AGRONOMIC STRATEGIES IN EXTRA-SEASONAL POTATO QUALITY PRODUCTION

Agronomic Strategies in Extra-Seasonal Potato Quality Production

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Abstract

The extra-seasonal production of potatoes is a typical crop of south Italy where the mild climate conditions allow both the early sowing in February with harvest in June and the late summer sowing (August) with harvest in winter (December). Nitrogen management, together with other agronomic techniques, can influence tuber quality and, consequently, the market and culinary destination of the product. With this aim two field trials were performed in Mirto-Crosia (CS) in order to evaluate the influence of three different times of nitrogen fertilization on the winter sowing crop and three levels of nitrogen on the summer sowing crop. Produced tubers were analysed (panel test) in order to define their quality and culinary destination. The different nitrogen management appears to influence tuber quality and seems to have also a primary role concerning the onset of off-flavours in the cooked product.

INTRODUCTION

In the Mediterranean area early potato crop covers an extension of nearly 25.000 ha which are mainly concentrated in the south part of Italy. Currently one of the main limitations of this crop is the unavailability of seed-tuber suitable for the peculiar environmental conditions and growing cycle; moreover, the narrow choice of cultivars and the fluctuations in terms of both qualitative and quantitative production of the early potato crop reduce the diffusion of this particular crop to other Italian areas (Giordano et al., 1999). Tuber characteristics are often inconstant: in fact the quality of those products depends on many factors such as cultivar, environment and agronomic management (Vecchio et al., 1990; Guarda, 1993). Among these factors nitrogen applications seem to be one of the main factors influencing nutritional and sensorial quality.

The aim of this trial was to investigate the possible use of self-produced seed tubers and the effect of the different agronomic strategies and nitrogen fertilizations on tuber quality.

MATERIALS AND METHODS

The field activities were performed in the Centro Sperimentale Dimostrativo of ARSSA – Calabria placed in Mirto-Crosia (CS) [39°37'00"] on the coast of the Ionian sea during year 2001; two trials with different sowing time were carried on: the first with sowing time in February and harvest in June (winter sowing trial) focused on the production of early potatoes, the other one with sowing time in August and harvest in December for the extra-seasonal potatoes production.

Winter Sowing Trial

Tubers of three cultivars with different levels of earlyness (‘Arinda’, ‘Merit’ and ‘Imola’) were planted in February on a sandy-loam soil; nitrogen fertilisation was performed with an amount of 150 kg N ha^{-1} with three different methods: the entire amount at sowing time (S), the entire amount at tuberisation time (T) and splitted 50% at S and 50% at T (ST). The adopted experimental design was a randomized block with four repetitions, the crop density was 7 tubers m^{-2} and during the crop development the culture

was attended with agronomic managements, irrigations and disease controls as usual. At harvest (June) biometric parameters and data of yield were collected; on some qualitative analysis was performed including: a) dry matter (DM), b) skin colour by means of the colorimetric method, c) washability, d) before cooking blackening (B), e) after cooking blackening (ACB) evaluated on fried tubers.

Moreover on a selected sample of tubers a sensorial analysis was performed; the adopted method was a panel test (six tasters) with the Quantitative Descriptor Analysis (QDA). This method is based on the evaluation of five sensorial descriptors (consistence, moisture, granulation, sweetness, typical taste) and nine aromatic descriptors (wheat, soil, mold, metal, fruits, grass, cooked, chestnut, starch). The sensorial and qualitative analysis were performed at the CISA Mario-Neri Institute in Imola, Bologna, Italy.

Summer Sowing Trial

Tubers with diameter of 35-45 mm of 'Arinda', 'Merit' and 'Imola' obtained only with the ST treatments from the winter sowing trial were planted in August 2001. The experimental design was a split-plot with plant density of 6 tubers m^{-2}. Nitrogen was applied with the ST method using three levels: 0, 75 and 150 kg N ha^{-1}. Tubers were harvested in December and total crop yield was determined.

Statistical Analysis

Data of both trials were processed with analysis of variance (fixed model) and the means were tested with the Pairwise comparison method (Bonferroni test for significance).

RESULTS AND DISCUSSION

For the "winter sowing trial" the entire cycle length was 107 and 114 days respectively for 'Arinda' and for the other two cultivars (Fig. 1); 'Arinda' appeared to be the earliest cultivar with 35 days from sowing to emergence (7 days before 'Imola' and 'Merit'); tuberization process showed a different length in 'Imola' with 16 days, while in 'Merit' and 'Arinda' it lasted 10 days. The yield of the winter sowing trial (Fig. 2) resulted to be strongly influenced by the cultivars: the average production detected for 'Imola', the most productive, was 38.3 t ha^{-1}, 'Arinda' produced 35.9 t ha^{-1} and 'Merit' only 28.4 t ha^{-1}. Also the interaction between cultivars and nitrogen distributions was significant and, in that sense, 'Imola' showed the best results with the splitted application of nitrogen (40.3 t ha^{-1} with the ST treatment), while 'Arinda' achieved the highest yield with the T treatment (38.5 t ha^{-1}) and 'Merit' with the S treatment (33.4 t ha^{-1}). The tuber quality (Table 1) was influenced by the different nitrogen applications, especially in 'Arinda' where the T treatment caused a change from A/B to B in the EAPR category, but the main result is the interesting increase of dry matter content observed in 'Arinda' and 'Imola' in correspondence of the T treatments. The blackening values observed (before and after cooking) resulted to be not affected by nitrogen treatments. Concerning sensorial analysis, cultivars strongly affected off-flavours characteristics: 'Arinda' showed mainly metal off-flavour and 'Merit' starch. Nitrogen affected moreover 'Imola' off-flavour: it showed chestnut off-flavour in correspondence of ST treatment and starch with the others. In the summer sowing trial, the most relevant observed phenomenon concerning the cycle length was the extremely slow and reduced emergence of 'Merit', that compromised very much the production of this cultivar. 'Arinda' showed the earliest emergence (25 days) and the shortest cycle with 100 days. The yield of the summer sowing trial was different in relation to the cultivars: mainly for the low production of 'Merit' (5.5 t ha^{-1}) compared with 'Arinda' (23.1 t ha^{-1}) and 'Imola' (16.8 t ha^{-1}). The nitrogen management strongly influenced the yield: 'Arinda' produced 28.9 t ha^{-1} with the 75 kg ha^{-1} treatment, while 'Imola' showed the highest yield (20.7 t ha^{-1}) with the 0 kg ha^{-1} treatment.

CONCLUSIONS

The winter culture has showed encouraging results for the production of early potatoes in the Calabria Region, with a good performance of early and late cultivar as 'Arinda' and 'Imola'. It might be possible to programme the presence of fresh tubers on the markets for a long period. The quality of those tubers appears to be good, but it could be enhanced with a rational management of the Nitrogen fertilizations. From the summer culture arise that it is necessary to improve the knowledge mostly about cultivar characteristics and cultivar adaptability to the environment; it is moreover important to promote the studies over the specific agronomical strategies for this particular crop.

ACKNOWLEDGEMENTS

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Tables

Table 1. Winter sowing trial: evaluation of tubers characteristics (sensory analysis).

Cultivar	Nitrogen application timing	Dry matter[1] (%)	Blackening[2]	EAPR category[3]	After cooking blackening	Off flavours
Arinda	S	15.85 b	2.15	A/B	0	Metal
	T	18.35 a	3.00	B	0	
	ST	16.64 a	2.00	A/B	0	Metal
Imola	S	18.29 b	3.25	B	0	Starch-Chestnut
	T	20.78 a	2.25	B	0	Starch
	ST	18.43 b	2.60	B	0.1	Chestnut
Merit	S	17.98 a	3.25	A	0	
	T	16.96 b	3.00	A	0	Starch
	ST	16.80 b	3.00	A	0	

[1] Means followed by the same letter are not significantly different for $P \leq 0.05$.
[2] Scale CISA: from 0 = extra white without blackening, to 6 = extra black.
[3] A = tubers with firm flesh useful for salade; B = tubers with flesh enough firm for every use.

Figures

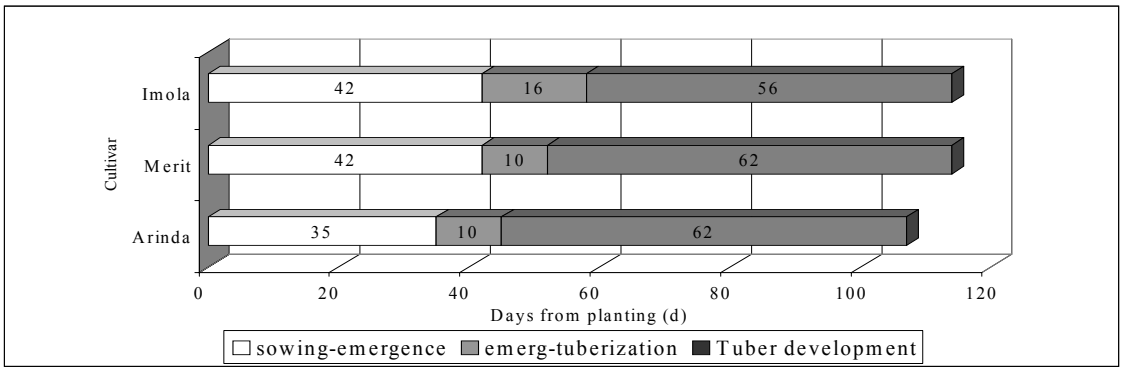

Fig. 1. Winter sowing trial: cycle length for the three cultivars.

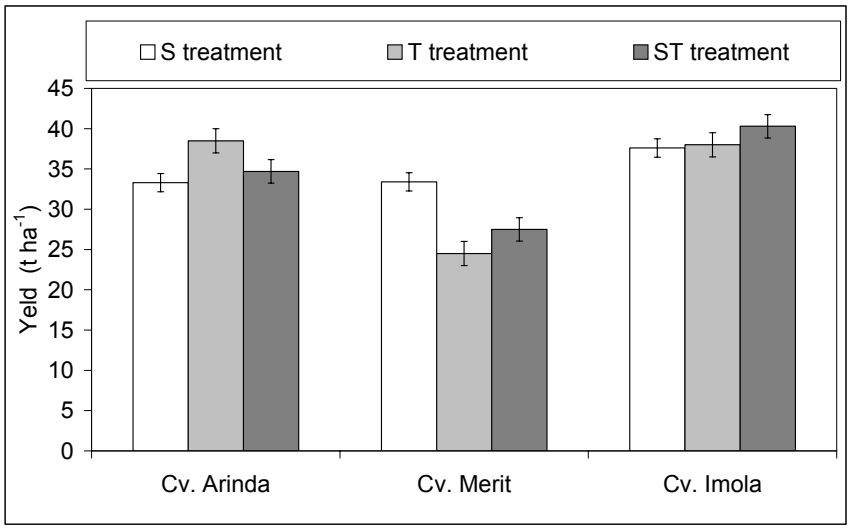

Fig. 2. Winter sowing trial: effect of nitrogen on the yield. Nitrogen fertilisation applied at sowing time (S treatment), at tuberisation time (T treatment) and 50% at S and 50% at T (ST treatment). Bars represent standard error.