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Aim: To evaluate the long-term effects of the cropping systems (conventional versus organic) and tillage management (plowed versus subsoiled soil) on crop yield and weed biomass in a 3-year crop rotation in the Mediterranean environment of Central Italy

INTRODUCTION

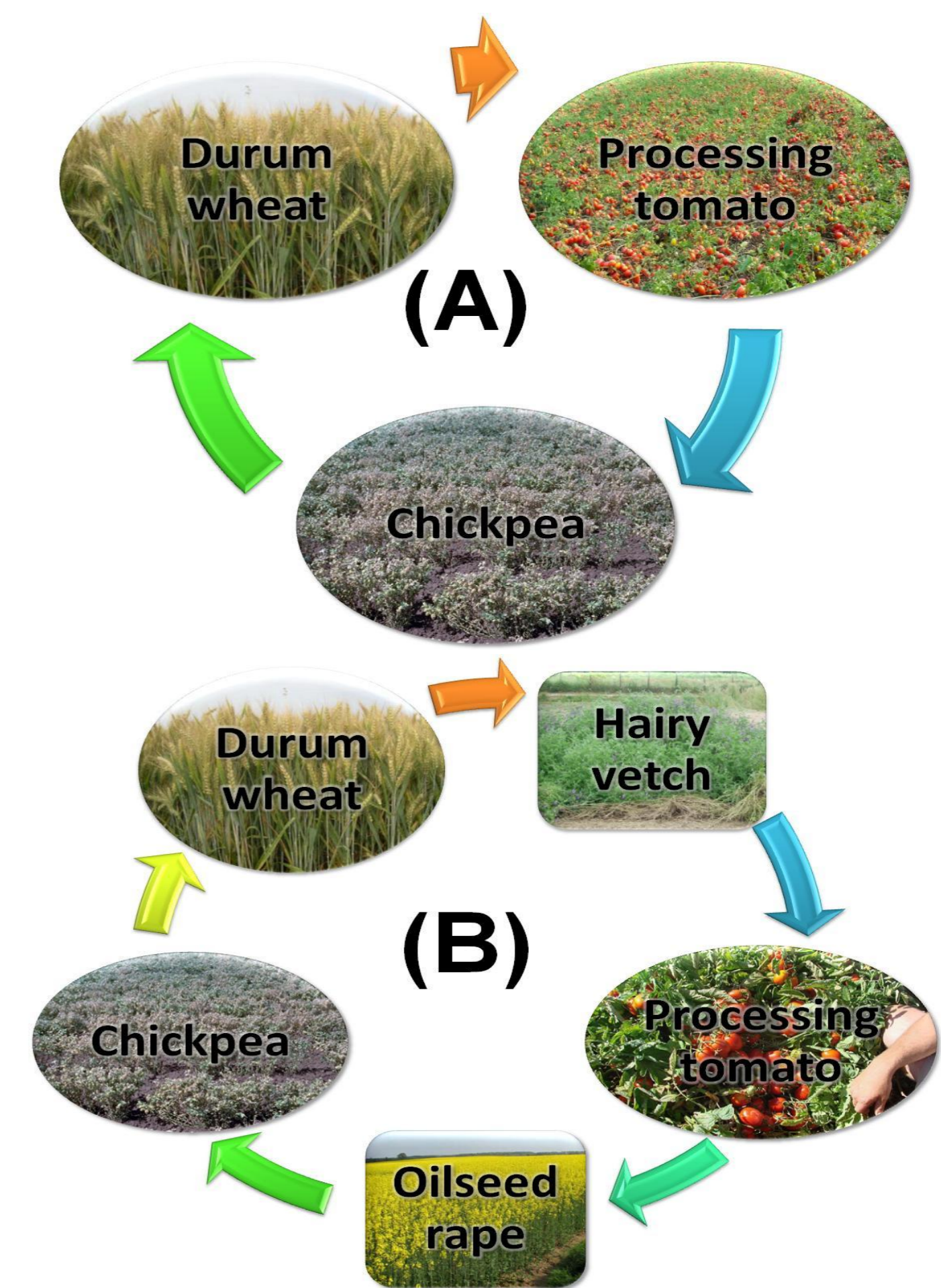
Agriculture must meet the twin challenge of feeding a growing population while simultaneously minimizing its global environmental impacts. Organic farming, which is a system aimed at producing food with minimal harm to ecosystems, is often proposed as a possible solution. However, critics argue that organic agriculture may give lower yields and therefore more land is required in order to produce the same amount of food as conventional farms, resulting in more widespread deforestation and biodiversity loss, thus undermining the environmental benefits of organic practices.

MATERIALS & METHODS

The long-term experiment was established in 2001 in order to compare organic vs. conventional cropping systems and plowed vs. subsoiled soil. A 3-year crop rotation was established in both cropping systems (chickpea, durum wheat and tomato). In the organically managed cropping system, the crop rotation was implemented with hairy vetch and oilseed rape cover crops which were green manured before tomato transplanting and chickpea sowing, respectively (Fig. 1). Furthermore, two soil tillage managements were compared:

- (i) inversion tillage consisting in moldboard plowing (depth of 30 cm) + disc harrowing;
- (ii) non-inversion tillage consisting in subsoiling (depth of 20 cm) + disc harrowing.

Figure 1. 3-year crop rotation adopted in conventional (A) and organic (B) cropping systems in the Long Term Experiment at Tuscia University.



RESULTS & DISCUSSION

The grain yield of durum wheat was higher in conventional than organic cropping systems (4.2 vs. 2.6 t ha⁻¹ of DM) probably due to the strong increase of weed proliferation in organic (124 vs. 64 g m⁻² of DM) especially when the grain filling stage was characterized by high precipitation. Conversely the tomato showed a higher marketable yield in organic compared to conventional cropping system (86 vs. 58 t ha⁻¹ of FM), even if weed infestation was lower in conventional compared to organic (45 vs. 109 g m⁻² of DM). In organic the tomato benefited from an abundant availability of soil nitrate released by the vetch residue, which was green, manured prior to tomato transplanting. The grain yield of chickpea was similar between the cropping systems (1.8 t ha⁻¹ of DM), even if weed infestation was slightly lower in conventional compared to organic (150 vs. 199 g m⁻² of DM). Regarding soil tillage, no differences were observed in the yield of the crops, while there was always more abundant weed infestation in no-inversion tillage compared to inversion tillage.

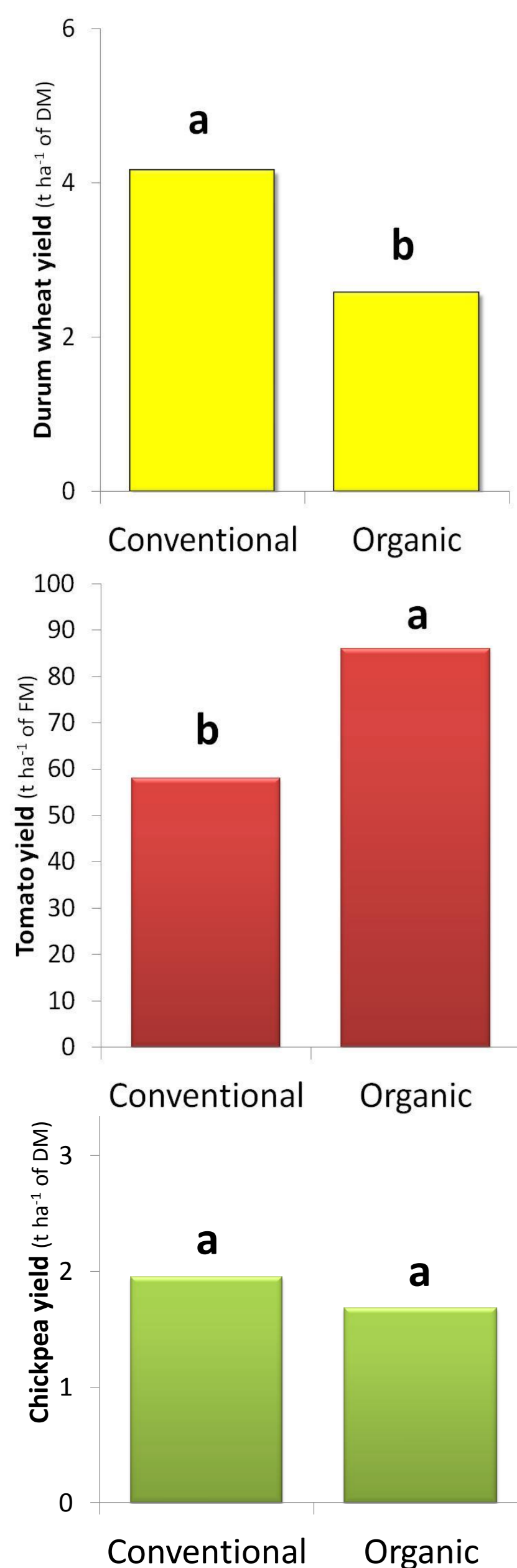


Figure 1. The main effect of cropping system on the yield of durum wheat, tomato, and chickpea crops, respectively. Values belonging to the same crop without common letters are statistically different according to LSD (0.05).



Figure 4. Panoramic view of the Long Term Experiment (LTE) in late spring.

CONCLUSIONS

There could be a crop yield gap between organic and conventional depending on the crop species. On average durum wheat yielded 38% less and tomato 48% more in organic than in conventional, chickpea had a similar yield in both cropping systems. Weed infestation was always higher in organic than in conventional (+ 89%) and in no-inversion tillage compared to inversion tillage (+ 56%).

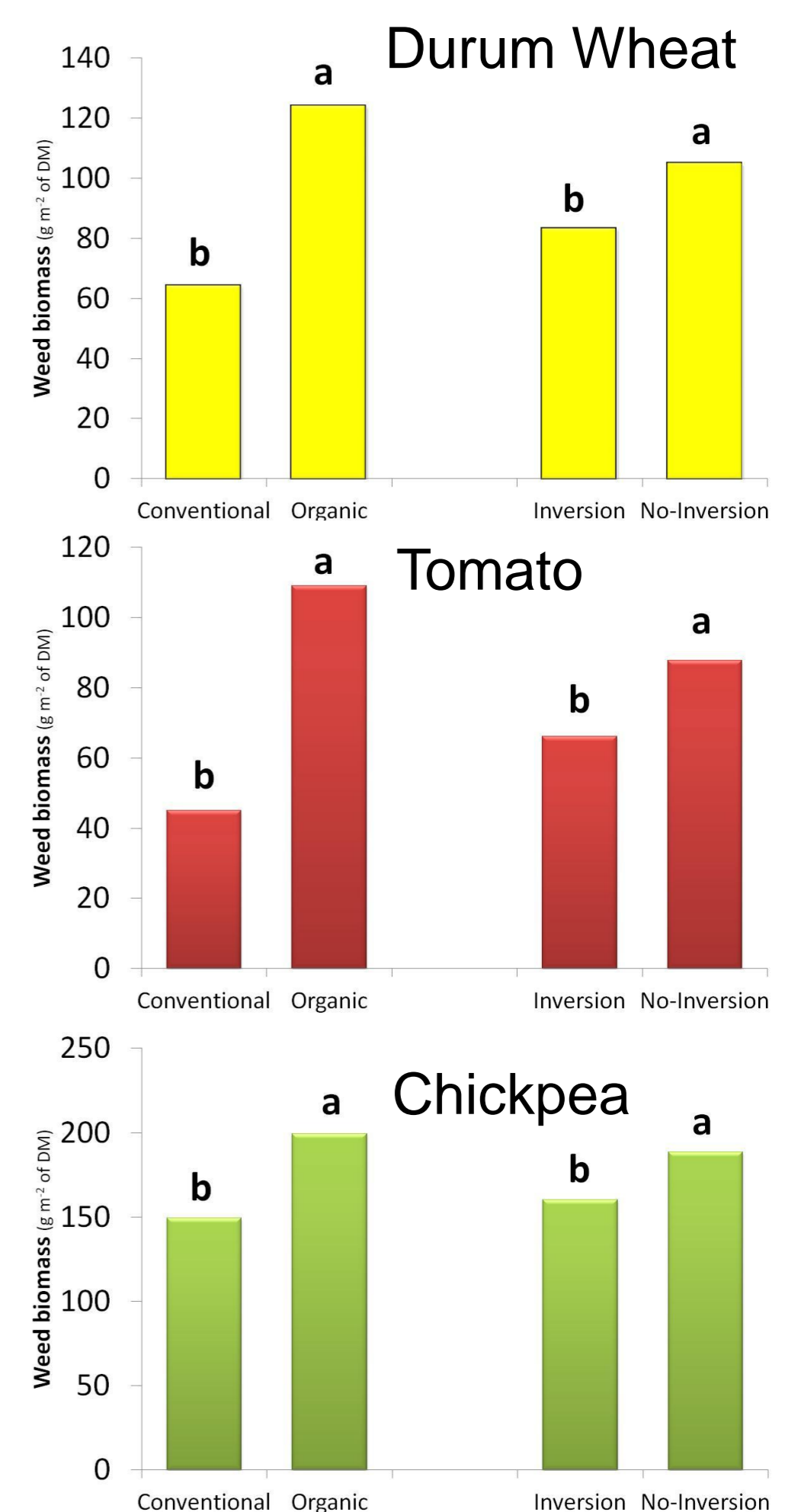


Figure 3. The main effect of cropping system and soil tillage on the weed aboveground biomass of durum wheat, tomato, and chickpea at crop harvesting stage, respectively. Values belonging to the same character without common letters are statistically different according to LSD (0.05).