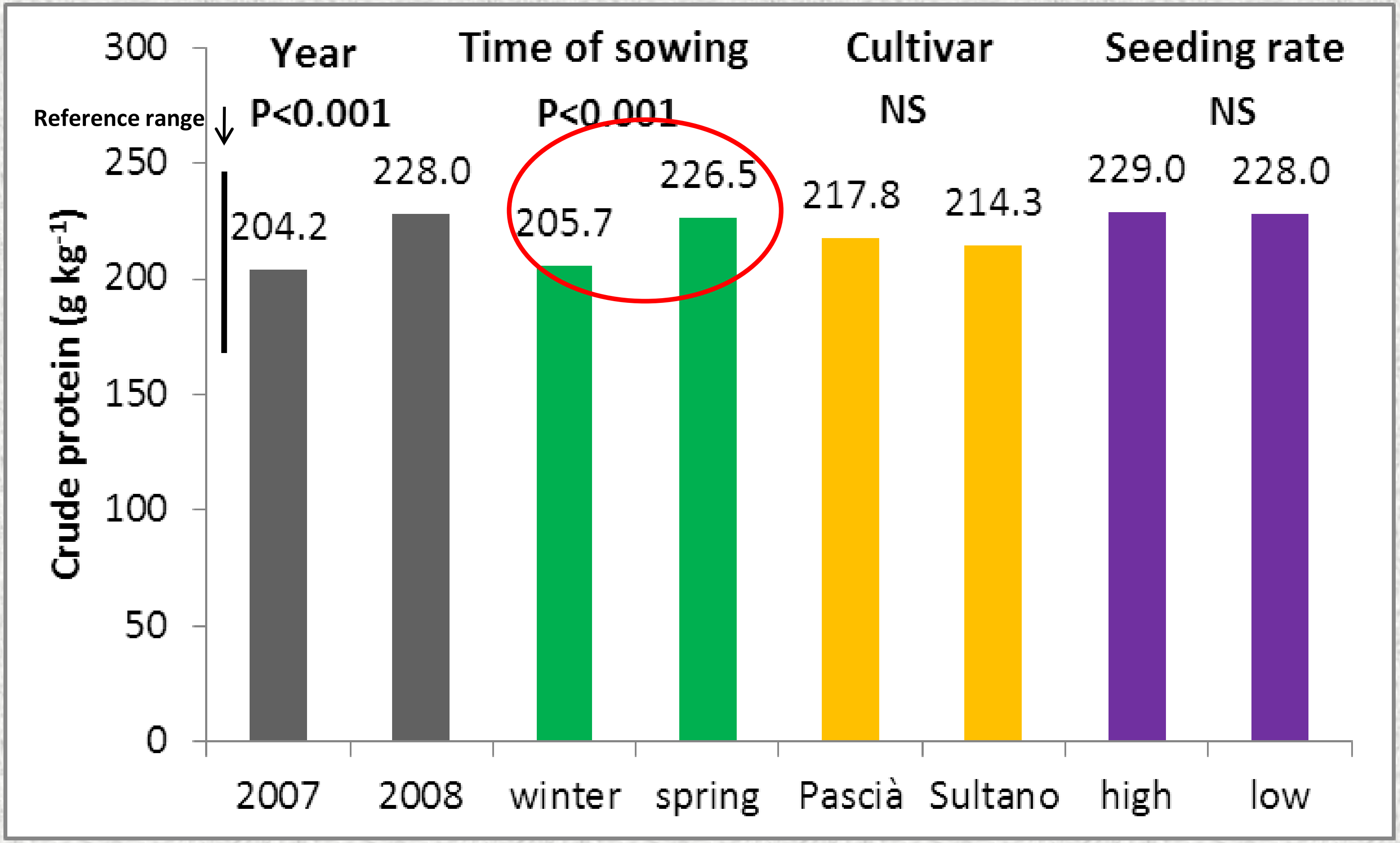
Grain yield (t ha^{-1}) and AB score (1-9 scale): effect of cultivar x year interaction



*The other interactions are not shown as they are not significant.

Results

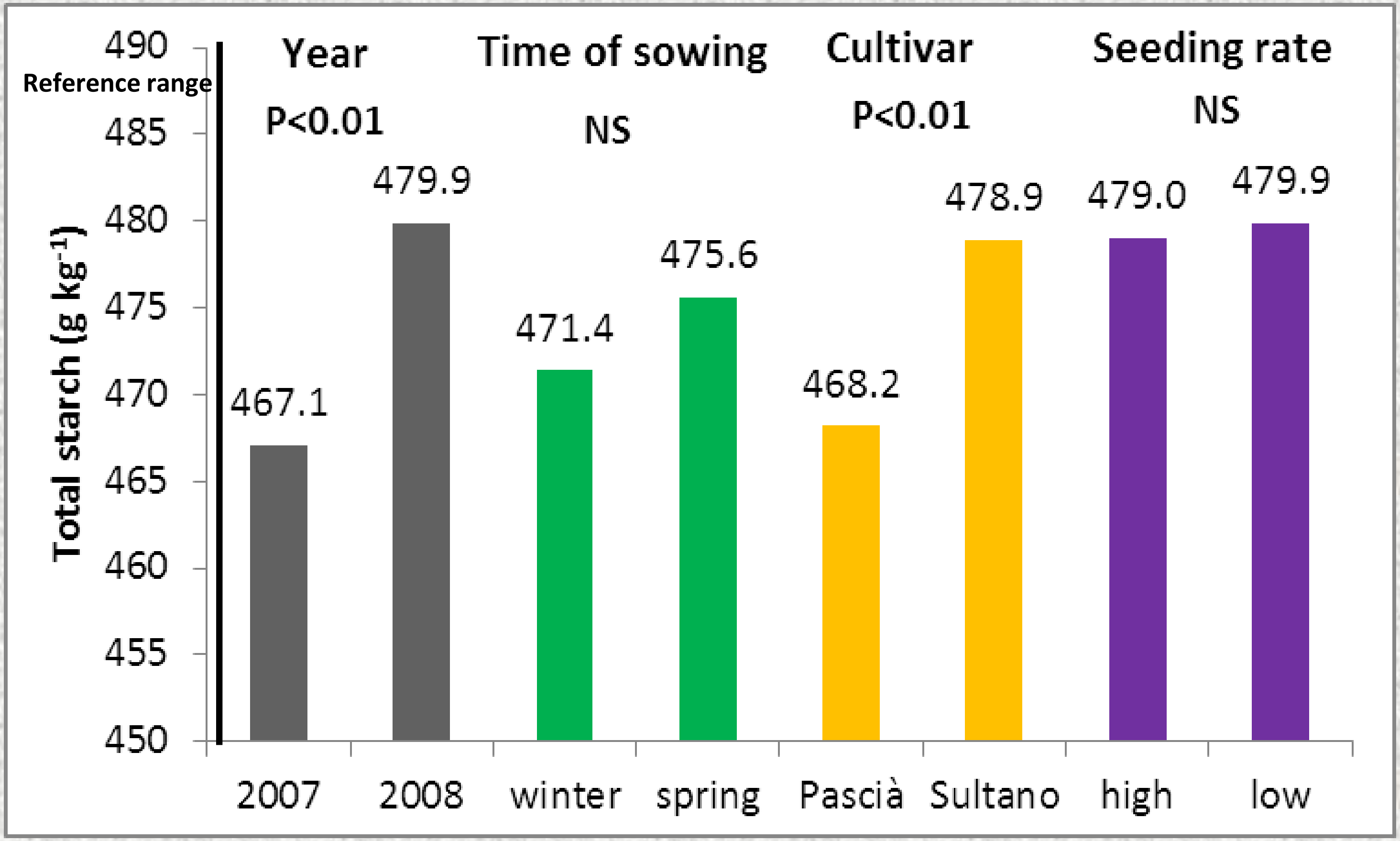
Crude protein (g kg^{-1}): effect of cultivar, year and time of sowing and seeding rate



*The other interactions are not shown as they are not significant.

Results

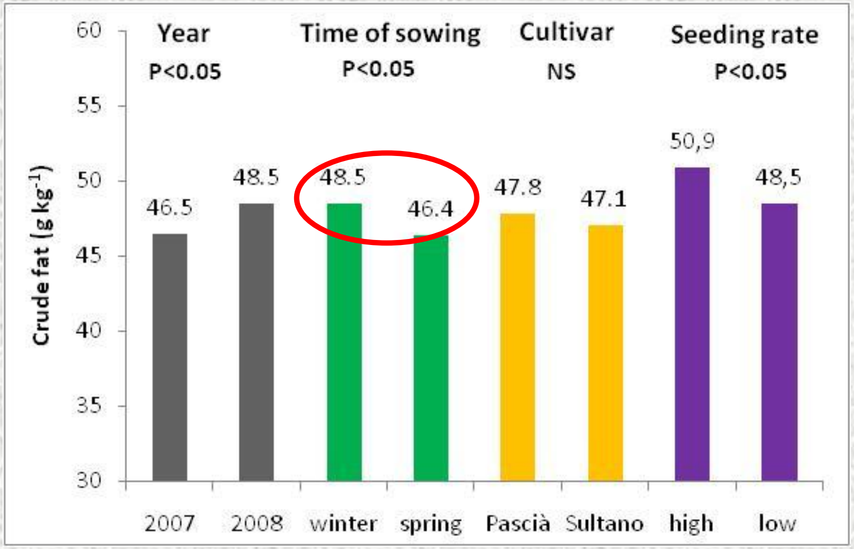
Total starch (g kg^{-1}): effect of cultivar, year and time of sowing and seeding rate

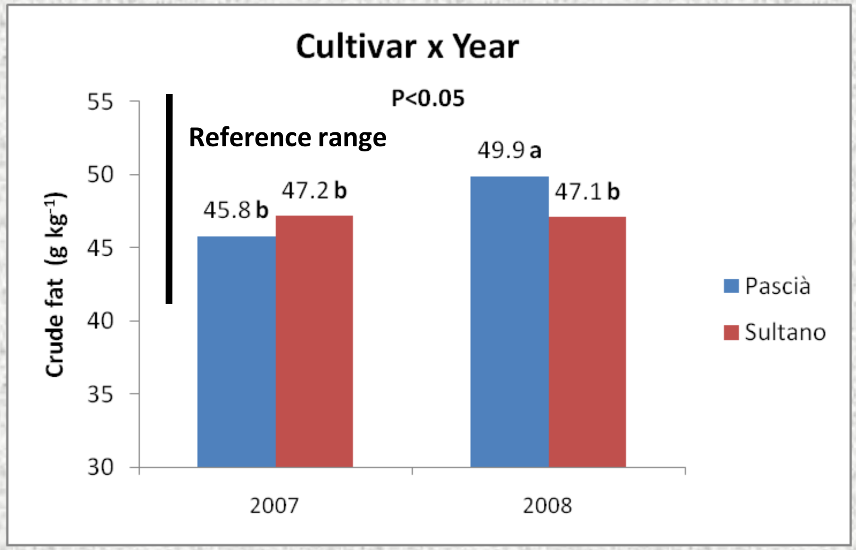


*The other interactions are not shown as they are not significant.

Results

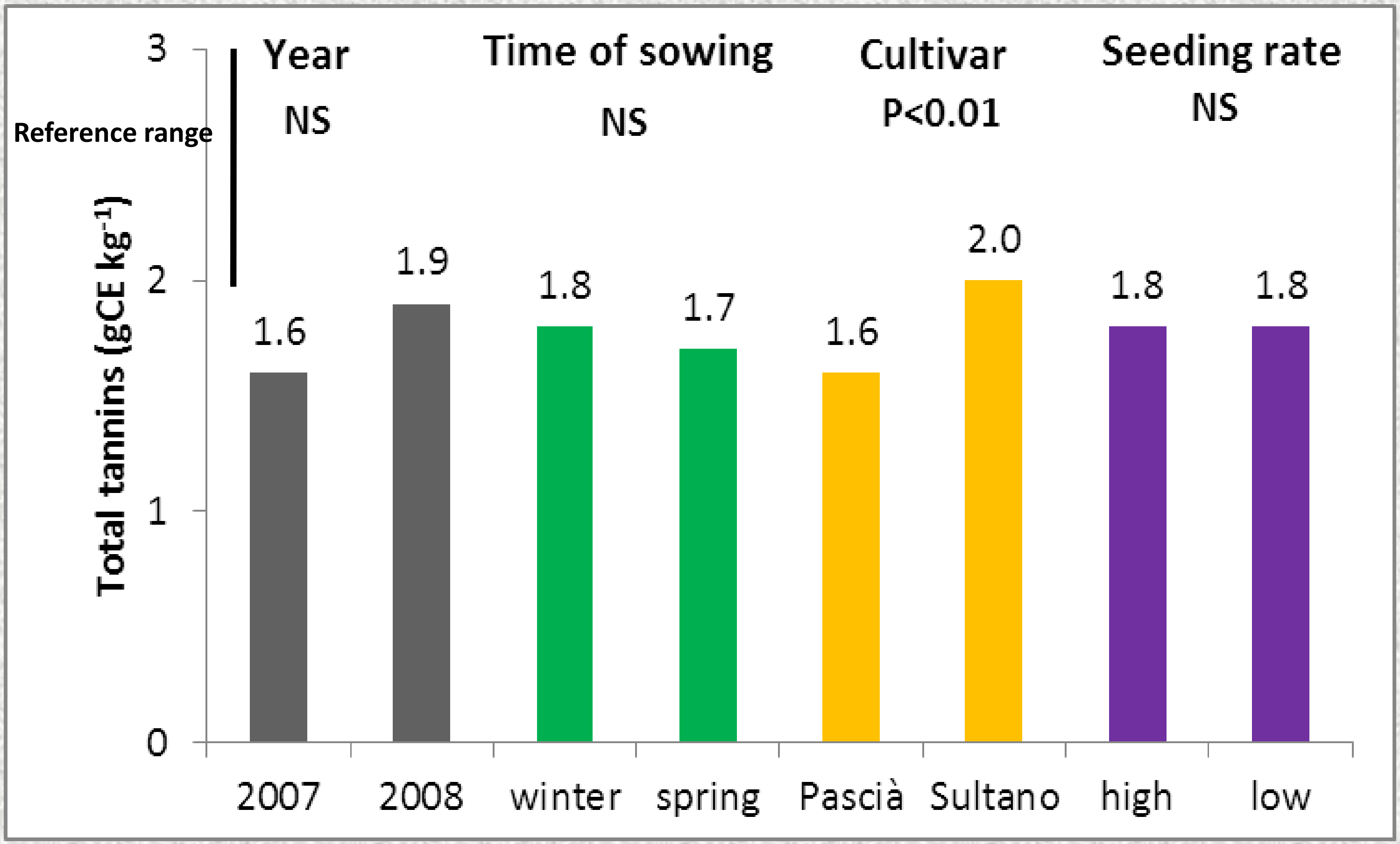
Crude fat (g kg-1): effect of cultivar, year and time of sowing, seeding rate and their respective interactions





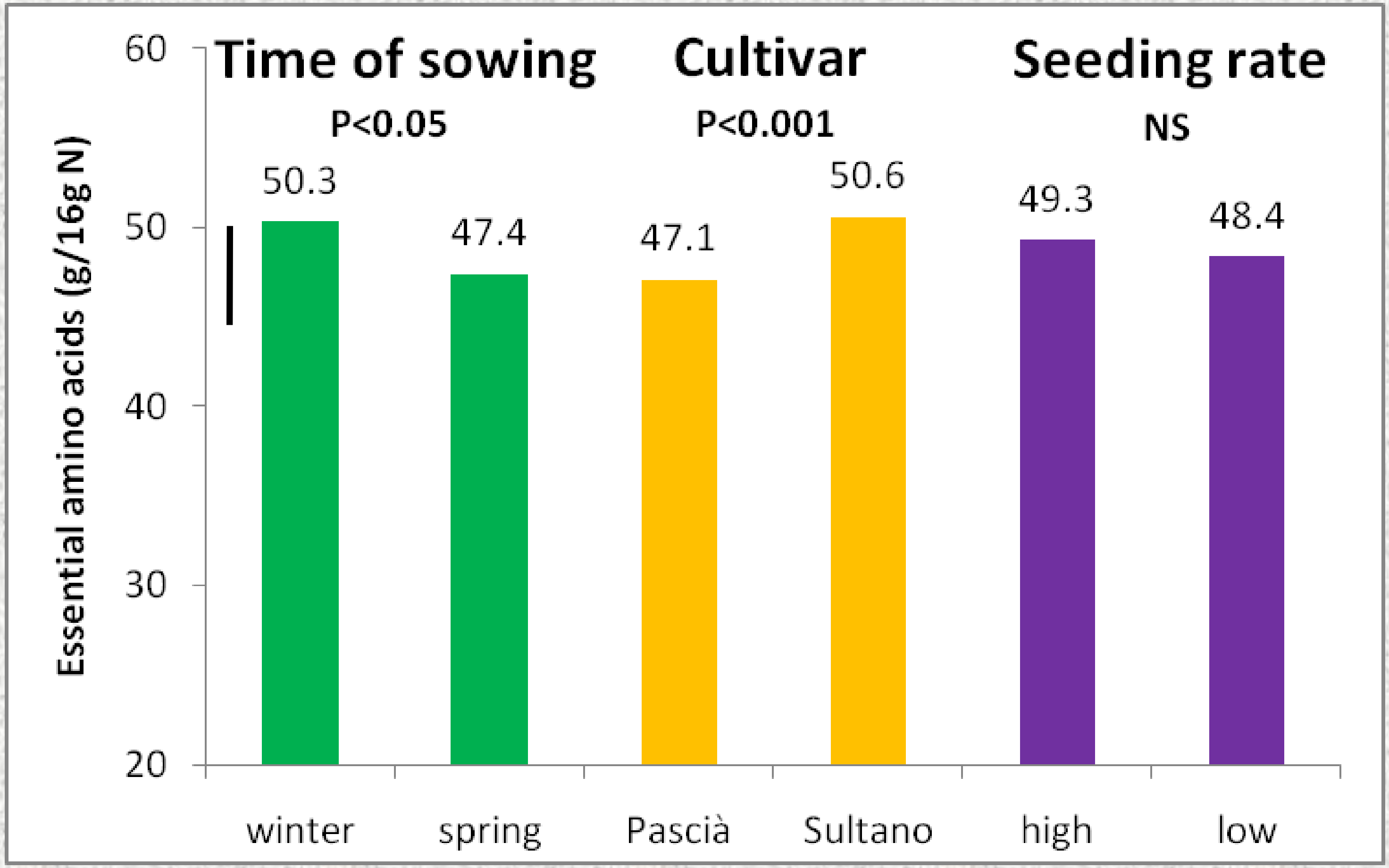
Results

Total tannins (gCE kg^{-1}): effect of cultivar, year and time of sowing and seeding rate



Results

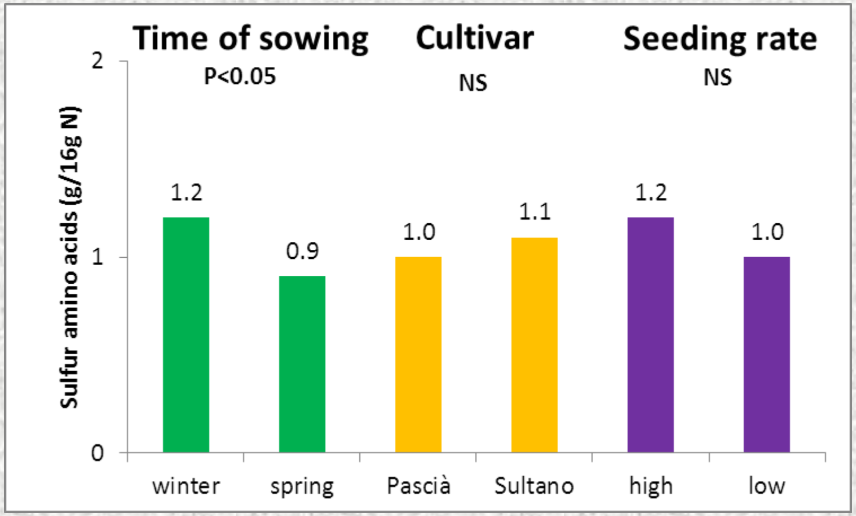
Amino acids compounds of seeds: effect of time of sowing, cultivar and seeding rate. Means are expressed as g /16 g N.



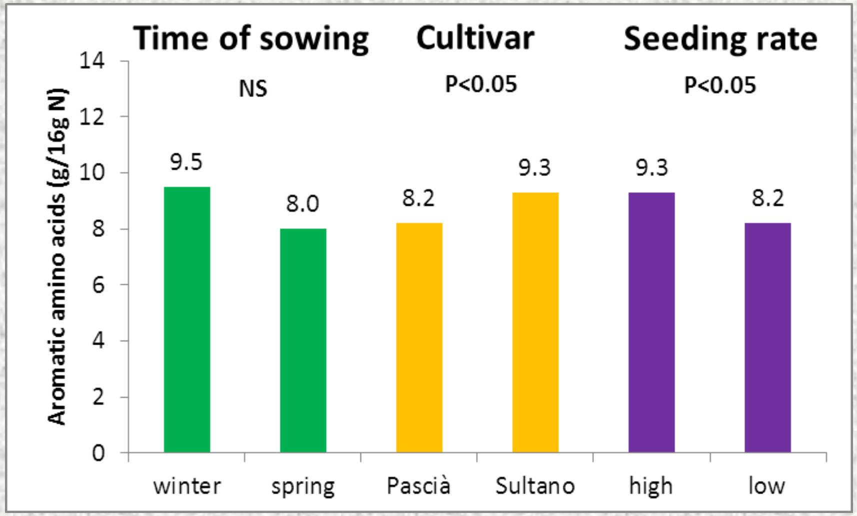
Essential amino acids: Arginine, Histidine, Isoleucine, Leucine, Lysine, Methionine, Phenylalanine, Threonine, Tryptophan, Valine.

Results

Amino acids compounds of seeds: effect of time of sowing, cultivar and seeding rate



Reference range: 1.5-6 g/16 g N



Reference range: 9-22 g/16 g N

SUMMARY

- Time of sowing was found to strongly affect both yield and chemical composition of seeds;
- Winter sowing appeared to be the best choice in the Mediterranean environment when cultivating to maximize the grain yield;
- On the other hand, late sowing improved CP content (+9%);
- The cultivar Sultano proved more productive than Pascià especially when climatic conditions were favourable for AB outbreak;
- Finally, the most appropriate seeding rate was the lower one (70 seeds m^{-2}), considering that plant density had relatively little effect on the considered parameters


Effects of Seeding Season and Density on Yield, Proximate Composition and Total Tannins Content of Two Kabuli Chickpea Cultivars
R. Ruggeri*, R. Primi, P. P. Danieli, B. Ronchi & F. Rossini
Dept. of Agriculture and Forestry Science, University of Tuscia, Viterbo, Italy
*presenting author: r.ruggeri@unitus.it
THANKS FOR YOUR ATTENTION