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The use of an innovative soil amendment in broccoli crop

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Introduction

The growing demand for food, resulting from the rapid growth of the world's population, can be met mainly thanks to the innovations of the agronomic techniques. To this end, the agronomic use of soil improvers is now more than ever a modern and innovative tool. The aim of this work was to assess the effects of Polyactive®, a micronized polyacrylamide polymer with soil improver action, on the growth and qualitative and quantitative characteristics of broccoli crop in open field conditions. The evaluation of the efficacy of the above commercial formulation was carried out taking into account different methods and doses of application.

Materials and Methods

The experimental trial was carried out at "Pugliese" farm located in the countryside of Matera (Southern Italy, 40° 42' N; 16° 42' E; 390 m a.s.l.). The trial involved the use of Polyactive®, consisting of micronized poly-acrylamide (with a maximum content of 0.05 % mono-acrylate as per legal limits) with high molecular weight and soluble in water, on the soil cultivated with broccoli crop (*Brassica oleracea* L. var. *italica* Plenck cv. Marathon F_1), transplanted on October 15th 2019 at a density of 4,2 plants m^{-2}. In particular, two formulations of Polyactive® (powder and gel at 2% concentration) and two doses of application to the soil (10 and 20 kg ha^{-1}) were used. In addition, the soil improver was applied on soil subjected to two tillage methods: 1) conventional, i.e. tilled soil and 2) no-tillage, with sod transplanting.

The conventionally tilled soil was subjected to a ploughing of 35 cm, followed by an harrowing and a milling. For each of the two tillage methods (tilled and no-tilled soil), four experimental treatments were considered resulting from the combination of 2 Polyactive® formulations with two application doses, and the addition of an untreated soil surface (control). Therefore, a total of ten experimental theses were compared, arranged according to a strip-plot design with three repetitions, placing in the main plots the two methods of soil tillage and in the sub-plots of 45 m^2 the Polyactive® treatments. The harvest of heads (corymbs) took place at the end of February 2020; at each harvest, fresh and dry weight of main (central) heads, head mean weight and dimensions were assessed on samples taken from ten plants from each sub-plot. All collected data were processed by analysis of variance (ANOVA) and main results are given in Table 1.

Results

Table 1 shows the influence of the application of the Polyactive® soil improver and the tillage soil treatment. In particular, it can be seen that broccoli grown on tilled soil have recorded significantly higher values for all yield and quality traits, compared to the no-tillage ones; notably, marketable yield has increased by 3.4 and 3.0 t ha^{-1} considering, respectively, the weight of the heads with and without leaves. In addition, powder treatment recorded yields higher than the control formulation of 2.4 and 1.6 t ha^{-1} considering the heads with and without leaves, correspondingly. At the same time, higher quality characteristics were observed compared to the GEL. With the same formulation the yields increased compared to the no-tilled, by 1.3 and 1.0 t ha^{-1}, respectively, for leaved and no-leaved broccoli heads. Moreover, the dose of 20 kg ha^{-1} allowed to obtain values significantly higher than those observed with dose of 10 kg ha^{-1}. The dry matter content is the only exception to the others, as statistically similar values have also been observed with varying dosages and different formulations of Polyactive®.The marketable heads, with and without leaves, increased by 1.3 and 1.0 t ha^{-1}, respectively, with the GEL application , compared with the untreated control, while the powder formulation increased by 2.4 and 1.6 t ha^{-1}.

Table 1. Effect of soil tillage and Polyactive® application on yield and qualitative traits of broccoli.

Treatments	*Marketable yield*		*Quality traits of heads*				
	Heads (t ha^{-1})		*Mean weight*	*Diameter*	*Height*	*Thickness*	*Dry*
	with leaves	*without leaves*	*(g)*	*(cm)*	*(cm)*	*stem (mm)*	*matter content (%)*
Soil tillage (L)							
no-tillage	3.5	1.8	36.8	5.3	9.7	13.2	11.7
tilled	6.9	4.7	99.0	8.9	15.1	21.6	10.5
Significance(1)	**	**	**	**	**	**	*
Polyactive (Poly) (2)							
Control	3.8 e	2.2 e	46.0 d	5.7 e	10.9 c	14.7 d	11.0
Poly. - gel 10	4.8 d	3.1 d	64.0 c	6.8 d	12.1 b	16.9 c	11.1
Poly. - gel 20	5.4 c	3.5 c	72.8 b	7.2 c	12.4 b	17.1 c	11.1
Poly. - powder 10	5.9 b	3.7 b	78.0 a	7.8 b	13.3 a	18.6 b	10.1
Poly. - powder 20	6.3 a	3.9 a	82.4 a	8.4 a	13.6 a	20.5 a	11.2
Significance(1)	**	**	**	**	**	**	ns
Interaction "L x Poly"							
Significance(2)	**	**	**	**	**	**	**

(1) *=significance of 0.05 P;**=significance of 0.01 P; ns= not significant differences

(2) The values in columns not having any letters in common differ significantly at 0,05 P.

Conclusions

The obtained results revealed the important properties of the innovative soil amendment such as the Polyactive®, which has been shown to induce optimal growth of broccoli plants. The positive effects of the new micronized polyacrylamide polymer on most of the yield and quality parameters of broccoli, could be due to the improvement of some soil physico chemical characteristics like water retention (Shahid *et al*., 2012) and ion exchange capacity for the controlled release of fertilizers (Aouada *et al*., 2012). These preliminary results need to be confirmed in future experiments aimed to deep the knowledge of the effects of micronized polyacrylamide polymer on soil physico chemical proprieties.

Aouada FA et al., 2012. Synthesis and characterization of novel pH sensitive PAAM-PMAA-CMC hydrogels and their applications in the controlled release of fertilizer. Hydrogels: Synthesis, characterization and applications (pp. 279-298).

Shahid SA et al., 2012. Improvement in the water retention characteristics of sandy loam soil using a newly synthesized poly(acrylamide-co-acrylic acid)/AlZnFe 2O 4 superabsorbent hydrogel nanocomposite material. Molecules, 17(8), 9397-9412. doi:10.3390/molecules17089397.