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Broad Bean Productivity under Conservation Agriculture

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Introduction

Conservation Agriculture is a farming system that promotes minimum soil disturbance (i.e. no- or minimum-tillage), maintenance of a permanent soil cover, and diversification of plant species (Hobbs et al., 2007; Rinaldi et al., 2022). It enhances biodiversity and natural biological processes above and below the ground surface, which contribute to increase water and nutrient use efficiencies and to improve and sustain crop production. Broad or faba bean (*Vicia faba* var. *minor* L.) is a grain legume that improves soil fertility and for this has an important role in rainfed crop rotations and in sustainable cereal crops production. It can be also planted as cover crops and green manures for its N fixation capability (López-Bellido et al., 1998).

Objective

The aim of the research is to verify how conservation (No-Tillage) and conventional (Minimum-Tillage) agriculture systems could affect the quality and yield of broad bean.

Materials and Methods

The field experiment was established in 2013 in Foggia (South of Italy) in a rainfed area. The experimental design consisted of the comparison of conservation (NT, no-tillage) and conventional (MT, minimum-tillage) agriculture systems, arranged in a randomized block design with five replications. Elementary plot size was 120m × 80m. The cropping system was a 2-year rotation of durum wheat with legumes or fallow. The MT treatment consisted of 2-3 passes of field disk cultivator (15 cm depth). In the 2020-21 growing season a non-selective herbicide (1.5 L 36% glyphosate per ha) was applied before sowing in the NT treatment. The sowing of broad bean o 23rd December 2020 (cv Vesuvio) was carried out with a no-till seeder equipped with disk type furrow openers. No fertilization was applied. Crop residues were removed in MT and chopped and left on soil surface in NT treatment.

Results

The crop development showed a LAI higher in MT than in NT in 2 out 3 measurement dates (Fig. 1). The final seed yield did not significantly differ between the two tillage treatments (1.06 vs 0.99 t ha^{-1}, respectively for NT and MT), while a greater 1000 seeds weight was observed in NT (Fig. 2): this highlights a plant health condition in seed ripening phase more favorable in NT than in MT. The total plant biomass (Fig. 3) did not significantly differ between the two treatments, and this produced a harvest index greater in NT than in MT (0.28 vs 0.25). The water balance indicated a larger soil water content at sowing and, consequently a capability of broad bean to extract more water in NT than in MT (Tab. 1); the WUE, both for seed and biomass, resulted similar between the two treatments.

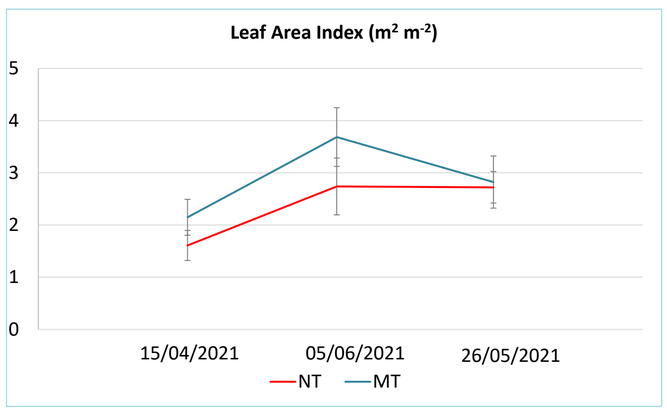
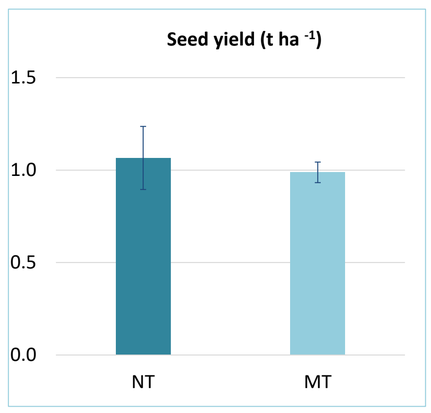


Fig. 1 Leaf Area Index of broad bean, measured in 3 sampling dates. The bars indicate the standard deviations.



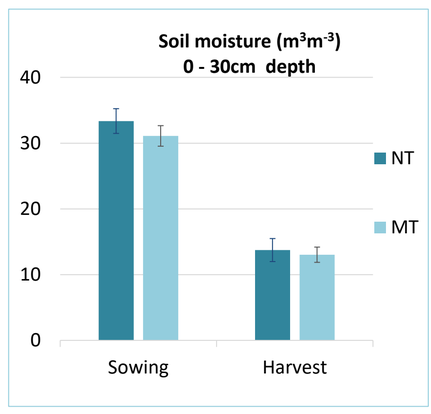
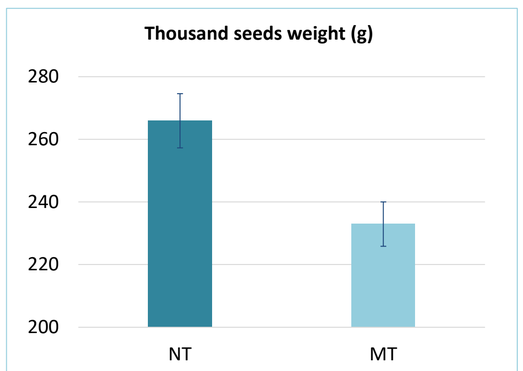


Fig. 2 Seed yield and thousand seeds weight of broad bean in the two tillage treatments. The bars indicate the standard deviations.



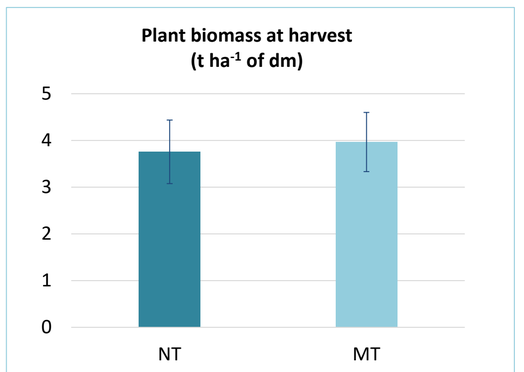


Fig. 3 Soil moisture at 0-30 cm depth measured with gravimetric method at sowing and at harvest times and total broad bean biomass yield at harvest. The bars indicate the standard deviations.

Conclusions

The two tillage practices - NT and MT- experimented on broad bean did not influence significantly seed and total aboveground biomass yields. The soil moisture content, and in particular the amount of depleted water from sowing to harvest, higher in NT than in MT, influenced positively the seed ripening in the final part of growing season. This also confirms the positive effects reported in literature of conservation agriculture and in particular of NT, in environments where water availability is main crop yield limiting factor.

	Soil Water Depletion (sowing-harvest) in 0.6m (mm)	Seasonal Water Use (mm)	WUE_seed (kg ha^{-1} mm^{-1})	WUE_biomass (kg ha^{-1} mm^{-1})
No-Tillage	66.59±21.78 a	302.59±21	3.51±0.42	12.55±1.81
Minimum-Tillage	48.82±16.29 b	284.82±16	3.48±0.36	13.96±1.68

Tab. 1 Water use and Water Use Efficiencies of broad bean (different letters indicate different values at P<0.05, test).

Acknowledgments:
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