

Determining Durum Wheat Quality to Obtain EU Incentives: Statistical Problems and Tentative Solutions¹

Determinazione della Qualità del Grano Duro per Ottenere gli Incentivi Comunitari: Problemi Statistici e Possibili Soluzioni

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Riassunto: Nell'ambito della complessa riforma delle Politiche Agricole Comunitarie (PAC), si inserisce anche la nuova regolamentazione dell'incentivo per la produzione e la diffusione delle varietà di frumento duro. Tale agevolazione è riconosciuta in funzione di un indicatore (*Quality Global Index* - QGI), costruito tramite la sintesi ponderata di quattro parametri qualitativi. L'attuale quantificazione del citato QGI non risulta statisticamente coerente e tende a produrre risultati discordanti con gli obiettivi ispiratori della normativa comunitaria. In questo lavoro, gli autori propongono una metodologia alternativa per la determinazione del QGI ed effettuano una comparazione critica dei metodi considerati utilizzando i dati rilevati dall'Istituto Sperimentale per la Cerealicoltura-ISC (annata agraria 2003/2004), nell'ambito della "Rete di confronto varietale sul frumento duro" condotta in Italia su 57 campi dislocati in 15 regioni.

Keywords: Durum Wheat Quality, Statistical Index, EU Agricultural Incentives.

1. Introduction

With the aim of stimulating the increase of "the quality" of durum wheat (production and diffusion) in the European area, the new PAC allows significant monetary incentives to farmers who use specific seeds – among the numerous varieties (*cultivars*) present in the market – with given characteristics. The EU regulation specified the parameters for the evaluation of this quality and the different weight of the same parameters in the calculation of the QGI indicator: hectolitic weight - HW (10%); protein level - PL (40%); gluten index - GI (30%); yellow index - YI (20%). It is not very clear, instead, the statistical procedure to be adopted for the calculation of the QGI, since the policy maker arranges the minimum limit – below which the admission to the EU incentive is not recognized – setting it at 98 (compared with 100 represented by the average of the *witness-cultivars*²).

¹ The views expressed in the paper are those of the authors and do not involve University of Foggia.

² The witness-cultivars are selected among the most diffused cultivars at national level. In Italy T=3 witness-cultivars are currently been individualized (Creso, Duilio, Simeto).

2. Statistical problems to calculate the QGI and proposed procedure

Under the conditions referred above and from a statistical point of view, the problem is to identify the best procedure to be used to synthesize the collected data for the quantification of the QGI. The presence of the witness-cultivars, base of reference for the calculation of the quality indicator, indirectly suggests the building of a series of weighted *index numbers*. As known (Cecchi C., 1995), there are two main techniques of aggregation (Ratio among Averages – RA and Average of Ratios – AR), while the synthesis functions with which they can be built are numerous. In general terms, we can define: x_{vc} as the value x of the variable v ($v=1,2,\dots,V$, $V=4$; $x_1=HW$; $x_2=PL$; $x_3=GI$; $x_4=JI$) for the c .th cultivar ($c=1, 2,\dots, n$); μ_{vT} as the average value of the variable v .th for the T witness-cultivars; p_v as the weight of the variable v .th in terms of percentage ($p_1 = 10\%$; $p_2 = 40\%$; $p_3 = 30\%$; $p_4 = 20\%$). Therefore, the QGI indicator of the c .th cultivar can derive from:

$$QGI_c^{RA} = \left[\sqrt[t]{\sum_{v=1}^4 (x_{vc} \cdot p_v)^t} \Bigg/ \sqrt[t]{\sum_{v=1}^4 (\mu_{vT} \cdot p_v)^t} \right] 100; \quad (1)$$

$$QGI_c^{AR} = \left[\sqrt[t]{\sum_{v=1}^4 \left(\frac{x_{vc}}{\mu_{vT}} \cdot p_v \right)^t} \right] 100. \quad (2)$$

In the past, an unjustified mistake was made in Italy in using the formula (1), setting $t=1$ (Corsi G., 2004 – Ente Nazionale SEMENTI), and so synthesizing variables quantified with non homogeneous measurement units. The ISC Institute (D'Egidio et al., 2005) currently uses the formula (2) setting $t=1$ (*Percentage Technique* – PT) and admitting the cultivars with $QGI \geq 98$ to the EU incentives. It must be pointed out that such a choice is explained by the necessity of eliminating the differences in the *measurement scales* of the V variables (both in terms of measurement unit and Interval of variation – $I_v = x_{v,max} - x_{v,min}$). In fact, as referred in Pasqui et al. (2000) HW varies among 60 and 88 ($I_1=28$); PL varies among 11 and 16,5 ($I_2=5,5$); GI varies among 0 and 100 ($I_3=100$); JI varies among 17 and 32 ($I_4=15$).

In any case, the PT is not the best method to solve the last problem and particularly when dealing with measurement scales in which $x_{v,min} \neq 0$ (e.g. HW, PL and JI). In such a situation the PT does not eliminate, but reduces the diversity between parameters in terms of I_v . At the same time, through the elaboration of the QGI indexes based on V parameters with different I_v , we could achieve (Russo and Spada, 2005) results in which the variables with a greater I_v (HW and above all GI) get a bigger importance with respect to those characterized by smaller I_v (JI and above all PL). With these premises, the weights are dangerously³ modified from p_v to p_v^* and influenced by the variability of the synthesized variables. If we want to keep unchanged the p_v weights, we have first

³ It must be remembered that the most important qualitative parameter for the EU Regulation (PL - weight 40%) becomes a marginal variable in the quantification of QGI, since it is the variable with the smaller I_v .

to transform the V variables to obtain new and homogeneous measurement scales for all parameters. For this reason, *standardization* or *normalization* of the V variables are the more used statistical tools to solve the described problem. However, normalization can be seen as the best choice, since we know the I_v for each variable (absolute minimum and maximum of the measurement scales). In formal terms (Delvecchio, 1995), it can be expressed as follows: $z_{vc} = (x_{vc} - x_{v,min}) / (x_{v,max} - x_{v,min})$ as the normalized value of the v .th variable for the c .th cultivar; $\mu_{z_v T}$ as the average value of the v .th normalized variable z for the T witness-cultivars. If we substitute x_{vc} and μ_{vT} for z_{vc} and $\mu_{z_v T}$ in the (1) and (2), it becomes indifferent to use the RA or the AR method. As known, the two methods lead to the same results for $t \rightarrow 0$. Therefore, a suitable QGI^* indicator can correspond to:

$$QGI_c^{RA} = QGI_c^{AR} = \prod_{v=1}^4 \left(\frac{z_{vc}}{\mu_{z_v T}} \right)^{P_v} = QGI_c^*. \quad (3)$$

3. Main results for Italian cultivar

We now carry out a critical comparison among the considered methods in the paper using the data collected by the ISC Institute (agricultural year 2003/2004), within the “*cultivar comparison project of the durum wheat*” conducted in Italy on 57 plot of lands displaced in 15 regions (the whole data base is also available in the web site www.cerealcoltura.it). Table 1 shows the differences between QGI_1 (which is the indicator now used in Italy) and QGI_2 (which is the indicator proposed in this work).

Table 1: *QGIs for the main Italian cultivars - a.y. 2003/2004.*

Cultivars	QGI ₁	QGI ₂	Cultivars	QGI ₁	QGI ₂
AVISPA	102	98	MERIDIANO	105	120
CANNIZZO	107	113	NEODUR	83	121
CLAUDIO	105	100	NORMANNO	112	134
COLORADO	106	136	OROBEL	102	132
CONCADORO	108	116	PORTORICO	95	95
CRESO*	97	87	PROMOTEO	108	109
DERRICK	102	116	PROVENZAL	92	94
DUETTO	74	85	QUADRATO	113	127
DUILIO*	97	97	SAN CARLO	108	132
DYLAN	105	127	SIMETO*	106	116
FIORE	103	81	SOLEX	101	107
GRECALE	108	141	TIZIANA	91	88
IRIDE	103	99	TORREBIANCA	107	121
LEVANTE	112	148	VETRODUR	87	98
WITNESS-CULTIVARS	100	100	VETTORE	107	125
			VIRGILIO	102	105

Asterisk: the 3 Italian witness-cultivars; Bold: average of the 3 Italian witness-cultivars; Grey box: cultivars with $QGI < 98$ (no EU incentives).

Observing the previous results, we must note the low correlation between the QGI_1 and the QGI_2 indicators ($r = 0,586$). In particular, the “rejected” cultivars are not the same if we use the two different quality indicators: on the one hand, a good correlation of the qualitative evaluation can be seen with regard to the cultivars Creso, Provenzal and Tiziana ($IGQ < 98$); on the other hand, a bad correlation is performed by the cultivars Duetto, Neodur, Vetrodur and Fiore. With regard to the latter, we must highlight that: the first 3 cultivars result “rejected” from the IGQ_1 indicator and “accepted” from the IGQ_2 indicator; the fourth cultivar is characterized by an opposite situation. These different results are not random. In fact, the cultivars Duetto, Neodur, Vetrodur are penalized in the PT procedure now used in Italy because of the bigger importance assigned to the Gluten Index (GI – variable with greater I_v). For the same reason, but with opposite effects, the cultivar Fiore is accepted by the IGQ_1 indicator although it has lower values for all the qualitative parameters with respect to the average of the witness-cultivars (except for the GI variable).

The observed results show the limits of the procedure now used in Italy⁴ and emphasize the opportunity to start a critical discussion, at national and EU level, on the best methodology to be used for the quantification of these important quality indicators. Such remarks are particularly important if we consider the meaning of the political strategy of the EU incentives for agricultural products and the considerable financial resources placed aside for this aim. An inappropriate statistical methodology to calculate a Quality Global Index for durum wheat can produce heavy interferences on the real effects of the EU agricultural incentives. In the specific case of the durum wheat, the procedure currently used in Italy by the ISC Institute, determines a significant change of the importance of the 4 qualitative parameters with regard to that stated by the European regulation.

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⁴ But also in the other EU countries.