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Effects of different fertilizers on quantity and quality of silage corn

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ABSTRACT: Different fertilizers, ammonia sulfate and urea (MIN), Fertil 12.5 (ORG) and Azoslow (ORG-MIN) were compared in a silage corn crop. Total biomass yield was above 55.0 t ha^{-1} for all fertilizers. Azoslow showed the highest dry matter content (40.8%). No differences among the fertilizers were found in protein content (4.9% on average) at waxy ripening, with the control showing the lowest value (3.9%). There were also no differences in silage quality among the fertilizers. The N budget was estimated in order to quantify the residual nitrogen amounts at harvest and the efficiency of fertilizers.

Key words*:* Organic agriculture, N budget, Corn silage yield and quality.

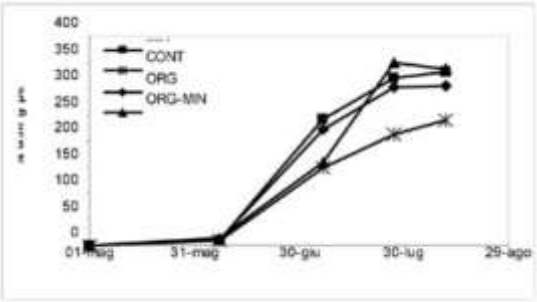
INTRODUCTION - Intensification of agricultural practices has caused environmental impacts such as excess nitrates and groundwater pollution, and degradation of soil chemical, physical and biological fertility (Havlin *et al.,* 1999). Proper soil fertility management is the main tool for improving quality and quantity in forage cropping systems. In organic farming, the negative impacts of agriculture on the environment could be attenuated, although many studies have shown the risk of nitrate leaching also in organic systems (Fagnano *et al.,* 2003). The aim of this paper was to compare mineral and organic fertilizers as regards corn silage production and environmental impact.

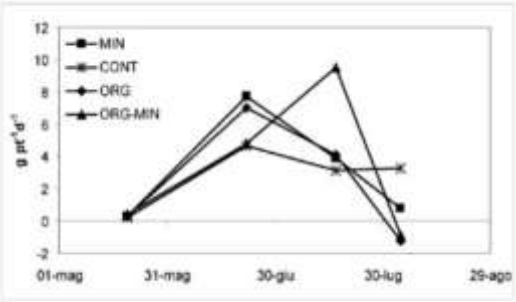
MATERIAL AND METHODS - Trials were carried out at the "Torre Lama" experimental farm of Naples University, Bellizzi (SA) 14°56'E, 40°37'N, 30 m a.s.l. The treatments were as follows: control (CONT); ammonia sulfate and urea (MIN); Fertil 12.5 (ORG); Azoslow (ORG-MIN). The doses were based on 160 kg ha^{-1} of N. All organic fertilizers were applied prior to sowing, while mineral fertilizers were applied at two times: 25% at sowing (ammonia sulfate) and 75% at the 7th leaf (urea). The harvested biomass and other biometric parameters were determined. Chipped plants were pressed and closed in plastic bags for 90 days; the silage corn was then analyzed to determine quality (Jarrige, 1981; AOAC, 1990*;* Calabrò *et al*, 2001; Di Francia *et al*, 2001). In order to determine the nitrogen budget, N derived from the mineralization of the SOM (Soil Organic Matter), N supply and N uptake were estimated. Moreover, the efficiency of the fertilizers was estimated as the ratio between uptake and sup-

ply. 40 mm of rain fell during the cropping period, while the ETmax was 458 mm; water deficit was compensated by applying water with a drip-irrigation system.

RESULTS AND CONCLUSIONS - Growth analysis - Biomass yield for all the treatments shows very rapid growth in June for MIN and ORG and in July for ORG-MIN (Fig. 1a). Indeed, Crop Growth Rate (CGR) peaked (> 7 g pt^{-1} d^{-1}) in the period 7/6 - 7/7 for MIN and ORG and in the period 7 - 27/7 for ORG-MIN (9.5 g pt^{-1} d^{-1}) (Fig. 1b).

Figure 1 Biomass yield (a) and crop growth rate (b).





Yield – Corn yield both of fresh and dry matter did not differ among the three fertilizers, all higher than CONT. Neither did the percentage of dry matter and leaf area at the end of flowering differ among the fertilizers, even if higher values were observed in the plants fertilized with ORG-MIN (Tab. 1).

Table 1. Corn yield at waxy ripening.

Treatments	Total Biomass t ha $^{-1}$ f.m.	Total Biomass t ha $^{-1}$ d.m.	Dry matter %	Protein % d.m.	Protein Kg ha-1	height cm	LAI
CONT	45.3 b	15.2 b	33.7b	3.9 b	598 b	283.3 b	2.28 b
ORG	62.1 a	22.8 a	36.7 ab	4.6 ab	1041 a	347.0 a	2.93 ab
ORG-MIN	55.2 ab	22.6 a	40.8 a	5.2 a	1181 a	332.0 a	3.41 a
MIN	60.4 a	22.1 a	36.6 ab	4.9 a	1082 a	328.0 a	2.75 ab
Significance	0.04	0.04	0.10	0.03	0.04	0.03	0.08
LSD	111	55	5.7	0.8	394	39	1.1

The analyses on corn silage showed no differences in ashes (7.1% on average), OM (92.9%), ADF (34.3%), cellulose (28.1%) and nutritive value (0.83 Milk F.U. kg-1). No differences in protein content were observed among the fertilizers, although they showed higher values than CONT. ORG showed lower values of ADL, NDF and hemicelluloses. On the whole, the corn silage was of average quality, with a low content in proteins and standard pH values (Tab. 2).

Table 2. Qualitative analysis of corn silage after 90 days (values in% DM).

Treatments	Protein	NDF	ADL	Hemicelluloses	pH
CONT	3.68 b	60.9 a	4.03 b	26.3 a	4.36 a
ORG	5.09 a	51.6 b	4.08 b	19.9 b	4.14 b
ORG-MIN	5.21 a	57.2 ab	5.31 a	21.0 b	4.20 ab
MIN	5.24 a	58.9 ab	4.75 ab	24.1 a	4.24 ab
Significance	0.05	0.07	0.07	0.03	0.01
LSD	0.8	3.2	1.0	3.8	0.2

Nitrogen budget - N derived from the mineralization of the SOM was evaluated assuming that the nitrogen uptake from the non-fertilized plants (114 kg ha^{-1}) is derived from the mineralization of the SOM ± the variations in mineral N in the soil layer 0-60 cm between sowing (119 kg ha^{-1}) and harvest (104 kg ha^{-1}) (Tab. 3).

Table 3. Elements for the nitrogen budget (kg ha^{-1}).

Treatments	Supply			Uptake	Budget	% efficiency
	Fertilization	Mineralization	Total			
CONT	0	99	99	114 c	-15 b	115 a
ORG	160	99	259	174 b	85 a	67 b
ORG-MIN	160	99	259	254 a	5 b	98 a
MIN	160	99	259	187 b	72 a	72 b
Significance	---	---	---	0.01	0.01	0.05
LSD				34	34	15

The supply of N was 99 kg ha^{-1} in CONT and 259 (160+99) in the three fertilized plots. Different uptakes were observed among the treatments: higher in ORG-MIN, intermediate for the other two fertilizers and lower in CONT. Therefore the nitrogen budget as a difference between total supply and uptake showed a surplus of N (70-80 kg ha^{-1}) for ORG and MIN. This surplus represents the amount of N available but not used by maize plants: indeed, the efficiency of N was low for these two fertilizers (≈ 70%), confirming that too rapid N availability (both from mineral fertilizer, and rapidly mineralizable organic fertilizer) does not allow efficient uptake of plants.

The different nitrogen availability could have caused the different growth rates shown in figure 1b and the greatest concentrations of N and proteins in ORG-MIN that allowed N efficiency close to 100% to be obtained. Hence the quantity of N not taken up by the crop and remaining in the soil in the post-harvest period was about zero. Therefore the environmental risks due to the surplus of mineral nitrogen in the soil after harvest were lower in comparison with the other two fertilizers. The problem of nitrates after harvest must not

be underestimated since autumn rainfall could cause leaching into the groundwater. In conclusion, fertilizers for organic farming produced increases in yield and nutritive value of corn silage similar to that obtained with ordinary mineral fertilization based on ammonia sulfate and urea, while slow release organic-mineral fertilizers led to a higher N uptake by plants, thereby reducing the residual post-harvest content of mineral N in the soil and reducing the risk of nitrate leaching into the groundwater.

REFERENCES - AOAC, 1990. Official Methods of Analysis, 15th ed. Association of Official Analytical Chemists, Washington, DC, USA **Calabrò** S., Bovera F., Marchiello M., Maresca A., Infascelli F., Piccolo V., 2001. Valutazione di diete per bufale in lattazione mediante il sistema INRA. Atti I Congresso Nazionale sull'Allevamento del Bufalo" Eboli, 3-5 October, 377-380. **Di Francia** A., Masucci F., Proto V., 2001. Evaluation of buffalo feeding according to INRA and CNCPS systems. Proc. ASPA XIII Congr., Florence, 141-143. **Fagnano** M., Merola G., Zena A., Quaglietta Chiarandà F., Moschetti G., Protopapa A., Piccolo A., 2003. Apporti di sostanza organica in un ordinamento orticolo ad agricoltura biologica: risultati preliminari sugli effetti di breve periodo. Rivista di Agronomia. 37:133-138. **Havlin** J. L., Beaton J. D., Tisdale S. L., Nelson W. L., 1999. Soil Fertility and Fertilisers – An Introduction to Nutrient Management. Prentice Hall – Upper Saddle River, sixth edition, New Jersey, pp 487. **Jarrige** R., 1981. Les constituants glucidique des fourrages: variations, digestibilité et dosage. In «Prévision de la valeur nutritive des aliments des ruminants». INRA, Versailles, 137-148.