RESEARCH CENTRE FOR INDUSTRIAL CROPS – BOLOGNA (ITALY)

POTENTIALLY MINERALIZABLE NITROGEN IN SOIL AMENDED WITH BIOCIDAL AND NON-BIOCIDAL PLANT MATERIALS

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Introduction

In recent years *Brassica* defatted meals have been studied for their biofumigant effect on soil-borne pathogens and pests (Lazzeri et al., 2004). However, when incorporated, these materials also supply the soil with nutrients, which may interact with crop nutrition.

Potentially Mineralizable Nitrogen (PMN) is a measure of soil ability to release inorganic N useful for crop N uptake. The AIM of this study was to compare the PMN of soil amended with *Brassica* meals with that of soil after incorporation of other plant materials: non-biocidal sunflower (*Helianthus annuus*) meals, biocidal *Brassica juncea* green manure, and inorganic N fertilizer.

Materials and Methods

Soil: silty clay (510 g clay, 435 g silt, and 55 g sand kg^{-1} dry soil; 2.1 g Kjeldahl N and 18 g organic C kg^{-1} dry soil; pH 8.1);

Treatments:

- **Control**
- **Brassica *carinata* (BC) pellets**
- ***Brassica juncea* green manure (GM)**
- **Inorganic N (Nmin)**
- **BC pellets + *B. juncea* GM**
- **BC pellets + Nmin**
- **BC pellets + *B. juncea* GM + Nmin**
- **Thermally deactivated BC pellets (TDBC)**
- **Non-biocidal sunflower pellets (SU)**

Amendment rates are reported in **Table 1**. Inorganic N was added as Ca nitrate at 98 mg N kg^{-1} dry soil).

Determination of the PMN: Plant material and/or N fertilizer were thoroughly mixed with the soil in pots, while GM had been finely chopped just before incorporation. After a week at room temperature, soil was distributed in vials and incubated at 30°C and 75% of plant-available water. The inorganic (nitrate + ammonium) N content in soil was determined at different time intervals **(DOI=days of incubation)** after the start of incubation.

The PMN was calculated as the difference between the inorganic N content in soil at DOI *t* and the N content in soil before treatment incorporation (Three replications for each treatment, at each time).

Table 1. Amounts and composition of the soil amendments used in the experiment. BC: *B. carinata*; SU: sunflower; GM: green manure; FM: fresh matter; DM: dry matter; GLs: glucosinolates.

Soil amendment	Added FM (t ha^{-1})	Added FM (g L^{-1} of wet soil)	Pellet or plant DM (%)	Pellet or plant moisture (%)	Kjeldahl N (g kg^{-1} FM)	Kjeldahl N (g kg^{-1} DM)	GLs (µmol g^{-1} FM)
BC pellets	2.5	1.79	94.9	5.1	61	64	150.7
SU pellets	2.5	1.79	92.9	7.1	49	53	-
B. juncea GM	100	71.5	23.4	76.6	5.1	22	2.5

Effect of soil amendments on PMN

At DOI 28 the soil amended with BC pellets + Nmin showed the highest PMN (**Table 2**), whereas the PMNs of the other treatments were not significantly different from the control. **At DOI 91** the PMN of BC pellets + *B. juncea* GM + Nmin and BC pellets + Nmin was significantly higher than the PMN of the other treatments, whereas the soil amended with SU pellets showed the lowest PMN. The lack of significant differences between biocidal (BC), non-biocidal (SU) and thermally deactivated Brassica pellets shows that the PMN was not significantly affected by the biocidal compound release. The simultaneous supply of inorganic N and organic matter (whether pellets or GM) gave rise to higher PMN values.

Table 2. PMN values for the compared treatments, at DOI 28 and 91. BC: *B. carinata*; GM: green manure; Nmin : inorganic N; TDBC: thermally deactivated *B. carinata* pellets; SU: sunflower.

Treatment	DOI 28	DOI 91	Mean of Treatment
	mg N kg^{-1} dry soil		
Control	13 b	36 cd	25 C
BC pellets	83 b	104 bc	93 B
B. juncea GM	14 b	84 bcd	49 BC
N_{min}	80 ab	136 bcd	108 B
BC pellets + *B. juncea* GM	89 ab	156 bcd	122 AB
BC pellets + N_{min}	217 a	224 ab	221 A
BC pellets + *B. juncea* GM + N_{min}	72 b	278 a	175 A
TDBC pellets	79 b	91 cd	85 B
SU pellets	76 b	68 d	72 B
Mean of DOI	80 B	131 A	

Upper-case letters were used for comparisons of the mean effects, lower-case letters for the comparison of first order interaction effects. The interaction DOI x Treatment was estimated at each DOI (comparison between treatments within each column). For each source of variation, means followed by the same letters are not significantly different for $P<0.05$, according to the Tukey-Kramer test for mean comparisons.

Green manuring with *B. juncea* produced a remarkable but delayed increase of PMN (**Fig. 1**).

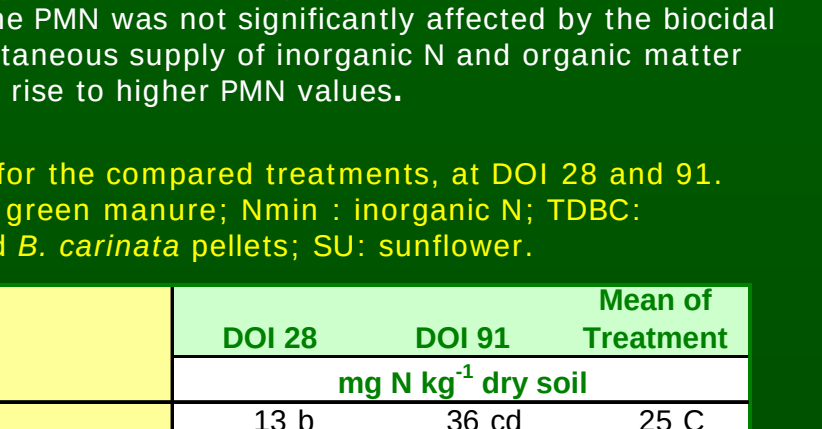

Figure 1. Time course of PMN for selected treatments.

Conclusions

These results support the hypothesis that, in addition to the potential partial or total substitution of synthetic fumigants in pest control due to biofumigant effects, *B. carinata* pellets could also supply the soil with organic N available for crop growth. Inorganic N release in soil amended with *B. carinata* pellets seems to occur at the same rate as in soil amended with non biocidal defatted seed meals. N availability for crops, following incorporation, was faster for pellets than for green manure. This is important to bear in mind when aiming to match plant N demand with fertilizer N supply.

References

Lazzeri L., Leoni O., Bernardi R., Malaguti L., Cinti S. 2004. Plants, techniques and products for optimizing biofumigation in full field. Agroindustria, 3:281-287.