Evaluation of the main bio-agronomic and qualitative characteristics of emmer (Triticum dicoccum Shübler) at different sowing times and nitrogen fertilizing levels

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Evaluation of the main bio-agronomic and qualitative characteristics of emmer (*Triticum dicoccum* Shübler) at different sowing times and nitrogen fertilizing levels

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Summary: The research was carried out in Foggia (Southern Italy) in 1991 and 1992 with the aim to determine the effects of three sowing times (the first in the second half of November and the following ones every fifteen days) and three nitrogen fertilizing treatments (0, 60 and 120 kg N.ha^{-1}) on the main quantitative and qualitative parameters in emmer (cv. Luna). Results were greatly influenced by seasonal weather, mostly by rainfall, which was higher and more regular in the first year; as a consequence, grain yields ranged between 3.3 t.ha^{-1} in 1991 and 1.2 t.ha^{-1} in 1992. As to planting dates, the best yield results were obtained in most cases with the earliest one. The effects of nitrogen, instead, were less evident; actually, the straw production only increased with the highest N dose. With reference to the grain quality, the increase in N doses would seem to produce a positive effect on protein and a reduction of fibre (NDF) content, while the increase in yield seems to get worse qualitative parameters.

Key words: emmer, sowing times, nitrogen

INTRODUCTION

Emmer adaptation to marginal areas has contributed to neglect its possible spreading in areas where other cereals are widely grown, providing higher yields but often requiring higher agro-technical inputs (Castagna, 1991; Perrino, 1991; Mariani et al., 1992; Castagna, 1992; Bozzini et al., 1994).

However, emmer grain has today a twofold utilization, which often varies according to the growing area. For animal nutrition, (Daunian Apennine and Upper Molise) it is considered to have a good feed value and is used for fattening of lambs and calves (D'Antuono, 1989). For human nutrition, (Tuscany, Lazio and part of Molise) it is experiencing a growing interest, so that market demand exceeds the national output (Tallarico, 1990). This induced to test the possibility to grow it in alternative areas and to identify the most appropriate agronomic techniques (Perrini et al. 1982; Mariani et al. 1992; Perrino et al. 1993; Castagna et al. 1994). Unfortunately, the difficulty in separating glumes from kernels seems to be a limiting factor for this use, when the common combine-harvester for durum wheat is used for threshing, resulting in a high incidence of broken seeds due to seed fragility. In the absence of an appropriate cleaning equipment (with related additional costs), emmer grain can be successfully used as such (kernels + glumelles), either whole or ground as a supplementary feed for animals. This would facilitate its spreading in mixed (cereal-zootechnical) farms, using the existing available equipments for threshing.

In short, the current interest of this crop and its possible spreading deserves further experimental studies on its adaptability to new areas and on more appropriate cultural techniques. With this in mind, the Agronomical Research Institute has undertaken a research aimed at testing the possibility to grow emmer even in areas traditionally grown with durum wheat, like those of Apulian Tavoliere.

MATERIALS AND METHODS

The trial was set on a split plot design with three sowing times (in large plots), spaced out 15 days starting from mid-November (the sowing time of durum wheat), and three nitrogen fertilizing levels (0, 60, 120 kg.ha^{-1}) per plots. Sowing (cv. Luna) was effected by rows, using 150 kg.ha^{-1} of dressed seeds. Nitrogen was applied as top dressing, splitting by half the scheduled amounts, at early tillering and at the start of shooting stage, respectively.

Through the cropping cycle the main growth stages were determined and the main quantitative and qualitative parameters were measured at harvest. Grain samples with glumes were ground and chemically analysed for the determination of protein N (Kjeldahl), then transformed into protein, of the NDF, using the Van Soest method (AA.VV., 1986) and of the mineral composition, using the FAO method (Cottenie, 1980).

RESULTS AND DISCUSSION

The research was carried out in the two-year period 1991-92 in Foggia, a typical area of the "Tavoliere", on a clay- silty soil, classified in the Soil Taxonomy as "Typic chromoxerert". The climate is "Accentuated Thermomediterranean" according to the FAO-Unesco. The two-year period was characterized by a rainfall (average -188) below the normal values (fig.1), in particular in the second year. The mean temperature was within the average, except in May and especially in the first year.

The different weather pattern resulted in a statistical difference between the two years (Table 1), in terms of grain (3.3 vs. 1.2 t.ha^{-1}) and straw yields (8.6 vs. 3.1 t.ha^{-1}) as well as for all the other agronomic parameters tested. The first sowing time showed better results as compared to the latest one (mid-December), with a higher grain yield. This shows that a quite hardy crop can also cope with the climatic difficulties occurring through the growing season, if sowing is not delayed.

In agreement with the results obtained by the same Authors (De Giorgio *et al.* 1987; Ferri *et al.* 1988) in the same area on durum wheat, the nitrogen application did not improve the grain yield, indeed the unfertilized control produced as much as the treatment with the minimum supply, whereas the yield was lower in the treatment with 120 kg.ha^{-1}.

The straw yield and the number of stems and ears.m^{-2} only showed a significant difference of both nitrogen supplies, as compared with the control. Among interactions, the "sowing time x nitrogen doses" proved to be significant only on grain yield (Figure 2), with higher yields for the first sowing time with both N doses. Such an influence became negative in the case of later sowing times, particularly with the highest N dose.

The same as for the agronomic factors, for the chemical ones (Table 2) as well, the year differences induced the variability of some parameters, such as protein, NDF, P_2O_5 and CaO contents, which exhibited a greater weather sensitivity. In particular, both the protein and the NDF in the 2nd year - which was drier - provided higher values, although with an opposite zootechnical meaning, with mean increments of 23% and 15% respectively. Both P_2O_5 and CaO contents, that varied with a higher increment in the 2nd year, did not involve any significant difference in the Ca/P ratio, which is a parameter of crucial importance for animal fodder use.

No significant differences were observed on the qualitative parameters as influenced by sowing times; it seems useful, however, to point out a slight tendency: to increase for the protein content, and to decrease for NDF and P_2O_5 contents when sowing was delayed. N doses, instead, affected significantly the protein and the NDF contents, with a rise in the protein and the reduction of the second parameter with the increase in the N level.

The greater nitrogen supply to the plants from fertlizer increased N uptake, which resulted in a higher protein content; on the contrary, N fertilization increases "soluble material" (other N-compounds, lipids, carbohydrates, etc.) to the detriment of fibrous components.

CONCLUSIONS

The extremely dry conditions of the two test-years suggest the responses obtained in this emmer (*Triticum dicoccum* Shübler) growing trial in the Tavoliere area to be successful. The yields in the first year (dry but with an acceptable autumn rainfall) and in the second year after 15 months of semi-drought, can be considered to be both satisfactory as compared with the standards of other winter cereals in the same years.

It would be interesting and useful to test the adaptation of other emmer varieties, which could be found to fit better to the difficult conditions of Southern areas. This discloses, however, one of the limitations of this crop, i.e. the poor contribution of studies in the setting up of new varieties.

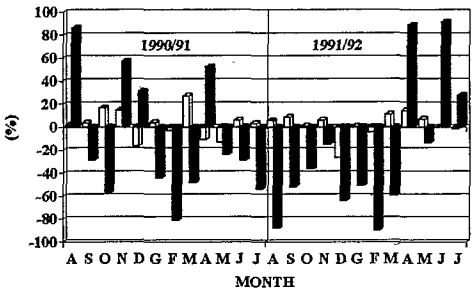

Figure 1. Per cent deviations of mean monthly temperatures ❑ and mean monthly rainfall ■ from the mean (1959/1989).

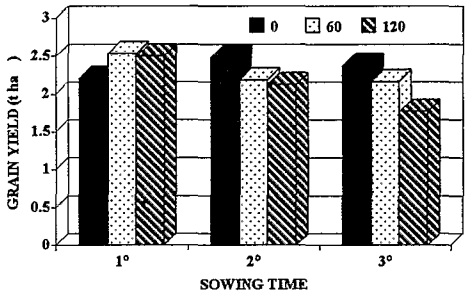

Figure 2. Mean values of the "sowing time x nitrogen doses" interaction on grain yield in two-year period.

Table 1. Effects of years, sowing times and nitrogen levels on yield and the main bio-agronomic parameters in emmer.

	Yield Grain (t ha^{-1})	Yield Straw (t ha^{-1})	Hectolitre Weight (1) kg	Ear Length cm	Plant Height up to ear base cm	Fertile ear/m² n.	Stem density/m² n.
Years							
1991	3.3 a	8.6 a	37.5 a	7.5 a	113.0 a	634.1 a	712.4 a
1992	1.2 b	3.1 b	35.1 b	8.4 b	75.6 b	331.9 b	364.9 b
Sowing Times							
1°	2.4 a	6.5	35.9	7.8	94.5	480.7	525.1
2°	2.3 ab	5.4	36.3	7.9	94.2	464.3	524.3
3°	2.1 b	5.8	36.8a	8.2	94.3	504.0	566.6
Nitrogen Doses (kg ha^{-1})							
0	2.3 a	5.1 b	37.8 a	7.4 b	92.7	444.4 b	492.2 b
60	2.3 ab	6.3 a	35.9 b	8.1 a	95.2	499.5 a	549.9 a
120	2.1 b	6.0 a	35.2 b	8.3 a	95.0	505.1 a	573.9 a

(*) The values followed by the different letters for each parameter are significantly different at 0.05 level (Student - Newman - Keuls Test).

(1) Hectolitre weight with kernels + glumelles.

Table 2. Effects of years, sowing times and nitrogen levels on the main chemical characteristics of emmer grain with glumelles.

	Protein	NDF	P_2O_5	K_2O	CaO	MgO	Na_2O	Ca/P
	g 100^{-1} g d.m.							
Years								
1991	10.84 b	29.41 b	0.826 b	0.586	0.0057 b	0.345	0.080	0.011
1992	13.33 a	33.68 a	1.000 a	0,570	0.0076 a	0.350	0.069	0.013
Sowing Times								
1°	11.77	30.20	0.969	0.572	0.0063	0.365	0.086	0.011
2°	12.05	32.72	0.896	0.567	0.0067	0.339	0.063	0.012
3°	12.38	31.59	0.866	0.597	0.0068	0.339	0.075	0.013
Nitrogen Doses (kg ha^{-1})								
0	10.73 c	33.94 a	0.859 b	0.542	0.0061	0.334	0.072	0.011
60	12.12 b	31.72 b	0.978 a	0.591	0.0072	0.369	0.079	0.013
120	13.41 a	28.68 c	0.896 b	0.603	0.0066	0.340	0.072	0.012

(*) The values followed by the different letters for each parameter are significantly different at 0.05 level (Student - Newman - Keuls Test).

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The three first authors provided the setting and the agronomic conduct of research, the two others ran the analytical determinations. The drafting of the text is to be equally attributed.