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EFFECT OF COVER CROPS MULCH ON WEED CONTROL IN ORCHARDS

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ABSTRACT

A field experiment was conducted at Quosar Orchard in Qazvin Iran during 2000-2002. Experimental treatments included three plant mulches [rye (Secale cereale L.), wheat (Triticum aestivum L.), hairy vetch (Vicia villosa Roth.)], glyphosate(SL 41%) applied twice, cultivation every 4 weeks and control (weedy check). Rye had the highest dry weight. Tansy mustard (Descurainia sophia L.) in the first year and henbit (Lamium amplexicaula L.) and madwort (Asperugo procumbens L.) in the second year were the winter annual weeds. Winter weeds were controlled by rye, wheat and vetch by 81.2, 77.2, 17.3% in the first year and 96.7, 96.9 and 89.3% in the second year, respectively. Milk weed (Cynanchum acutum L.), field bindweed (Convolvulus arvensis L.) and prostrate knotweed (Polygonum aviculare L.) were the summer weeds in both years. Rye, wheat, and vetch after cutting, and glyphosate treatments controlled 45, 72, 42, and 46% of weeds in the first year and 73, 65, 58 and 81% in the second year compared to control, respectively. In the second year rye, wheat, vetch and glyphosate controlled 67, 55, 45 and 72% of milk weed, 73, 67, 60 and 85% of field bindweed and 100, 100, 100 and 56% of prostrate knotweed, respectively. Average fruit yield in both years were lowest under control treatment.

KEY WORDS: Cover crop, rye, wheat, hairy vetch, glyphosate, cultivation, weeds, orchard

INTRODUCTION

In recent decades, herbicide usage has increased in fruit production. Long-term soil structural integrity, nutrient availability, water infiltration and retention, and beneficial soil macrofauna can be harmed by herbicide and cultivation (Haynes, 1981; Haynes and Goh, 1980; Hipps and Samuelson, 1991; Hogue and Neilsen, 1987). An alternative approach to the uses of herbicides is the use of cover crops. Previous research recommended the use of a live winter mulch in orchards that is killed in early spring, either naturally or by herbicides (Atkinson *et al.* 1980; Soong and Yap, 1976; Skroch and Shribbs, 1986). Cover crops residues on the soil surface reduce soil erosion, nutrient leaching and runoff, damages soil structure and organic matter content, and suppress weeds (Barnes and Putnam, 1983; Putnam and DeFrank, 1983; Mohler, 1991; Libel *et al.*, 1992, Ateh and Doll, 1996; Swanton and Murphy, 1996). The objective of this study was to determine the effect of various cover crops on weed control in orchards as compared to herbicide application and cultivation.

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MATERIALS AND METHODS

Experiment was conducted in a 5-year-old peach orchard in Qazvin Iran during 2000-2001 and 2001-2002 growing season. Six two-tree replications of the following treatments were established: a) glyphosate applied in May and in July at 6 lha $^{-1}$, b) disc cultivation from April to July every four weeks, c) planting rye at 160 k gha^{-1}, d) planting hairy vetch at 45 kg ha $^{-1}$, e) planting winter wheat at 170 kg ha^{-1}, and f) control (not weeded). Cover crops were seeded in October 15 and October 23 in 2000 and 2001, respectively. In late April cover crops were mowed and left on the ground. On 8 March, 1 April and 22 April, cover crops biomass were collected from two random 0.5m^2 quadrats in each plot, oven dried at 70°C, and weighed. The biomass of each winter weeds species present in these quadrats was also determined. The summer weeds present in the two quadrats of each treatment were also counted and their dry weights (DW) were determined on 25 May, 15 June and 5 July. Trunk circumference and fruit yield were measured in July 2000, 2001 and 2002 to determine the overall growth response to the treatments. In 2001, treatments were repeated over the 2000 experiment after moldboard plowing and disking.

RESULTS AND DISCUSSION

Rye biomass was more than wheat and hairy vetch in the all of sampling dates in 2000 and 2001 (Table-1). Rye and wheat had the greatest biomass compared to hairy vetch in spring in 2000 (Table-1). In the second year because of late planting, rye and wheat biomass was lower. The reduction in cover crops biomass was due to poor stand establishment in the fall and winter injury to the cover crops.

The major winter weeds in 2000 were mainly tansy mustard (*Descurainia sophia* L.), and in 2001 were henbit (*Lamium amplexicaula* L.) and madwort (*Asperugo procumbens* L.). In 22 April 2000 sampling rye, wheat and hairy vetch living mulch reduced winter weeds biomass by 94, 78.8 and 0%, respectively compared to weedy check. However in the second year (2001) winter weed biomass was reduced by 97.5, 98.1 and 93.6%, respectively. The better effect of hairy vetch on the winter weeds in the second year may be attributed to the accumulated allelopathic effects of both years and/or to the type of winter weeds.

Table-1. Cover crops and winter weeds biomass (g DW·m^{-2}) in different times.

	Cover crops (g DW·m^{-2})			Winter weeds (g DW·m^{-2})		
Treatments	**8 March**	**1 April**	**22 April**	**8 March**	**1 April**	**22 April**
2000						
rye	225bc[a]	295bc	432a	12.1c	56.3bc	18.1c
wheat	83.2e	145cde	324ab	15c	43.8c	64abc
hairy vetch	33.6f	115de	172cd	33.1c	117abc	347a
control	-	-	-	150ab	180ab	303ab
2001						
rye	139bc	165b	213a	13.2d	12.9d	16.5d
wheat	74.6e	95.9de	135bcd	9.9d	12d	12d
hairy vetch	94de	120cd	133bcd	45.1d	42.5d	42d
control	-	-	-	280c	498b	660a

[a] Mean separations for cover crops biomass and winter weeds biomass were done independently. Means within a year followed by the same letter are not different using Duncan multiple range test, P= 0.05

As cover crops were decomposed, their biomass were decreased with time and thus more growth of the summer weeds was observed (Table-2).

There were no differences in summer weed biomass between cover crops treatments and glyphosate in 2001 (Table-2). However weeds in the glyphosate treatment were less and in the hairy vetch treatment were more than in any of the other treatments. Weed biomass in the weedy check was significantly higher than other treatments.

Summer weed density in control treatment was significantly higher than other treatments (Table 2). In 2001, rye, wheat, hairy vetch and glyphosate decreased weed density by 45, 72, 42 and 46%, respectively and in 2002, by 73, 65, 58 and 81%, respectively compared to control.

Table-2. Summer weeds biomass and density in different times.

	Biomass (g DW m^{-2})			Density (1 m^2)		
Treatments	25 May	15 June	5 July	25 May	15 June	5 July
2001						
rye	74.1cde[a]	21.1f	131bcde	20def	27cdef	48abcde
wheat	162bcde	92bcde	146bcde	20def	16f	13f
hairy vetch	143bcde	62de	184abcd	25def	43abcde	32bcdef
glyphosate	46.7e	52de	71.6de	35abcdef	36abcdef	23def
control	256abc	253abcd	550a	72a	69a	61abc
2002						
rye	-	-	-	25h	35fg	37fg
wheat	-	-	-	33g	41f	51e
hairy vetch	-	-	-	41f	51e	60d
glyphosate	-	-	-	19h	24h	25h
control	-	-	-	103c	123b	141a

[a] Mean separations for summer weeds biomass and density were done independently. Means within a year followed by the same letter are not different using Duncan multiple range test, P= 0.05.

The major summer weeds in 2001 and 2002 were milk weed (*Cynanchum acutum* L.), field bindweed (*Convolvulus arvensis* L.), and prostrate knotweed (*Polygonum aviculare* L.). In 2001, the density of milk weed and field bindweed were similar in control and other treatments in all samplings (Table-3). In 2002, control had more milk weed and field bindweed than in any other treatment and glyphosate and rye had fewest milk weed and field bindweed. Prostate knotweed density in 2001, was reduced by rye and wheat mulch 100%, while other treatments did not have differences from the control. In 2002, the mulch of rye, wheat and hairy vetch reduced prostate density by 100%, but glyphosate reduced prostate density only 56% compared to control.

Reduction in weed population when cover crops are used in orchards has been reported (Smeda and Putnam, 1988; Calkins and Swanson, 1995; Bhutani *et al.*, 1995; Sainju, 1997). The physical presence of cover crops mulch on the soil surface can greatly reduce weed density and biomass (Putnam and DeFrank, 1983; Masiunas *et al.* 1995; Ateh and Doll, 1996). Likewise, allelochemicals arising directly or indirectly from mulch or

residue suppress weeds (Bell and Muller, 1973; Barnes and Putnam, 1983; Putnam and DeFrank 1983; Barnes and Putnam, 1986; Brown and Morra, 1995).

Increasing levels of biomass with uniform soil coverage enhances weed suppression (Teasdale *et al.*, 1991; Buhler 1995; Teasdale, 1996; Vidal and Bauman, 1996). So, further research for proper cover crops management is warranted to enhance weed suppression by them.

Table- 3. *Cynanchum acutum*, *Convolvulus arvensis* and *Polygonum aviculare* density (m^{-2}) measured at different times during 2001 and 2002.

	Weed density (m^{-2})					
	2001			2002		
Treatments	25 May	15 June	5 July	25 May	15 June	5 July
Cynanchum acutum						
rye	15a[a]	12a	9a	15g	19efg	20efg
wheat	15a	12a	9a	19efg	24def	29cd
hairy vetch	7a	15a	12a	25cde	29cd	33c
glyphosate	16a	17a	9a	15g	13g	16fg
control	11a	5a	9a	48b	52b	61a
Convolvulus arvensis						
rye	5bcd	15b	33a	11efg	16def	17de
wheat	4cd	4cd	4cd	15def	17de	21cd
hairy vetch	3cd	5bcd	1d	16def	21cd	27c
glyphosate	8bcd	7bcd	0d	4g	11efg	9fg
control	7bcd	3d	3d	47b	55a	61a
Polygonum aviculare						
rye	0c	0c	1bc	0c	0c	0c
wheat	0c	0c	0c	0c	0c	0c
hairy vetch	15abc	21abc	19abc	0c	0c	0c
glyphosate	7abc	8abc	11abc	5b	7b	7b
control	25abc	17abc	28ab	8b	16a	19a

[a] Mean separations for weed density of each weed species were done independently. Means within a year followed by the same letter are not different using Duncan multiple range test at P≤0.05.

Increase in trunk circumference after two years was highest in hairy vetch treatment but did not differ significantly from rye, wheat, glyphosate and cultivation treatments (Table-4). Fruit yield of wheat, hairy vetch and glyphosate treatments were significantly more than the control treatment and control had the lowest fruit yield (Table-4).

Table- 4. Trunk circumference and fruit yield after two years.

Treatments	Trunk circumference (cm)	Fruit yield (kg/tree)
rye	2.9ab[a]	3.4ab
wheat	2.3ab	5.3a
hairy vetch	3.8a	4.8a
cultivation	2.7ab	4.ab
glyphosate	2.4ab	4.7a
control	1.8b	1.7b

[a]Means within a column followed by the same letter are not different using Duncan multiple range test AT P≤ 0.05.

CONCLUSIONS

This study suggests that including cover crops in orchards can provide weed control and fruit yield similar to glyphosate application. However, weed suppression from cover crops varied among cover crops.

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