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Non-Chemical Weed Control in Winter Canola (*Brassica napus* L.)

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Abstract. Cultural practices, management techniques and product quality are important factors which can influence the field heath and food security. Application of low input agriculture strategies, like as organic farming will result to high quality and safe products. In order to reduce herbicide use and enhancing quantity and quality of canola seed (cultivar Hyola308) a field experiment was conducted at Varamin, Iran, on 2007-2008 growing season. Seven experimental treatments consisted of Chemical weed control using Trifluralin (2.5 $l.ha^{-1}$) + sethoxydim (1.0 $l.ha^{-1}$), integrated reduced dose of the same herbicides to between rows cultivation, twice cultivation, integrated pre-irrigation (25 days before sowing) to cultivation at stem elongation stage, black plastic mulch, weed-free and uncontrolled weed were arranged in randomized complete blocks with four replications. Results indicated that canola grain yield, yield components, oil percent were significantly decreased due to weed interference. The highest crop height, leaf area index, grain and oil yield obtained from black plastic mulch treatment. This non-chemical treatment has also significantly reduced weed density and dry matter. However there was no significant difference between plastic mulch and integrated control treatments (pre-irrigation + cultivation). Since mulching practices in trade canola fields is so difficult and relatively expensive, simple integrated (agronomic and mechanical) weed control treatment including irrigation the field 25 days before planting with the aim of removing emerged winter weeds via seedbed preparation practices + cultivation at stem elongation stage could be recommended.

Keywords: organic farming, weed control, mulching, herbicide, winter canola, cultural practices

1. Introduction

Canola (*Brassiaca napus* L.) has been obtained the second rank after soybean (*Glycine max* L.) as the most important source of vegetable oil worldwide. During the past 20 years promote consumption of canola oil has surpassed peanut, sunflower and cottonseed (Raymer, 2002). Canola seeds are not only a rich source of oil (40-45%), but also a source of good quality protein (25%) (roshdy, *et al.,* 2008). Weeds are considered as one of the most important determinative factors in canola fields. They compete with crop plants for light, water, nutrients, space and may have some allelopathis effect. Canola is a slowly growing crop and thereby exposed to severe competition by weeds. However, at the early stage of growth, the canopy of canola leaves grew up over the rows and covered the field, hence, shading might suppress weed growth beneath. In addition, weeds with branched and vigorous root systems inhibit the development of canola plant through severe nutrition deprivation; hence the growth, yield and its quality will be reduced (roshdy, *et al.,* 2008). Rose and Bell (1982) pointed out that growing some weed species such as wild mustard (*Sinapis arvensis*) and stinkweed (*Thlaspi arvensis*) in canola fields reduced canola seed quality by increasing the level of erucic acid in the extracted oil and the glucosinolates content of the remaining meal.

Hands hoeing still the conventional weed control practice in canola and other row spacing field crops around the world. Recently the hand labor is becoming scare because their wages have been increased. However, the manual weeding could not be perfectly provided. This is turn presents to view the needs for another reasonable alternative. Some substantial benefits can be gained through the use of herbicides,

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compared with alternative means of weed control, such as mechanically weeding by hand or machine, herbicides are less expensive, faster and sometimes more selective. Toll (1989) stated that Butisan S (metazachlor) @ 2 L ha^{-1} applied at the cotyledon stage of spring rape gave 78-87% control of *Atriplex* spp, *Stellaria media* and *Matricaria inodora* and increased the canola seed yield by 240 kg ha^{-1}.Maximum reduction in weed density was observed in the treatment where trifluralin was applied @ 1.5 kg a.i. ha^{-1} (Tanveer, *et al.,* 2005). Herbicide application (Treflan at the rate of 1 to 2 litre/ha) significantly reduced the weed density and dry matter and produced the highest seed yield (31% increase to control treatment) in rapeseed.(khan and momtaz, 1995). Nevertheless herbicide application may have several important environmental issues. These include unintended damage occurring both on the sprayed site, and offsite. Herbicide use also injures the human and animals.

Integrated weed management (IWM).is the most important strategies to avoid herbicide environmental issue and increasing inputs productivity (Swanton and Weise, 1991). An IWM approach to land management combines the use of complementary weed control methods such as: mechanical control, herbicide application, land fallowing and biological control. Findings of singh *et al.,* (2001) showed that seedbed integrated with preplant fluchloralin at the rate of 1.0 kg/ha achieved excellent control of all major weeds and recorded the highest seed yield of 1682 kg/ha. Behdarvandi and Modhej (2007) observed the use of herbicide treatment integrated with twice cultivation had highest canola seed yield and oil performance. According to Paudel (2008) Trifluralin applied at 1 lit ai /ha in combination with intercultivation in mid March gave 200% less weed biomass than weedy whereas 187% higher yield of canola than weedy plots. The present report describes the effect of integrated methods on weed density and biomass and the seed yield of canola.

2. Materials and Methods

Experiment was conducted at Agronomic Research Centre, Agriculture faculty, Varamin, Iran. Seven experimental treatments consisted of T1: Chemical weed control using Trifluralin (Treflan 48-EC) @ 2.5 kg a.i. ha^{-1} + sethoxydim (Nabo-S 12.5-EC) @ 1 kg a.i. ha^{-1}, T2: integrated reduced dose of the same herbicides(Trifluralin @ 1.25 kg a.i. ha^{-1} + sethoxydim @ 0.5 kg a.i. ha^{-1}) to between row cultivation, T3: twice cultivation(before rosette & at stem elongation stage), T4: integrated pre-irrigation (25 days before sowing) to in-row cultivation at stem elongation stage, T5: black plastic mulch, T6: weed-free and T7: uncontrolled weed were arranged in randomized complete blocks with four replications. Each experimental unit consisting of six rows (6 m long and 60 cm apart). Canola seeds were sown at a rate of 4.00 kg ha^{-1} in 26^{th} November 2007 and the harvesting date was 5^{th} June 2008. Nitrogen @ 100 kg ha^{-1} and phosphorus @ 70 kg ha^{-1} were applied in the form of urea and diammonium phosphate, respectively. Whole amounts of P and half of N was broadcast and incorporated to the soil at sowing time and remaining half of N was broadcast at flowering. Additional canola seedlings were thinned 15 days after sowing to maintain a plant to plant distance of 5cm. Trifluralin was sprayed before sowing and sethoxydim at stem elongation stage by Knapsack sprayer. In row cultivation was done with goose-foot cultivator. In mulching treatment, the entire soil surface was covered with black plastic mulch and then was cut out a small hole for the plants to poke through. All other agronomic practices were kept uniform and normal for all treatments. Plant height (cm), dry matter (kg ha^{-1}) and yield parameters including siliques number $plant^{-1}$, number of seeds $silique^{-1}$, 1000-seed weight (g), seed yield (kg ha^{-1}) and seed oil content (%), also weed related traites including weed density (m^{-2}), fresh biomass (g m^{-2}) and weed dry matter (g m^{-2}) were recorded following standard procedures. Leaf area Index (LAI) was measured from five randomly selected plants from the two centre rows of each plot at the pod appearance stage. Weed samples were also taken by randomly throwing a quadrate of 0.25 m^{-2} area at the same time. Analysis of variance was performed using the SAS computer software package and treatment means were compared using Duncan's multiple range test at 5% of probability.

3. Results and Discussion

3.1. Weed Density and Dry Matter

The dominant weeds in the unconrtoled weedy plots were turnip weed (*Rapistrum rugosum*), flixweed (*Descurainia sophia*), londen rocket (*Sisymbrium irio*), madwort (*Asperugo procumbens*) and wild oats

(*Avena fatua*). Highest density and dry weight of weeds belonged to wild oats and madwort (58 plant/ m^{-2} and 74 g/ m^{-2}, respectively). Fresh and dry weights of broad and narrow leaved weeds recorded at silique appearance stage were significantly affected by weed control treatments (table 1). Black plastic mulch reduced density and dry matter of broad leaved, grassy and total weeds over other weed control treatments followed by treatment of integrated pre-irrigation to cultivation at stem elongation stage (96% and 92% controlled, respectively) (table 2). Minimum decrease of weed density and dry weight was recorded in twice cultivation treatment (table 2). Amount of weed control in Chemical treatment (Trifluralin @ 2.5 kg a.i. ha^{-1} + sethoxydim @ 1 kg a.i. ha^{-1}) and integrated chemical (Trifluralin @ 1.25 kg a.i. ha^{-1} + sethoxydim @ 0.5 kg a.i. ha^{-1}) to cultivation was 81% and 65% respectively. Tanveer *et al.,* (2005) obtained minimum weed dry matter in trifluralin @ 1.5 kg a.i. ha^{-1}.

Table 1. Analysis of variances indicating the effects of various experimental treatments on crop plant and weeds

Mean squares										
		Canola							Weeds	
S.O.V.	d.f.	LAI	Height	Silique / Plant	seed/ silique	1000-Seed Weight	Seed yield	Oil content	D.M.	Density
Replication	3	0.7	69.58	33.9	9.7	0.02	59073.7	0.86*	0.015	0.018
Treatment	6	3.3**	299.92**	71.46**	97.09**	0.59**	3957725.7**	132.92**	1.81**	1.54**
Error	18	0.12	36.454	17.84	7.34	0.04	61364.14	16.66	0.02	0.01
C.V. %		14.4	6.3	18	10.2	4.7	9.2	2.7	9.8	7.5

* and ** are significant at %5 and %1 percent level, respectively.

3.2. Crop Plant Height and LAI

Referring to the table 1 there are significant differences between treatments on LAI and height of canola plants. The highest plant height was recorded in black plastic mulch treatment (107 cm) (table 3). It has also the greatest leaf area index (3.8), and was statistically apart with treatment of integrated pre-irrigation to cultivation at stem elongation stage.

3.3. Siliques Number per Plant

Using black plastic mulch significantly influenced the number of siliques $plant^{-1}$ which produced 101 pods $plant^{-1}$ against the minimum (29) in uncontrolled weed treatment (table 3). Lower number of siliques in weedy check might have been due to greater weed-crop competition. The results are similar with those of Yadav *et al.,* (1999) who observed that number of pods $plant^{-1}$ increased when weed population was reduced by herbicide application. Positive relationship was observed between number of siliques and 1000-seed weight with seed yield. Similar Results were reported by Mekki, (2003). Cheema *et al.,* (2001) have also reported that the increased canola seed yield was mainly due to increasing the number of siliques per plant.

3.4. Number of Seeds per Silique

Data presented in table 1 revealed that Number of seeds/silique was affected by different weed control treatments. Black plastic mulch produced maximum seeds/silique (30) and was statistically at par with treatment of integrated pre-irrigation to cultivation at stem elongation stage (table 3). More number of seeds/silique in these treatments can be attributed to better weed control resulting in better utilization of resources and inputs by crop plants.

Table 2. Effect of experimental treatments on weed control in canola

treatment	weed density (m^{-2})	weed dry weight (g m^{-2})	control (%)
T1:herbicides(Trifluralin+ sethoxydim)	22.2c	34.8c	81
T2: herbicide+ cultivation	55.5b	69b	65
T3: twice cultivation	57.5b	75b	61
T4:integrated agronomic and mechanical	17.7c	18c	91
T5: black plastic mulch	9.7d	8.4d	96

T6: weed free	0e	0e	100
T7: weedy check	173.5a	257.7a	0

sharing the same letter(s) in a column do not differ significantly by Duncan's multiple range test at 5% of probability

3.5. 1000- Seed Weight

Data in table 1 showed that there are significant differences between treatments on 1000- Seed weight (table 1). Maximum amount (4.70 g) was obtained with application of black plastic mulch, whereas minimum seed weight (3.6 g) was recorded in weedy check (table 3). Severe weed-crop competition in weedy check might be the reason for lighter weight of seeds. These results are in line with those obtained by Saudy, (2004).

3.6. Seed Oil Content

Concerning seed oil content was also significantly affected by different weed control treatments (table 1). It reduced due to weed competition in weedy treatment (27.4 %). While the highest amount of seed oil recorded in treatments of weed-free, black plastic mulch and integrated pre-irrigation to cultivation (about 34%, table 3). It has been obviously referred to significant weed control in above mentioned treatments. However Roshdy *et al.,* (2008) observed insignificant difference due to application of hand hoeing treatments in oil %.

3.7. Seed Yield

Seed yield was highly significant affected by weed management strategies (table 1). In general, data in Table 3 show that seed yield (3593 kg ha^{-1}) has significantly increased by using black plastic mulch in comparison to the treatment had twice cultivation (2504 kg ha^{-1}) and the treatments received herbicide (2600 and 2437 kg ha^{-1}). Minimum seed yield (761 kg ha^{-1}) was also obtained at weedy check. But wasn't statistically observed significant difference between the treatment of black plastic mulch and the treatment of integrating the pre-irrigation 25 days before sowing plus cultivation at stem elongation stage (3503 kg ha^{-1}), (Table 3). Such increase in seed yield mainly due to the lowest weed intensity associated with canola plants as a result of direct effect of weed management method either by black plastic mulch or by pre-irrigation plus cultivation. The increase in seed yield under treatment of black plastic mulch estimated by 370% over the weedy check and 38% over the herbicide treatment, while the increase due to herbicide estimated by 241% over the uncontrolled treatment. Similar findings were reported by Yadav, (2004) who concluded that unchecked weeds caused nearly 37.5% seed yield loss. Makki *et al.,* (2010) have reported yield and yield components significantly increased due to weeds control. Since, the entire weed control methods significantly increased seed yield over uncontrolled treatment, is believed to be a direct or indirect expression of a reduction in weed-crop competition which significantly helped to increase seed yield (Singh *et al.,* 2001). Data presented in table 3 show that the yield attributes mainly seed yield/plant, number of pods and seeds/pod as well as 1000-seed weight were significantly affected due to using different weed management methods. These results are in line with those obtained by Chauhan *et al.,* (2005).

In generally data was presented show that canola yield and yield components significantly increased as a result of using black plastic mulch. but since mulching practices in trade canola fields is so difficult and relatively expensive, simple integrated (agronomic and mechanical) weed control treatment including irrigation the field (25 days before planting) with the aim of removing emerged winter weeds via seedbed preparation practices + cultivation at stem elongation stage, could be recommended.

Table 3. LAI, height, yield and yield component of canola in response to weed control treatments

treatment	LAI	Height (cm)	Silique / Plant	seed/ silique	1000-Seed Weight(g)	Seed yield (kg ha^{-1})	Oil content (%)
T1:herbicides(Trifluralin+ sethoxydim)	2.1d	91bc	66ab	27a	4.4ab	2600b	30.5b
T2: herbicide+ cultivation	2.3cd	89bc	67ab	26a	4b	2437b	28.7c
T3: twice cultivation	1.9d	92bc	51bc	26a	4.3ab	2504b	28.7c
T4:integrated agronomic and mechanical	3.2ab	102ab	74ab	30a	4.7a	3490a	34.7a

T5: black plastic mulch	3.8a	107a	101a	30a	4.6a	3593a	34.8a
T6: weed free	3bc	99ab	79ab	29a	4.7a	3690a	34.2a
T7: weedy check	1.1e	81c	29c	16a	3.6c	761c	27.4d

sharing the same letter(s) in a column do not differ significantly by Duncan's multiple range test at 5% of probability

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