10th AISTEC Conference

GRAINS FOR FEEDING THE WORLD

Jointly organized with ICC
on the occasion of the World Expo Milan 2015
1 – 3 July 2015

Conference Proceedings

LE UNIVERSITÀ PER EXPO 2015
COMITATO SCIENTIFICO DEL COMUNE DI MILANO

EXPO MILANO

Milano Comune di Milano

Edited by

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AISTEC 1995 - 2015

ICC 1955 - 2015 60 YEARS ANNIVERSARY

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Authors are responsible for the content of their contributions

Minor editing and layout by Francesca Melini and Francesco Martiri (CRA-NUT, Roma, Italy)
Cover by Diana Elwin (ICC, Vienna, Austria) as modified by Francesca Melini

c/o CREA-NUT – Research Center on Food and Nutrition
Via Ardeatina, 546 - 00178 Rome, Italy

ISBN: 978-88-906680-4-3

Printed in Italy

Old Sicilian wheat landraces as a tool to optimize organic and low-input farming systems

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Abstract
In the first half of the 20th century, a number of durum wheat and some bread wheat landraces have been widespread in Sicily, due to their environmental adaptability. However, the farmers have progressively neglected these genotypes replacing them with new varieties selected for dwarf and high yield ability. In recent years, this old germplasm was again valued to optimize organic and low-input farming systems and for certain peculiar quality features of the grains appreciated to produce typical products. In the present work four old wheat cultivars (three of durum wheat and one bread wheat), were assessed for the main agronomic traits as well as for the quality of grain. The results evidenced appreciable variation of the studied biological, agronomical and qualitative traits of the wheat cultivars.

Introduction
Changes in E.U. agricultural policy towards sustainability are essentially based on the recovery and exploitation of local biodiversity and on reduction of auxiliary input to meet environmental protection and food quality growing demand. In this framework, a particular role is played by old landraces able to produce typical food for local consumption and worldwide spreading of Italian excellences (Newton *et al.*, 2010). In Sicily, a number of durum wheat and some bread wheat landraces have been widely grown up to the first half of last century, due to their adaptability to semiarid climate of Mediterranean areas (De Cillis, 1942), although most of these genotypes are characterized by strong plant height, lateness and low productivity as well. Thanks to the joint work of researchers and farmers, different durum and bread wheat landraces have been preserved as a part of the large cereal germplasm available until the beginning of 1950 when the replacement with modern wheat cultivars selected by breeders for dwarf, high yielding ability and gluten tenacity began. Besides adaptability and some valuable agronomic traits as resistance/tolerance to abiotic stress and insects, pathogens and weeds, recent studies highlight appreciable chemical, technological, sensorial and nutraceutical properties such as fibres, antioxidants, vitamins and minerals content (Dinelli *et al.*, 2009; Gallo *et al.*, 2010). In the present work, we assessed four Sicilian old wheat cultivars for the main biological and agronomical traits and for grain quality.

Material and methods
Three durum wheat landraces ('Margherito', 'Russello' and 'Timilia'), an old variety ('Senatore Cappelli') and a bread wheat landrace ('Maiorca') collected in representative cereal areas of Sicily, were grown in 2008-2009 in the experimental station of Catania University 'Primosole' locality (37°24' N., 15°03' E., 10 m s.l.m.) in eastern Sicily, on a clayey soil. The sowing (December 21) was performed on plots of 4 m^2 replicated three times. During the trial, which was conducted without chemical input (fertiliser and herbicide), the earing stage of growing cycle and plant height were

measured for each cultivar. After the harvest, samples of 15 representative spikes and grain obtained within undisturbed area of each plot were collected to evaluate their characteristic. In particular, for quality analyses, a grain sub-sample of each cultivar was milled using an experimental mill, and the qualitative features of the semolina were determined. Protein content (% d.m.) was analyzed with Infratec 1241 Grain Analyzer (Foss Tecator, Höganas, Sweden) using a calibration based on Kjeldahl method. The yellow semolina color index (b*) was determined by CR 300 Minolta colorimeter using CIE Judd-Hunter color values. Dry gluten content and gluten quality were determined through a Glutomatic 2200 apparatus, according to the method UNI 10690 (1979). Alveograph indexes, strength of dough (W) and ratio of tenacity (P) to extensibility (L), were determined using a Chopin alveograph according to UNI (1995) method 10453. Farinograph curves were obtained using a Brabender instrument for the evaluation of water absorption, mixing time, degree of stability and softening index following the AACC method 54–21.02 (2000). The bread-making test was carried out according to the AACC 10-10 procedure (1979), modified for durum wheat by Boggini and Pogna (1989).

Results and discussion

Durum wheat cultivars were slightly earlier than bread wheat 'Maiorca', whereas the latter had lower height as well as reduced values of the examined spike and grain traits (Fig. 1 a b c, d, e and f).

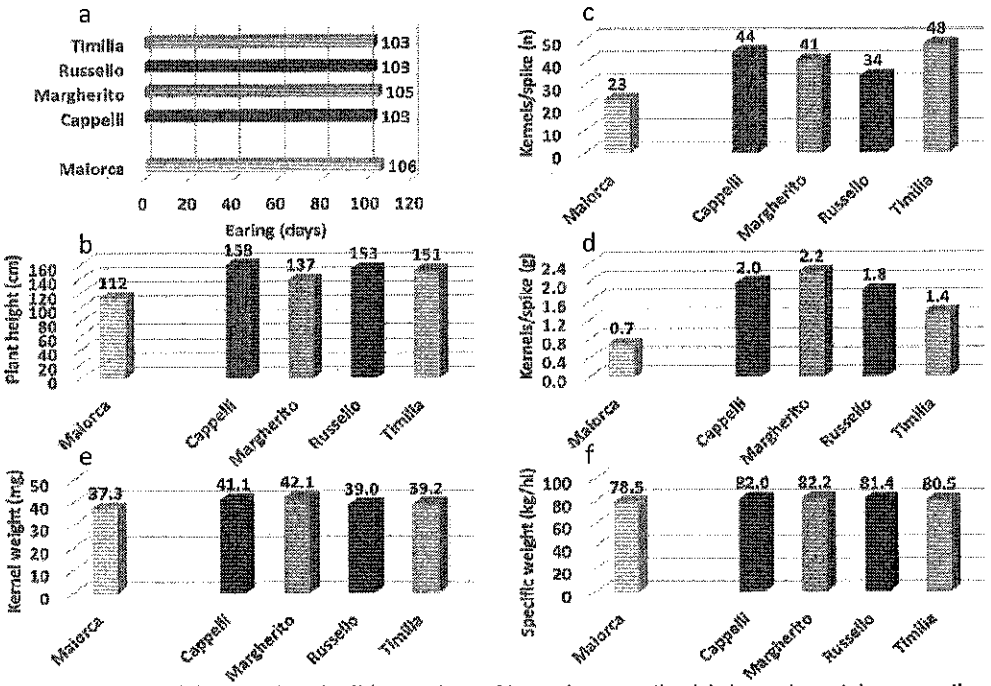

Figure 1. Earing (a), plant height (b), number of kernels per spike (c), kernels weight per spike (d), thousand kernel weight (e) and grain test weight (f) of the tested wheat landraces

Among the durum wheat landraces, 'Russello' had markedly lower number of kernels per spike, whereas lower kernel weight per spike was observed for 'Timilia'. All the durum wheat landraces evidenced a test weight greater to 80 kg/hl.

All the tested wheat landraces evidenced a high protein and gluten content, but in particular the durum wheat landraces 'Timilia' and 'Russello', whose values were highest for both the traits (Tab. 1). On the other hand, the same durum wheat landraces had very low gluten index. This is an indication that these old genotypes have a high fraction of weak gluten, which makes the derived products more easily attacked by digestive enzymes. As expected, 'Maiorca' bread landrace showed

a very low yellow index of flour, whereas the durum wheat genotypes reached values about two-fold higher.

Table 1. Protein content, dry gluten content, gluten index and yellow index of the tested wheat landraces

Wheat landraces	Protein (% d.m.)	Dry gluten (%)	Gluten index	Yellow index (b*)
Maiorca	14.8	12.2	52.1	10.5
Margherito	15.2	13.1	46.3	19.8
Russello	16.1	14.1	12.3	21.8
Cappelli	15.7	13.5	42.4	20.1
Timilia	16.4	14.3	28.1	18.7

The results of rheological test are reported in Table 2. Wide variability was observed for alveographic and farinograph indexes. In particular, as expected, 'Maiorca' bread wheat evidenced high W associated with low P/L. Among the durum wheat landraces, 'Margherito' and 'Cappelli', being two genotypes selected starting from the same North African population, had similar values, which denote a medium strength, whereas 'Russello' and 'Timilia' showed a low strenght, which is associated with balanced value of the P/L ratio in first landrace and with high tenacity in the second one.

Table 2. Rheological characteristics of the tested wheat landraces

Wheat landraces	Alveograph		Farinograph			
	W (10^{-4} J)	P/L	H_2O absorption (%)	Mixing time (s)	Dough stability (s)	Softening index (B.U.)
Maiorca	225.6	0.75	53.8	138	294	55
Margherito	158.5	2.32	66.4	246	144	108
Russello	54.5	1.56	61.2	150	210	110
Cappelli	167.2	2.45	66.8	252	156	95
Timilia	74.6	4.55	67.4	162	150	130

Both 'Maiorca' and 'Russello' reached values of dough hydration normally observed from genotypes of bread and durum wheat, respectively. The other landraces evidenced high water absorption (> 66%).

Dough mixing time was found the lowest in 'Maiorca', and lower in 'Russello' and 'Timilia' among the durum wheats. Dough stability, the time during which the mixture maintains a consistency around 500 U.B., reached the highest value for the bread wheat landrace 'Maiorca'. The durum wheat genotypes evidenced a low stability, confirming the gluten weakness. On the contrary, dough softening index measured after 12 min. from the maximum peak, was found the lowest for 'Maiorca' bread wheat, and lower for 'Cappelli' among the tested durum wheat cultivars.

Table 3 shows the results of the experimental baking test. The bread wheat 'Maiorca', as expected, reached the highest volume (> 500 cm^3). The loaves height was found closely correlated to the volume (r= 0.995***), being the dough placed in trays of known size.

'Maiorca' reached lowest bread weight, thus water absorption, which indicates a lower yield in bread, while 'Timilia' had the highest weight of the loaves among the durum wheats due to the high crumb moisture (data not shown). Crumb porosity was found as the most developed in 'Russello',

well developed in 'Margherito' and 'Cappelli' and undeveloped in 'Timilia', while in bread wheat 'Maiorca' was medium developed. As expected, the crumb color depending on the semolina color, has maintained the same trend. The results of the experimental baking test show that almost all the studied landraces, except 'Timilia', have a good bread-making quality.

Table 3. Baking test of the of the tested wheat landraces

Wheat landraces	Loaf volume (cm^3)	Loaf height (mm)	Loaf weight (g)	Crumb porosity (1-8)*	Crumb yellow index (b*)
Maiorca	515.0	90	139.5	6	11.2
Margherito	472.5	85	145.6	5	20.6
Russello	465.0	83	152.3	4	23.1
Cappelli	480.0	88	141.4	5	21.4
Timilia	355.0	72	161.2	7	19.1

* 1: most porous; 8: less porous

The preliminary assessment of old bread and durum wheat cultivars highlighted appreciable variation of the studied biological, agronomical and grain quality traits, which represents further information to exploit these precious genetic resources.

References

AACC 2000. American Association of Cereal Chemists, Approved Methods, 1979: Methods 10-10. Approved Methods, 2000: 54-21.02. St. Paul, MN.

Boggini G., Pogna N.E. 1989. The breadmaking quality and storage protein composition of Italian durum wheat. Journal of Cereal Science, 9: 131-138.

De Cillis U. 1942. I frumenti siciliani. Stazione Sperimentale di Granicoltura per la Sicilia. Pubbl. n. 9. Catania, p. 323.

Dinelli G., Segura Carretero A., Di Silvestro R., Marotti I., Shaoping F., Benedettelli S., Ghiselli L., Fernàndez Gutièrrez A. 2009. Determination of phenolic compounds in modern and old varieties of durum wheat using liquid chromatography coupled with time-of-flight mass spectrometry. Journal of Chromatography, 1216: 7229-7240.

Gallo G., Lo Bianco M., Bognanni R., Saimbene G., Orlando A., Grillo O., Saccone R., Venora G. 2010. Durum wheat Bread: old Sicilian varieties and improved ones. Journal of Agricultural Science and Technology, 4(4): 11-17.

Newton A.C., Akar T., Baresel J.P., Bebeli P.J., Bettencourt E., Bladenopoulos K.V., Czembor J.H., Fasoula D.A., Katsiotis A., Koutis K., Koutsika-Sotiriou M., Kovacs G., Larsson H., Pinheiro de Carvalho M.A.A., Rubiales D., Russell J., Dos Santos T.M.M., M.C. Vaz Patto 2010. Cereal landraces for sustainable agriculture. A review. Agronomy for Sustainable Development, 30: 237-269.