

Weed suppression in organic pepper (*Capsicum annuum* L.) with winter cover crops

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ABSTRACT

Weed control is a major constraint for organic production around the world. Field studies were conducted in pepper (*Capsicum annuum* L.) from 2004 to 2006 at the Black Sea Agricultural Research Institute experimental field in Turkey to determine the weed suppressive effects of winter cover crops. Treatments consisted of ryegrass (*Lolium multiflorum* L.), oat (*Avena sativa* L.), rye (*Secale cereale* L.), wheat (*Triticum aestivum* L.), geleme clover (*Trifolium meneghinianum* Clem.), Egyptian clover (*Trifolium alexandrinum* L.), common vetch (*Vicia sativa* L.), hairy vetch (*Vicia villosa* Roth.) and a bare fallow with no cover crop. Weed density and total weed dry biomass were assessed at 14, 28, and 56 days after incorporation to quantify effects of cover crops during a subsequent pepper crop. Cover crop establishment was similar in both growing seasons and individual species produced in the range of 1800–3500 kg/ha biomass. Ryegrass produced the greatest biomass compared with other species. Weed dry biomass production just before cover crop incorporation varied with year and cover crop species. Hairy vetch, ryegrass, oat and common vetch were the most competitive cover crops based on total weed dry biomass. Hairy vetch was the most promising cover crop and reduced weed density by 73% and 70% at 28 and 56 DAI, respectively. Pepper yields were higher following all cover crops except Egyptian clover. The highest yield was obtained from hairy vetch plots in both years. This research indicates that cover crops such as hairy vetch, ryegrass, oat and common vetch could be used in integrated weed management programs to reduce weed infestation in organic pepper.

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1. Introduction

Environmental concern has arisen from potential negative impacts of herbicides on non-target organisms, beneficial species, spray drift of residues in food, ground water contamination, weed resistance and poisoning hazards, especially mammalian toxicity (Schroeder et al., 1993; Kropff and Walter, 2000). As people learn more about possible adverse effects of herbicide exposure, they become more interested in alternative farming systems. Because of these potential problems and increased public pressure on conventional agriculture, there is increasing interest in organic farming systems in Turkey as well as many other countries.

Turkey is the third largest producer of Pepper (*Capsicum annuum* L.) after China and Mexico (Anonymous, 2007). Many farmers are willing to transition to organic pepper production because of

premium prices and the fact that it can be processed into various products. But, they also face the lack of effective weed management strategies. Organic vegetable producers rank weed management as the most important production problem because there are very few effective weed control options for organic production (Beveridge and Naylor, 1999).

Organic vegetable producers experience significant losses from weeds (Beveridge and Naylor, 1999). Cultivation and hoeing are the most common methods used to control weeds in organic production systems in Turkey (Ates, 2007). The effectiveness of interrow cultivation in suppressing weeds in organic production systems is well known, but fossil fuel cost has been increasing dramatically in the past two years, which brings additional costs to farmers (Sainju and Singh, 2008). These techniques are time consuming and require a considerable amount of power. Therefore they are not always successful or cost-effective (Ngouajio et al., 1997).

Pepper seedlings after transplanting are weak competitors because of their slow growth (Norsworthy et al., 2007). As a result, fruit yield losses can reach up to 44% when crops are infested with

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Table 1

Main broadleaved and grass weed species present at the experimental area and their relative proportion (means of 2005 and 2006 combined).

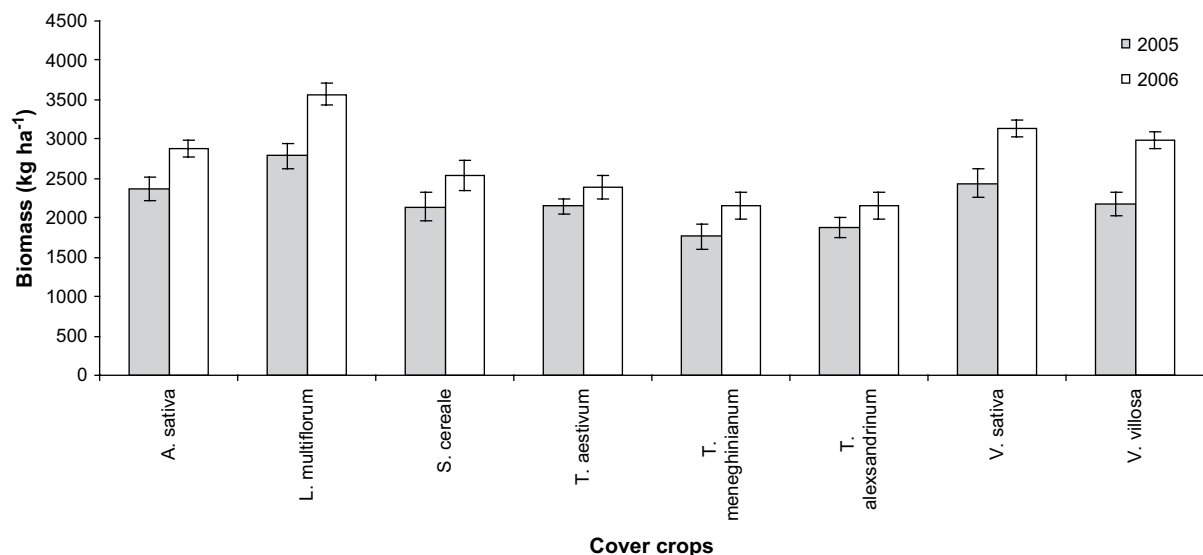
Group	Common name	Latin binomial	Bayer Code ^a	Relative proportion (%)
Broadleaved	Field bindweed	<i>Convolvulus arvensis</i> L.	CONAR	9
	Common purslane	<i>Portulaca oleracea</i> L.	POROL	8
	Curly dock	<i>Rumex crispus</i> L.	RUMCR	7
	Wild mustard	<i>Sinapis arvensis</i> L.	SINAR	6
	Velvetleaf	<i>Abutilon theophrasti</i> Medik.	ABUTH	5
	Common vetch	<i>Vicia sativa</i> L.	VICSA	4
	Wild buckwheat	<i>Polygonum convolvulus</i> L.	POLCO	4
	Yellow pea	<i>Lathyrus aphaca</i> L.	LATAP	3
	Musk thistle	<i>Carduus nutans</i> L.	CRUNU	3
	Shepherd's-purse	<i>Capsella bursa pastoris</i> (L.) Medik.	CAPBP	3
	Wild chamomile	<i>Matricaria chamomilla</i> L.	MATCH	2
	Black nightshade	<i>Solanum nigrum</i> L.	SOLNI	2
	Fumitory	<i>Fumaria officinalis</i> L.	FUMOF	2
	Red clover	<i>Trifolium pratense</i> L.	TRIPR	2
Grasses	Barnyardgrass	<i>Echinochloa crus-galli</i> (L.) P.B.	ECHCR	8
	Blackgrass	<i>Alopecurus myosuroides</i> Huds.	ALOMY	7
	Perennial ryegrass	<i>Lolium perenne</i> L.	LOLPE	5
	Yellow foxtail	<i>Setaria glauca</i> (L.) P.B.	SETGL	3
	Poverty brome	<i>Bromus sterilis</i> L.	BROST	3
	Bristly foxtail	<i>Setaria verticillata</i> (L.) P.B.	SETVE	2
Others ^b	–	–	–	<12

^a Names of weeds are described by five Bayer digit code.^b This includes all weed species that were present at less than 2%.

weeds like purple nutsedge (*Cyperus rotundus* L.) (Morales-Payan et al., 1997). Norsworthy et al. (2007), found that Palmer amaranth [*Amaranthus palmeri* (S.) Wats.] interference with bell pepper can cause 94% reduction in bell pepper fruit number. In another study, chilli pepper required an average of up to 12.2 weeks of weed free maintenance to avoid losses above 5% (Amador-Ramirez, 2002). Therefore, organic pepper production needs reliable and highly effective weed management strategies. One of the most successful systems is the use of cereal and/or legume cover crops for physical and allelopathic weed control (Teasdale, 1996; Ngouajio and Mennan, 2005; Mennan et al., 2006; Norsworthy et al., 2007).

Cover crops are useful tools for weed control in vegetable cropping systems (Ngouajio et al., 2003; Ngouajio and Mennan, 2005). The ability of cover crops to suppress weeds depends on many factors and residues of some cover crops have selective effects on weed species (Putnam et al., 1983; Barnes and Putnam, 1987; Weston, 1990; Teasdale, 1996; Barberi and Mazzoncini, 2001; Nagabhushana et al., 2001). Therefore, cereal, legume and mustard cover crops are widely used in various cropping systems.

Currently, organic vegetable producers in Turkey and throughout the world have limited information on management strategies that provide adequate weed suppression while

**Fig. 1.** Biomass production (kg ha⁻¹) of cover crops prior to incorporation in 2005 and 2006. Vertical line represents standard error of the means ($P < 0.05$).

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