



FULL LENGTH ARTICLE

# Effects of cover crops and weed management on corn yield



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Received 22 December 2013; accepted 28 February 2014

Available online 12 March 2014

## KEYWORDS

Corn;  
Companion crops;  
Cover crop;  
Grain yield;  
Weed

**Abstract** One of the most important replacement methods used instead of chemical herbicide and conventional tillage is cover and companion crops' application which is a major factor in sustainable agriculture. In order to determine the best cover crop in controlling weeds of corn field and its further effects on corn yield, an experiment was carried out in a factorial arrangement based on RCB design with three replicates. The treatments of this experiment included companion crops (clover, hairy vetch, basil and dill) as first factor and time of sowing cover and medicinal plant (synchronic sowing with corn and sowing 15 days after corn sowing) as second factor. The results showed that ear weight, ear length, leaf weight, grain length and yield were significantly influenced by companion crops and sowing date. Whereas, weed biomass was influenced by cover crop type × sowing date interaction. Also, the results indicated that increasing biomass weed resulted in linear reduction of grain yield. The highest ear weight, ear length, leaf weight, grain length and yield were obtained for cultivation of clover with corn. Synchronic cultivation of companion crops with corn had higher grain length and yield compared with cultivation 15 days after corn. The lowest weed biomass was recorded for concurrent cultivation of corn with clover due to rapid growth and high competitive power of clover in the early stage of growth.

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## 1. Introduction

Corn is C<sub>4</sub> plant and high production of grain and biomass to feed has increased areas under this crop in many developing countries. Improper and overuse of chemical herbicides may lead to problems such as: herbicides remain in soil, resistance of weeds to them and groundwater pollution. Studies showed that about 25–30 annual and perennial weed species grow in corn field (Evans et al., 2003).

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Peer review under responsibility of King Saud University.



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Crop yield loss could be caused in high extent by increase in the weed biomass, weed density and weed species (Blackshaw et al., 2002). Weeds are one of the greatest limiting factors to efficient crop production. As a consequence of structural and financing problems the cultural condition of the soil deteriorates and weeds proliferate; many species are hard to kill (Farkas, 2006). Weed infestation, results in severe reduction in crop yield as in the condition of pure corn culture, corn losses of 40–60% have been reported (Thobatsi, 2009).

Today weed control is performed by a very advanced technology and knowledge control operations properly require thorough knowledge of plants, soil crop management system and many environmental parameters associated with weed control operations (Bolandi Amoghein et al., 2013). A factor that is currently used as an index for evaluation of crop management in each country or even each field is the amount of attention on weed management. Choice of this index is for reason that in the case of the absence of a correct management damage caused by these weeds is more than the damage caused by infestation and disease (Gupta, 2006).

Environmental pollution and contamination of surface water and groundwater by herbicides is one of the most important human concerns (Abdin et al., 2000). The most commonly used alternative methods rather than herbicides and plowed, are cover crops. There is a wide agreement in the literature that vigorous living cover crops will suppress weeds growing at the same time as the cover crop (Brennan and Smith, 2005). Cover crops can prevent the development of weed population, control the soil disease, soil enrichment through nitrogen fixation in soil, improve soil structure, preventing absorption of nitrogen, increase the soil organic matter and decrease the soil, for these reasons they are cultivated (Kruidhof et al., 2008). A legume cover crop, such as common vetch, can supply most of N required for maximum maize yield (Clark et al., 1997; Bayer et al., 2000). In addition, vetch can improve soil water quality compared with bare fallow by reducing erosion during fall, winter, spring, and increasing organic matter (Sainju and Singh, 1997). Therefore, the objective of this research is to investigate the effects of companion crops on weed control and corn yield in the Tabriz climatic condition.

## 2. Materials and methods

This research was conducted in 2010 at the Research Farm of the University of Tabriz, Iran (latitude 38°05'N, longitude 46°17'E, altitude 1360 m above sea level). The climate of research area is characterized by mean annual precipitation of 271.3 mm, mean annual temperature of 10 °C, mean annual

maximum temperature of 16 °C and mean annual minimum temperature of 2.2 °C. The soil is sandy loam with EC of 0.68 ds m<sup>-1</sup>, pH of 8.1 and field capacity of 28.8%. Treatments including companion crops (synchronic sowing of corn–red clover, synchronic sowing of the corn–vetch, synchronic sowing of corn–basil, and synchronic sowing of corn–dill) and sowing date (T<sub>1</sub>: synchronic sowing of cover crops with corn and T<sub>2</sub>: sowing cover crops 15 days after planting of corn) were allocated in plots as a factorial based on RCB design with 3 replications. Each plot consisted of 10 rows with 4 m length, spaced 25 cm apart. In each plot one row of corn was planted with one of companion crops in the specified sowing date. Density of corn, red clover, vetch, basil and dill, were 8, 100, 75, 38 and 30 plants per m<sup>2</sup>, respectively.

Dry weight of ear, ear length, leaf weight, grain length, grain yield and weed biomass were recorded. Ear length and weight were measured at the time of maximum ear delivery (shortly after pollination). At maturity, when seed moisture content was about 14%, plants from two middle rows in each plot were harvested and grain yield of corn was counted and subsequently biomass of common weeds in corn field including *Amaranthus retroflexus*, *Convolvulus arvensis*, *Acroptilon repens*, and *Cuscuta* Sp was calculated by randomly sampling on 0.5 × 0.5 m<sup>2</sup> in each plot.

Statistical analysis was performed with MSTATC and SPSS software and Excel software was used to draw the figures. Duncan test was applied to compare means of each trait at 5% probability.

## 3. Results and discussion

### 3.1. Weed biomass

The analysis of variance of data showed significant effects of companion crops and sowing date on weed biomass. The interaction of companion crops × sowing date was also significant for this trait (Table 1). The lowest and the highest weed biomasses were achieved with corn planting simultaneously with clover (13.75 g m<sup>-2</sup>) and planting of dill 15 days after corn (60.2 g m<sup>-2</sup>), respectively. Delayed planting of cover crops in corn field resulted in increasing weed biomass (Fig. 1). Forage plants such as clover and vetch due to rapid establishment and growth capacity in field compared with medicinal plants such as basil and dill are more suitable and effective for weed control. In fact, medicinal plants due to low growth rate and establishment especially in early growing season cannot compete with weeds as well as forage plants. Increasing weed biomass also resulted in linear reduction of corn grain yield

**Table 1** Analysis of variance of the data of corn plants under treatments.

S.O.V.	MS						
	df	Weed biomass	Seed length	Leaf weight	Ear length	Ear weigh	Grain yield
Replication	2	59.16 <sup>ns</sup>	0.082 <sup>ns</sup>	215.96 <sup>**</sup>	3.65 <sup>**</sup>	0.053 <sup>ns</sup>	171.22 <sup>ns</sup>
Companion crops	3	1516.01 <sup>**</sup>	0.44 <sup>**</sup>	1305.12 <sup>**</sup>	24.81 <sup>**</sup>	11.2 <sup>**</sup>	11705.4 <sup>**</sup>
Sowing date	1	178.89 <sup>**</sup>	0.54 <sup>**</sup>	507.84 <sup>**</sup>	6.01 <sup>**</sup>	0.33	7518.25 <sup>**</sup>
Sowing date × companion crops	3	125.41 <sup>*</sup>	0.70 <sup>ns</sup>	45.35 <sup>ns</sup>	0.668 <sup>ns</sup>	0.077 <sup>ns</sup>	4.56 <sup>ns</sup>
Error	14	37.38	0.20	4.44	0.413	0.62	35.202
C.V. (%)	–	17.6	3.7	1.2	2.2	2.7	5.4

ns, \*\*\*, non-significant and significant at  $p \leq 0.05$  and  $p \leq 0.01$ , respectively.

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