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Cover Crops and their Effects of Time Harvesting on the Control of Weed in Citrus Orchards in Northern Iran

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Weed are one of the most important problems in newly established orchards.Weed compete with young trees of citrus trees can reduce the growth. In order to investigation of effect of cover crops (*Vicia sativa* L. and *Trifoliumalexandrinum* L.) to control weed in citrus orchards in northern Iran, This studywas conducted by randomized complete block design with thirteen treatment and three replication (8 treatments of the two cover crop with different harvest times, two treatments of herbicide, plowing and weeding and treatment of control). The results of this study showed, berseem clover to common vetch has better performance in reduced weed . There was a noticeable decrease of dry and wet weight and density of weed in harvest and drop off residuesof berseem clover on fifth of April.spring is the best time to harvest it. When we use common vetch as a cover crop, the best time to harvesting is the middle spring.

Key words: Cover crops, Weed, Berseem clover, Common vetch.

Cover crops are crops planted primarily to manage soil fertility, soil quality, water, weed, pests, diseases, biodiversity and wildlife in agroecosystems (Lu et al. 2000). Farmers choose to grow and manage specific cover crop types based on their own needs and goals, influenced by the biological, environmental, social, cultural, and economic factors of the food system within which farmers operate (Snapp et al. 2005).

Chemical methods are used routinely to control weed in the world. Using herbicides are often applied more than necessary, cause environmental problems and increase the costs of production. Therefore some researches have been conducted to investigate the alternative methods to chemical control recently. Cover crop treatments for weed control are considered as an alternative method to herbicide applications investigated intensively. Besides of this, cover crops have potential to form an important component in such an approach and can be a useful tools for weed suppression in sustainableagricultural systems (Bond and Grundy, 2001; Kruidhof *et al.,* 2008) including many useful advantages such as;

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improvement of soil structure (Thiessen-Martens *et al.,* 2005), enhancement of soil organic matter, carbon dynamics and microbiological function (Steenwerth and Belina, 2008), reducing soil erosion (Malik *et al.,* 2000), soil enrichment by nitrogen fixation (Sainju *et al.,* 2001), insectarium for many beneficial arthropod species (Grafton-Cardwell *et al.,* 1999) and enhancement populations of soil macrofauna (Blanchart *et al.,* 2006).By reducing soil erosion, cover crops often also reduce both the rate and quantity of water that drains off the field, which would normally pose environmental risks to waterways and ecosystems downstream (Dabney *et al*., 2001).

Some cover crops suppress weed both during growth and after death (During growth these cover crops compete vigorously with weed for available space, light, and nutrients, and after death they smother the next flush of weed by forming a mulch layer on the soil surface) (Blackshaw *et al*. 2001).Thick cover crop stands often compete well with weed during the cover crop growth period, and can prevent most germinated weed seeds from completing their life cycle and reproducing.Weed are one of the most important problems in newly established orchards. Especially in organic orcharding, the importance of weed management is much more than conventional orcharding (Kitis et al, 2010).

Weed compete with young citrus trees significantly reduced their growth. Florida organic citrus growers emphasized that weed control was the most critical factor for growers to be successful during the transition to organic production. A majority of Florida citrus growers expressed a strong interest in the use of cover crops such as perennial peanut to prevent soil degradation and suppress weed growth (Linares et al 2007). Farzanian et al) 2007), expressed that Generally in terms of biomass production and weed control, common bean, mung bean and cowpea are probably most suitable cover crops and easy to grow and to manage.

Lack of information on effective weed management practices pertinent to organic citrus production systems may therefore hamper a successful transition from conventional to organic citrus production (Mesh, 2001).The cost of weed control around 10% of the total cost is estimated in citrus orchards in Florida (Singh and Tucker, 1983). Hand weeding and plowing are the most common method used for weed control in organic farming; however, it is time consuming and not always successful or cost-effective (Ngouajio et al. 1997). Therefore, organic farming systems need reliable and highly effective weed management strategies based on ecological approaches. One of the most successful systems is the use of cereal and/or legume cover crops for physical and allelopathic weed control (Isýk et al. 2009, Mennan *et al.,* 2009b; Norsworthy et al. 2007).

Note that useful non-chemical control methods instead of chemical methods is the goals of sustainable agriculture, The present study attempts to evaluate the effect of planting cover crops such as *Vicia sativa* L. and *Trifoliumalexandrinum* L on weed control, Select the best time to harvest this plants and by using of different treatments compared them with cover plants for weed control in soil.

MATERIAL AND METHODS

The studied area is located in Tonekabon city , Mazandran Province, northern Iran,on a longitude of 50° 40 ‘ 46 and a latitude 36 ° 53 ‘ 25 “ the north.The height of area is 20 meters above sea level. Trees away from each other are 5×5m and All of them are 6 years old. Regarding information about weather provided from synoptic station in Tonekabon, the maximum and minimum temperature are 35 ° C and -2 ° C, and the average yearly raining is between 800upto 1500 ml.

In this study was used of cover crops*Vicia sativa* L. with Common Name of common vetch and *Trifoliumalexandrinum* L. with common name of berseem clover from Legume category. study was done in citrus orchards, berseem clover were cultured on fifth of September,2010 and common vetch were cultured on twentieth of October, 2010. Seed rate for them was considered respectively 25 and 45 kg /ha. Germination of seeds before sowing was measured. common vetch and berseem clover germination were respectively, 92 and 90 percent. In this study was used of randomized complete block statistical design with 13 treatment and 3 replication. Treatments are given in Table 1.This treatments were applied after one year planting of cover crops in 2011.

Sampling methods of weed

Study of diversity and biomass of weed were done during the three phases. 1) Wet and dry weight and density of weed species separately on 5 May 2) Wet and dry weight and density of weed species separately on 5 june 3) Wet and dry weight and density of weed species separately on 5 september.

Weed sampling was done from all treatments, So that quadrats with dimensions of 0.5 × 0.5m were randomly sampled in 2 locations in each plot of treatmet. All weed species were counted separately. Density of each species was calculated in m². For calculate the wet weight of weed, they were harvested and weighted and were placed in the envelopes. In each replication, all of envelopes containing weed to measure biomass (dry weight) were dried 48 hours in the oven 75 °C temperature. After then were weighted by scale with 0.01 g. Data analysis was performed by SPSS software and comparison data was done by using Duncan's multiple domain test.

RESULTS

The dominant weed species in this study were *Equisetum arvense*, *Amaranthusretroflexus* and *Cyperusrotundus*. Pay attention to the result of table 2, Analysis of variance in the first period of weed removal (fifth April) in 13 replication showed that there is no significant differences between treatments and replicates in terms of dry and wet weight of weed (gr/m²) and density (n/m²) of weedin the probability level of 0.01.

The result of analysis of variance in the seconed period of weed removal (fifth June) in 13 replication showed that there is significant differences between treatments and replicates in terms of dry and wet weight of weed (gr/m²) and density (n/m²) of *Equisetumarvense, Amaranthusretroflexus, Cyperusrotundus* and other weed in the significant level of 0.01 ($p<0.01$) (table 3). As can be seen in table 3, There is also significant differences between wet and dry weight of weed in 3 replications of treatments in the significant level of 0.05.

Means comparison of data obtained of wet and dry weight (gr/ m²) of weed and density (n/m²) of *Equisetum arvense, Amaranthusretr oflexus, Cyperusrotundus*and other weed in the significant level of 0.05 by using of Duncan's test in figure 1 indicate, There is maximum of dry and weight weed in control treatment (54.57gr and535.3 gr) and minimum of them belongs to weeding (0.5gr) and four treatments of berseem clover in the second period of removal weed (fifth June) that there is no significant difference in the significant level of 0.05 with common vetch treatments except of second treatment (harvest and drop off residues of berseem clover on the twentieth April).

Density of*Equisetum arvense*was the haighest in the first and second treatments of common vetch (5.5) that has significant differences with other treatments in the significant level of 0.05 except of using Glyphosate herbicide. The lowest density of*Equisetum arvense*were observed at four treatment of berseem clover (0.5) and

Table 1. List of 13 treatments used in this study after one year planting of cover crops

1.	*Vicia sativa L.*	harvest and drop off residues of common vetch on fifth April
2.	*Vicia sativa L.*	harvest and drop off residues of common vetch on the twentieth April
3.	*Vicia sativa L.*	harvest and drop off residues of common vetch on fifth May
4.	*Vicia sativa L.*	harvest and transmission residues of common vetch on fifth May
5.	*Trifoliumalexandrinum L.*	harvest and drop off residues of berseem clover on fifth April
6.	*Trifoliumalexandrinum L.*	harvest and drop off residues of berseem clover on the twentieth April
7.	*Trifoliumalexandrinum L.*	harvest and drop off residues of berseem clover on fifth May
8.	*Trifoliumalexandrinum L.*	harvest and transmission residues of berseem clover on fifth May
9.	Glyphosate	Using of Glyphosate herbicide on fifth May
10.	Paraquat	Using of Paraquat herbicide on fifth May
11.	Plowing	Plowing on fifth May
12.	Weeding	Weeding from on fifth of April until fifth May
13	control	

Table 2. Analysis of variance wet and dry weight (g/m²) and density (n/m²) of weed to separate species on fifth April

F	Mean Square (ms)	Sum of square (s)	Degrees of Freedom (df)	Mean S quare (ms)	Studies factors
1.42 ns	133720.33	267440.67	2	Replication	Wet weight
0.99 ns	93926.919	1127123.03	12	Treatment	
	94497.861	2267948.67	24	Error	
1.52 ns	548.032	1096.06	2	Replication	Dry weight
1.73 ns	625.823	7509.88	12	Treatment	
	360.837	8660.10	24	Error	
2.61 ns	11.308	22.62	2	Replication	*Equisetum arvense*
1.33 ns	5.752	69.03	12	Treatment	
	4.335	104.05	24	Error	
0.03 ns	0.077	0.15	2	Replication	*Amaranthusretroflexus*
0.55 ns	1.269	15.23	12	Treatment	
	2.327	55.85	24	Error	
2.45 ns	17.718	35.44	2	Replication	*Cyperusrotundus*
0.45 ns	3.244	38.92	12	Treatment	
	7.218	173.23	24	Error	
0.10 ns	0.103	0.21	2	Replication	Other weed
0.59 ns	0.581	6.97	12	Treatment	
	0.991	23.79	24	Error	

ns: no significant differences

Table 3. Analysis of variance wet and dry weight and density (n/m²) of weed to separate species on fifth June

F	Mean Square (ms)	Sum of square (s)	Degrees of Freedom (df)	Mean S quare (ms)	Studies factors
4.78 *	291812.4	583624.8	2	Replication	Wet weight
14.71**	897454.4	10769452.5	12	Treatment	
	61030.1	1464721.8	24	Error	
4.84 *	3240.8	6481.57	2	Replication	Dry weight
13.74 **	9206.5	110477.57	12	Treatment	
	670.2	16085.19	24	Error	
2.56 ns	1.64	3.28	2	Replication	*Equisetum arvense*
16.34 **	10.47	125.69	12	Treatment	
	0.641	15.38	24	Error	
2.71 ns	2.026	4.05	2	Replication	*Amaranthusretroflexus*
4.67 **	3.491	41.90	12	Treatment	
	0.748	17.95	24	Error	
1.48 ns	2.154	4.31	2	Replication	*Cyperusrotundus*
4.76 **	6.953	83.44	12	Treatment	
	1.459	35.03	24	Error	
1.83 ns	3.179	6.36	2	Replication	Other weed
12.95 **	22.466	269.59	12	Treatment	
	1.735	41.64	24	Error	

** significance in 0.01 level
* significance in 0.05 level
ns: no significant differences

weeding. Maximum density of*Cyperusrotundus*was in second treatment of common vetch (5.17) and using of Paraquat herbicide (5.16) that was observed significant differences between maximum and minimum density.

The maximum density of *Amaranthusretroflexus*is in control and plowing treatments (3.16) that has significant differences in the significant level of 0.05 with third, fourth (0.83)treatments(common vetch) ,Fifth (0.5), seventh and eighth (0.83)treatments (berseem clover) and weeding (0.5) treatment. otherweed was less in all treatments of common vetch and berseem clover that dont have significant differences together but this differences is quite significant with control (8.83), plowing (6.8) and Paraquat herbicide (7.5) treatment.

Pay attention to table 4, The result of analysis of variance in the third period of weed removal (fifth september) in the studied treatment showed that there is significant differences between treatments and replicates in terms of dry and wet weight of weed (gr/m²) and density (n/m²) of weed in the significant level of 0.01 ($p<0.01$) (table 4). This different between dry weight of weed and density of *Cyperusrotundus* in 3 replications of treatments is significant respectivelyin the probability level of 0.05 and 0.01

Figure 2 shows comparison means of data obtained of wet and dry weight (gr/m²) and density (n/m²) of weed in the third period of weed removal (fifth september). The maximum of dry and wet weight of weed in addition to control (81gr and 99.5 gr) treatment was observed in first (79.5gr and 89.5gr) and second treatment (70.5gr and 78.83gr) of common vetch that have quite significant differences with other treatments in the probability level of 0.05.

The lowest wet and dry weight of weed was observed in the fifth treatment (berseem clover, 2gr and 2.8gr). Density of *Equisetumarvense* in first (98.7) and second treatments (94.5) and control (99.5) is maximum and in fifthand sixth treatments (0.5 and 12.8) was minimum that have significant differences with other treatments in the probability

Table 4. Analysis of variance wet and dry weight and density (n/m²) of weed to separate species on fifth september

F	Mean Square (ms)	Sum of square (s)	Degrees of Freedom (df)	Mean S quare (ms)	Studies factors
5.51*	237.462	474.92	2	Replication	Wet weight
70.49**	3036.021	36432.26	12	Treatment	
	43.073	1033.74	24	Error	
2.54 ns	93.103	186.21	2	Replication	Dry weight
92.29 **	3385.731	40628.77	12	Treatment	
	36.686	880.46	24	Error	
0.68 ns	30.333	60.67	2	Replication	*Equisetum arvense*
71.57**	3190.936	38291.23	12	Treatment	
	44.583	1070.00	24	Error	
1.30 ns	70.692	141.38	2	Replication	*Amaranthusretroflexus*
52.95 **	2872.466	34469.59	12	Treatment	
	54.248	1301.95	24	Error	
10.62**	234.333	468.67	2	Replication	*Cyperusrotundus*
169.81**	3745.197	44942.36	12	Treatment	
	22.056	529.33	24	Error	
3.29 ns	102.462	204.92	2	Replication	Other weed
124.19 **	3865.808	46389.69	12	Treatment	
	31.128	747.08	24	Error	

** significance in 0.01 level
* significance in 0.05 level
ns: no significant differences

level of 0.05. *Amaranthusretroflexus* has the lowest density in fifth and sixth treatments (4.5 and 1.2) and Glyphosate herbicide treatment (7.2). Density of *Cyperusrotundus* was highest in four treatments of common vetch and control that there is no significant differences with weeding treatment but this different is significant with berseem clover, herbicides and plowing treatments. The lowest density of *Cyperusrotundus* was observed in fifth treatment (3.8) that have quite significant differences with other treatments in the probability level of 0.05. Density of other weed is minimum in fifth, herbicides treatmentsand plowing (6) that have significant differences with other treatments.

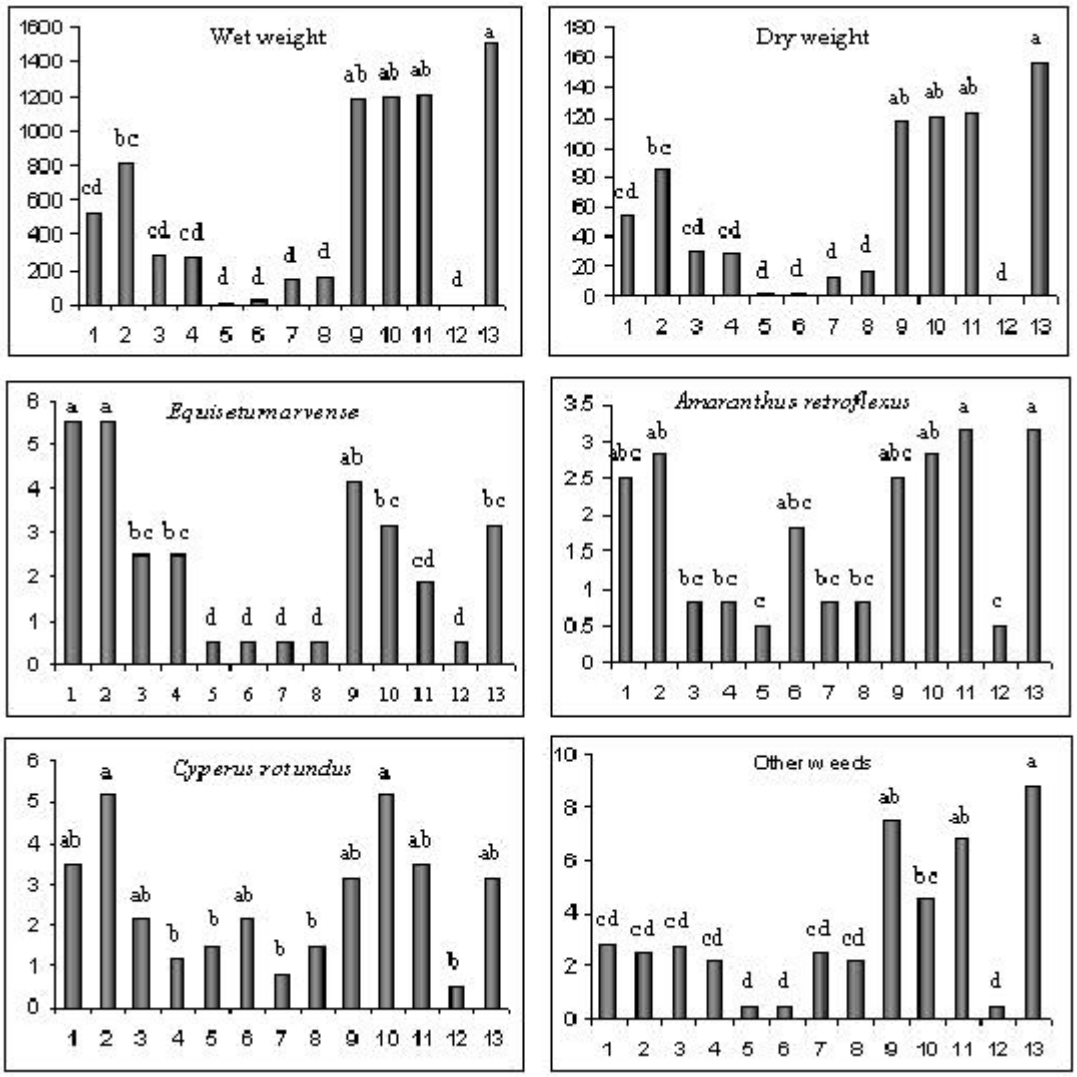

Fig. 1. Comparison means of wet and dry weight (g / m²) and density (n/m²) of weed to separate species on fifth June (the averages that have one common letter by Duncan's exam do not have different in probability level of 0.05)

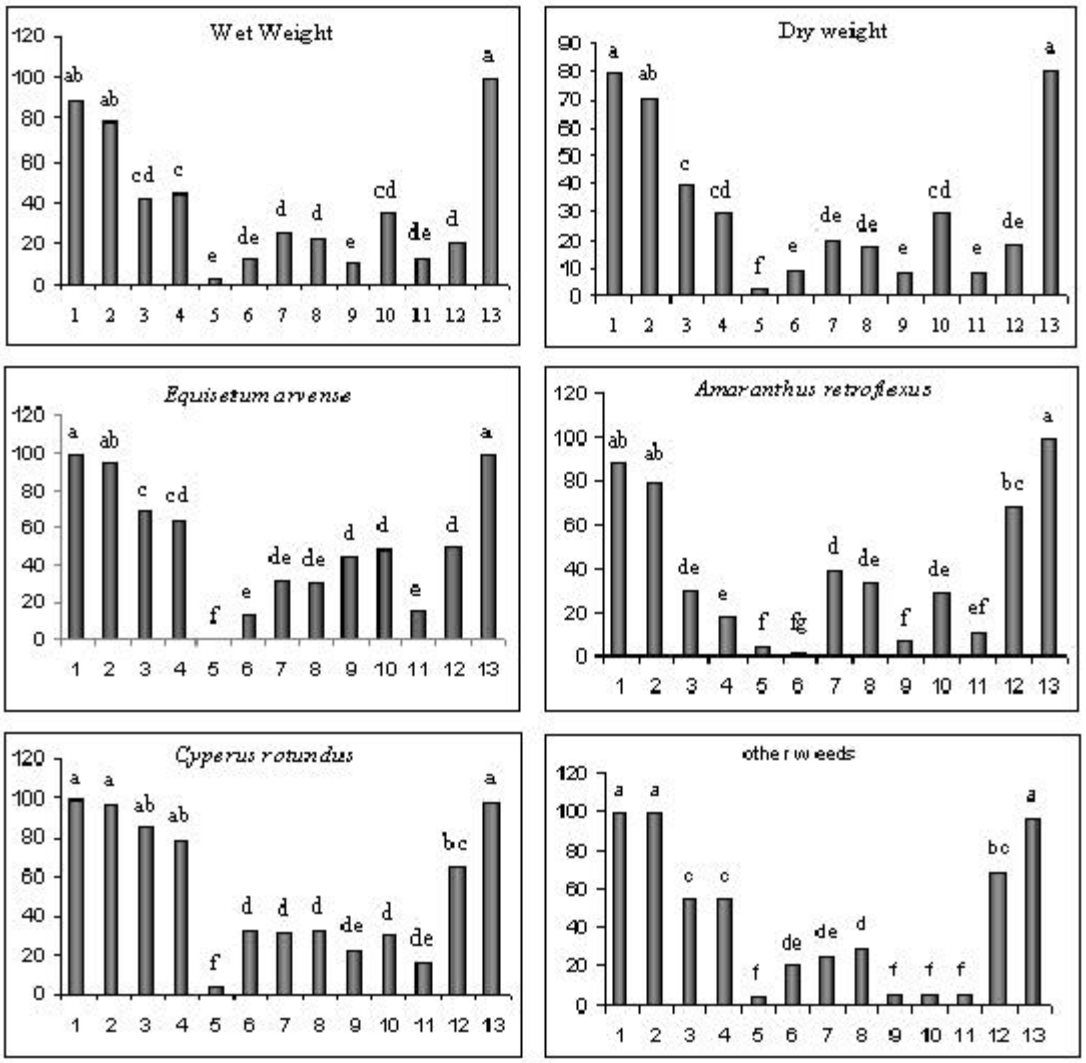

Fig. 2. Comparison means of wet and dry weight (g / m²) and density (n/m²) of weed to separate species on onfifth September (the averages that have one common letter by Duncan's exam do not have different in probability level of 0.05)

DISCUSSION

As can be seen in Table 2, Cover plants on 5 May is not as noticeable for weed control in the different treatments, However, analysis of variance in the second and third period indicates that the presence of cover crops reduced weight and density of weed (Table 3 and 4).Mennan et al, (2009a) by investigation of effects of various cover crops on the dry biomass production of weed species at the time of cover crop termination in 2005 and 2006 concluded that weed biomass was the highest in the control without cover crops followed by *T. meneghinianum, T.alexandrinum, V. villosa, V. sativa, T. aestivum and A. sativa. Secalecereal* and*L. multiflorum* were the most suppressive species, reducing total weed dry biomass respectively by 90% and 88% in 2005, and by 82% and 75% in 2006.

Pay attention to the result of means comparsion Figure 1, Berseem clover cover crop (four treatment) and weeding treatments significantly reduced the weed on 5 june. Performance of berseem clover is better than

common vetch.harvestand drop off or transmission residues of common vetch on fifth May have better performance in reducing weed than harvest and drop off its residues on fifth April. So if you use the common vetch (*V. sativa*) to reduce weed during this period, it will better, harvesting was done in late May. The use of herbicides and plowing are not recommended for reduce weed in this period.

Olness and Lopez in 2000 indicated that common vetch more than one year Hay increased Corn yield. Because of this legume has better tolerability than the shadow.Results of the studies ofKoloren and Uygur(2010) showed that, the cover crop (*V. sativa*) was the most efficient method providing 2.95% efficacy in orchard (3 years old) than the other control methods. During the observations, 63 weed species have been found in the citrus orchard. Kitis et al , (2011), Overall three-years results of the study were evaluated, living mulch application reduced weed density and cover proportion average of 42.8% and 45.9% respectively,compare to control. Biomass and dry weight of weed were also reduced by living mulch in all years of the experiment. The results indicate that living mulch application by common vetch is an important alternative weed suppression method for ecological weed management.

The result of means comparsion of wet and dry weight (gr/m²) and density (n/m²) of weed to separate species in end of period on fifth september (figure 2), Also confirm the better performance of berseem clover than common vetch. herbicides and plowing treatments had more effective role in reducing weed than common vetch in this period.Because cover crops can be good control of weed, they should be effectively developed and produce high biomass (Hartwing and Ammon,2002). In control treatment because of there was not a factor in reducing weed growth, weed used of environmental condition and had high growth, Therfore, weight and density of weed was increased.

Berseem clover cover crop because of good vegetative growth in winter further than common vetch treatments reduces the density of weed, it reduces the light that enters below the canopy by creating competition and canopy cover and it don't allow to weed growth (Tucher and Singh,1983). Effect of cover crops (winter legume) in weed control showed that they are good competitors against weeds, Except in the case of biomass cover crops is low that weed are dominant.

Common vetch has high growth in May that reaches its peak in June, This is true when it should be removed from the gardens since it is considered as a weed. common vetch hadn't suitable vegetative growth and did not make a good cover on the soil surface, the weed had used of nutrients and soil moisture and they formed severe competition with common vetch, Therefore, common vetch treatments had less effect on the density of weed than berseem clover treatments.

Pay attention to the result of experiment of this study; harvest and drop off residues of berseem clover on fifth April is the best treatment for reducing wet and dry weight and density of weed, Because berseem clover in this treatment could decrease weed due to make wide canopy. According to research (Blakshaw et al.,2001), using of *Melilotusofficinalis*(Yellow sweetclover) as green manure showed that weed densities in April before planting the succeeding wheat crop were 75 to 97% lower in yellow sweetclover than in untreated fallow treatments, suggesting that a portion of the weed suppression effect may be due to allelopathic compounds being released from decomposing yellow sweetclover.

The best time for harvesting of berseem clover is early spring when this plant has the highest vegetative state, Before accumulation of branches and leaves to be too critical. Because of excessive branches and leaves of berseem clover and remove it later, Lead to reduced access to light in underside of leaves and branche, The incidence of fungal diseases as result. Therefore, the plant canopy will be reduced and the more light will be reached on the soil surface, result in increasing seed germination and growth of weeds.

CONCLUSION

In order to control weeds in citrus orchards in northern Iran, berseem clover cover crop is preferable than common vetch, This plant can be planted in September and it is harvested in early spring of next year and its residue is left on the ground as mulch, Because of the herbicide, plowing and weeding don't use, reduce environmental pollution and high labor

costs,Therfore by improving soil nutrition, increase of porosity and rate of water permeability and nitrogen fixation in soil act as a green manure in the orchards, if you use common vetch as a cover crops, it will better a year after planting it, harvesting and leaving off residue occurs in mid-spring

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