Aspects of Applied Biology 79, 2006
What will organic farming deliver? COR 2006

Effects of organic fertilisers and compost extracts on organic tomato production

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Summary

The effects of various fertilizers and different compost extracts on crop health and tomato yield were studied in the field in 2004–2005 in two locations in Iran. Treatments included different fertilizers (cattle, sheep and chicken manures, green-waste and house-hold composts and chemical fertilizers) and five aqueous extracts (from cattle manure, chicken manure, green-waste and house-hold composts and water as control). The effect of fertilizer type on tomato yield was significant in both locations ($P < 0.05$). Organic fertilizer use did not obtain higher yields compared to using chemical fertiliser. Generally, chicken manure and green-waste compost led to the highest and lowest tomato yield among different organic fertilizers, respectively. The effect of aqueous extracts was not significant on either crop health or tomato yield with these results were being very limited and inconsistent. Improved efficacy of acceptable alternatives to agrochemicals, especially in organic farming, is required.

Key words: Compost, disease, *Lycopersicum esculentum*, marketable yield

Introduction

The problems associated with the use of hazardous chemicals for crop protection and weed control have received increasing attention worldwide, since pests, diseases and weeds become resistant to chemical pesticides and environmental pollution and ecological imbalances may occur. In sustainable agricultural systems, non-renewable petrochemical resources should be replaced by biologically-based renewable inputs (Quimby *et al*., 2002). The foundation of organic farming is a microbially active soil enriched with organic matter and a balanced mineral diet. Humus building practices and additions of rock minerals not only supply plant nutrients, but increase tolerance to insects and diseases, help control weeds, retain soil moisture, and finally, ensure produce quality (Diver *et al*., 1999). However, there are reports showing that using organic fertilizers increased development of some diseases. For example, Chauhan *et al*. (2000) found that increasing application of farm yard manure from 25 to 75 t ha^{-1}, increased disease severity of stem rot (*Rhizoctonia solani*) in cauliflower.

In many studies, application of compost extracts (compost teas), which are filtrated solutions of mixtures of compost materials and water, showed promising results on crop protection after a soaking period referred to as "extraction time". Also, organic fertilisers such as liquid pig manure, matured cattle manure and sugarcane husks applied directly to the soil showed promising results for control of some crop diseases (DeCeuster & Hoitink, 1999; Viana *et al*., 2000). The effects of compost application either as extracts to the foliage or as soil amendments on plant disease control may be due to direct antifungal or resistance inducing/plant strengthening effects. However, the mechanisms by which compost extracts work are not well known but seem to vary depending on the host/pathogen relationship and the mode of application. Goldstein (1998) reported that composts and compost extracts activate disease resistance genes in plants. These genes are activated in response to the presence of a pathogen. They mobilise chemical defences against the pathogen invasion, although often it is too late to avoid the disease. Plants growing in compost may have these disease-prevention systems already running (Sullivan, 2001). Brinton *et al*. (1996) examined compost teas in relation to their development and use for controlling plant pathogenic fungi such as late blight in potatoes. They found that the key factors influencing effectiveness were the age of the compost (extracts from older composts were more effective than those from younger extracts), and the nature of its source ingredients.

In this study, the objectives were to study the efficacy of various organic and chemical fertilizers and different compost extracts from different types of compost feed-stocks, on tomato production.

Materials and Methods

The study was carried out in Experimental Field Research Stations of Ferdowsi University of Mashhad, in two locations including Mashhad and Shiravan in Iran, during 2004–2005. The second year of this experiment has been started and is in the field this year in the same locations. The experiments were designed as strip plots based on complete randomized block design with three replications. Treatments included different kind of fertilisers (cattle, sheep and chicken manures, green-waste and house-hold composts and chemical fertilisers) in main plots and five extracts (from cattle manure, chicken manure, green-waste and house-hold composts and water as control) in sub plots. A deep moldboard ploughing was applied to the whole trial field in autumn. Three weeks before transplanting of tomato, six different fertilizers were applied and immediately after that a rotary cultivator was used. Based on the results of soil tests, 260 kg ha^{-1} of nitrogen and 125 kg ha^{-1} phosphorus at seed bed preparation were used. Each plot contained 4 rows with 75cm widths and four meter lengths. Tomato seedlings (Super Quein *var*.) were hand-transplanted to the irrigated field at the second week of April, after raising the seedlings for six weeks in the nursery. Hoe re-ridging was undertaken manually using a locally manufactured hoe two weeks after transplanting. Tomatoes were irrigated immediately after transplanting and then every six days until the end of fruiting. Composts and manures were extracted with water (1:10 W/V) 48 hours before using in the field. The extracts were applied at the start of flowering and at the beginning of tomato fruit production. During the growing season, tomatoes were regularly observed and any disease, pest or disorders were recorded. To determine tomato yield, 9 m^2 in the middle of each plot was marked and during July and August, tomato fruits were picked and weighed three times. The data were statistically analysed (ANOVA) by applying Minitab and means were compared by using Tukeys Tests ($P < 0.05$).

Results and Discussion

ANOVA results showed that the effect of fertilizer type on tomato yield was significant in both locations ($P < 0.05$). Organic fertiliser use did not obtain higher yields compared to using chemical fertiliser (Figs 1 & 2). In general, chicken manure and green-waste compost led to the highest and lowest tomato yield among the different organic fertilisers, respectively. The effect of aqueous extracts was not significant on either crop health or tomato yield, however, extracts from house-hold compost seemed to produce higher yields compared to other treatments. The effects of aqueous extracts were very limited, inconsistent and non-significant. Manure extracts and compost extracts did not give effective influences on tomato health and yield.

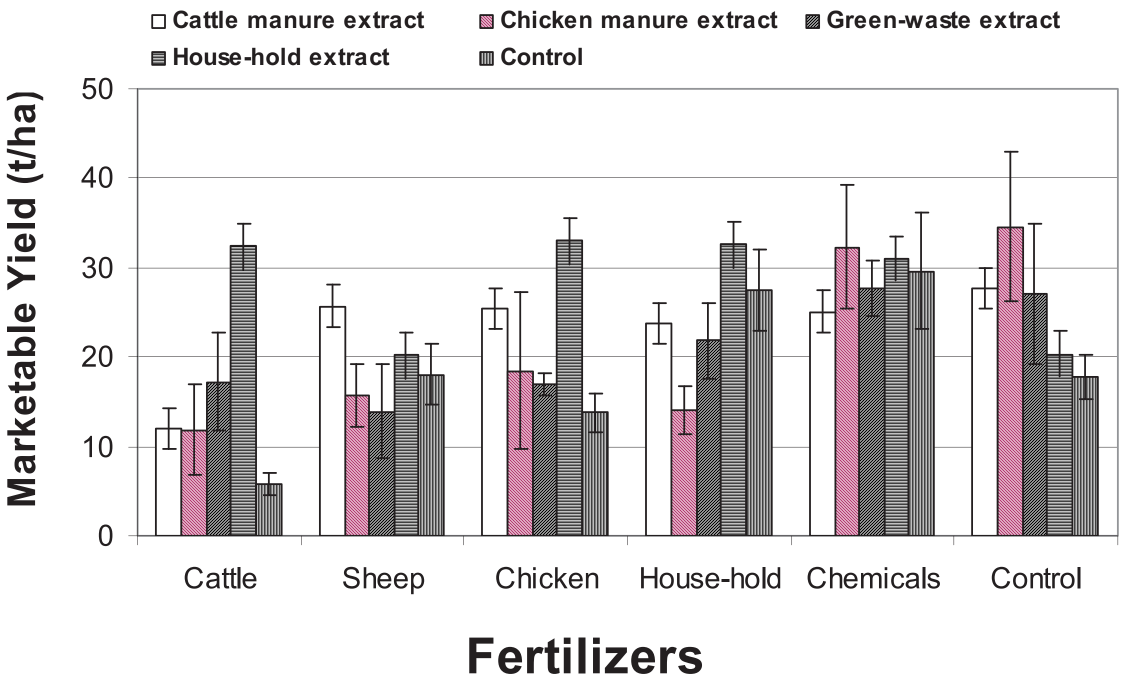

Fig. 1. Effect of different fertiliser and compost extracts on marketable yield of tomato in Mashhad. Each point represents the mean of 4 replications and error bars represent +/- SE of the mean.

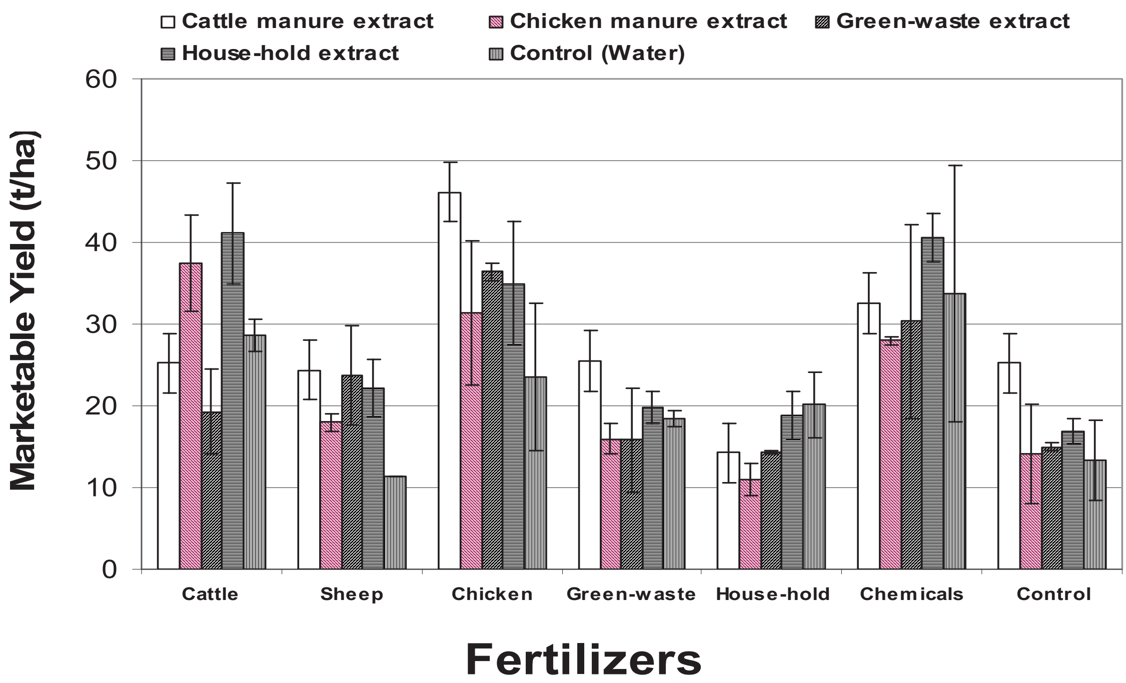

Fig. 2. Effect of different fertiliser and compost extracts on marketable yield of tomato in Shiravan. Each point represents the mean of 4 replications and error bars represent +/- SE of the mean.

The achievement of consistent effects is dependent upon producing extracts that are exactly the same from batch to batch from an individual compost feed-stock and this is a key challenge (Ghorbani *et al*., 2005). The incorporation of organic matter such as compost in the soil may be a viable alternative to chemicals for crop protection, and be more effective than compost extracts applied to the foliage. Composts' contribution to nitrogen fertility must also be taken into account because nutrient effects may influence the severity of pathogens (Phukan, 1993).

Acknowledgements

The authors wish to acknowledge Ferdowsi University of Mashhad for financial support, providing experimental field, materials and storage facilities. The authors also wish to thank Dr M Nassiri for his help and advice for statistical analysis.

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