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Weeds control in lentil (*Lens culinaris*) fields sown on different times by suitable dose of linuron as a post-emergence herbicide

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Abstract

The present study was aimed to weeds control in lentil fields sown on different times by suitable dose of linuron as a post-emergence herbicide in Tabriz region. Post-emergence herbicide; Linuron, was used in concentrations of 1000 cc ha^{-1}, 1250 cc ha^{-1} and 1500 cc ha^{-1} as recommended dose to control weeds in its 2-4 and 4-6 leaves stages. The treatments were laid out in a split plot factorial experiment with 3 replicates. Mean comparisons revealed that secondary branches in lentil plants better developed up to 6 branch in spraying time of 4-6 weed leaves stage, but only 4 branch from spraying time of 2-4 weed leaves stage. There is no significant difference between spraying times of linuron on number of pods per plant of lentil in early sown (5^{th} March) and 30 days later (5^{th} April) dates. Completely developed pods per plant were averaged 26.5 and 20 pods in 5^{th} March and 5^{th} April. Based on means of data obtained, when lentil cultivated on5^{th} March and sprayed with lorox on 4-6 weed leaves stage, grain yield increased up to 1578 kg ha^{-1}, but in those seeds sown on the same time and sprayed with lorox on 2-4 weed leaves stage yield reduced to 1157 kg ha^{-1}. Whereas, in late sown lentils on 5^{th} April at both spraying times yield reduced significantly. In late sown lentils weeds did not suitably controlled. But in early sown crop farmers could decrease weeds damage by application of 1250 cc ha^{-1} linuron. In our experiment weeds above ground biomass ranged from 2.1 g m^{-2} in 5^{th} April sowing time and 4-6 weed leaves stage up to 0.62 g m^{-2} in 5^{th} March sowing time and 2-4 weed leaves stage. This study resulted that in early sown lentils herbicide application can be economized. It seems that early sowings could be effective in weeds control in lentil fields.

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Introduction

The lentil (*Lens culinaris*) is an edible pulse. It is a bushy annual plant of the legume family, grown for its lens-shaped seeds. Lentils have been part of the human diet. Lentils are an essential source of inexpensive protein in many parts of the world, especially in Asia, which have large vegetarian populations (Zeldes, 2011). Lentil which grows naturally in Iran, can easily become widespread, yielding the highest quantity and quality and provide income to small farmers and also diversify the crop system. Production of lentil has undergone an increase in recent decades under conditions of Iran.

Because of the lentil growth period is short; each delaying in sowing will result in shortening of that once more. Lentil is usually sown in early spring for seed production; although in cold climates may give rise to poor emergence, and a weak crop that has little chance of producing a high quality yield at harvest.

In Soufizadeh *et al.* (2006) opinion, hand weeding is a cost-effective method for weeds control. Chemical weeds control in fields is prevalent by farmers. Combined application of 0.11 L.ai/ha Haloxyfop-R-Methyle plus Bentazone resulted in economize of nearly 0.5 L.ai/ha in recommended dose of Bentazone, and there was a additive effect between these two herbicides. In an experiment conducted by Raje *et al.* (1999) on saffron, Bentazone plus Fusalide or Bentazone plus Haloxyfop-R-Methyle had a good controlling effect on weeds flora.

In an experiment conducted by Vahedi Sheikhhasan (2012) five weeks after spraying wheat plants that had been treated with over-dose of Sulfosulfuron, Sulfosulfuron+Met-sulfuron and Iodo-sulfuron+Meso-sulfuron (100% of recommended dose), produced 1618, 1658 and 1620 g m^{-2} biomass, respectively, but only 1325 and 1210 g m^{-2} biomass were produced in reduced dose of Sulfosulfuron and Iodo-sulfuron+Meso-sulfuron (60% of recommended dose), respectively. Based on Vahedi Sheikhhasan (2012) results, in treatments of 60% of recommended dose of Sulfosulfuron and Iodo-sulfuron+Meso-sulfuron weeds did not control, completely.

Lentil is one of the legumes susceptible to weeds. The present study was aimed to weeds control in lentil fields sown on different times by suitable dose of linuron as a post-emergence herbicide in Tabriz region.

Materials and methods

Experimental location

The experiment was conducted at the Research Station of Varzgan, East Azarbaijan (Lat. 38°, 5´; Long. 46°, 17´ and elevation 1360 m), Iran, during 2011-2012, in a sandy loam soil with pH of 7.6 and organic matter of 1%. Varzgan is located in the north-west of Iran and the climate is semiarid and cold; in spite of dispersed precipitation in summer, it's arid and average annual precipitation is 270 mm. The experimental field had been in a corn-potato rotation cycle for the last two years.

Linuron is a substituted urea compound registered for use as a herbicide to control a wide variety of annual and perennial broadleaf and grassy weeds on both crop and non-crop sites. Linuron is registered for use on numerous crop sites such as forage crops, field crops, fruits, vegetables, and ornamental crops. In non-crop applications, linuron is used on alleys, fencerows, fairways, highway rights-of-way, sod-fields, streets and vacant lots.

Experimental procedure

The experimental area was ploughed in the fall and manured with 7 t ha^{-1} and then disked and plotted before sowing the seeds. Based on soil analysis field was fertilized with 50 kg ha^{-1} urea, 80 kg ha^{-1} P_2O_5 and 40 kg ha^{-1} K_2O. In this study, post-emergence herbicide; Linuron, was used in concentrations of 1000 cc ha^{-1}, 1250 cc ha^{-1} and 1500 cc ha^{-1} as recommended dose to control weeds in its 2-4 and 4-6 leaves stages. This herbicide has been previously tested safe on well established lentil plants. The treatments were laid out in a split plot factorial experiment with 3 replicates.

A local high yielding variety of lentil that has been inoculated with *Rhizobium legominosarum*, was sown at 85 seeds m^{-2} in 25-cm rows in 5th March as (early sowing date) and 5th April (as conventional sowing date). At maturity in 11th July, lentil plants at the center 1-m^2 portion of each plot were hand harvested.

Statistical analysis

All data were statistically analyzed based on RCBD using MSTAT-C software. The means of the treatments were compared using the least significant difference test at * $P < 0.05$.

Results and discussion

Variance analysis

Variance analysis of weeds control in lentil fields sown on different times by linuron (Table 1) indicated that effect of sowing date on seed yield, spraying time on stem height and number of secondary branches, sowing date× spraying time on number of pod per plant and seed yield, herbicide dose on seed yield, sowing date× herbicide dose on number of pod per plant and seed yield, spraying time× herbicide dose on weeds biomass and sowing date× spraying time× herbicide dose on weeds biomass were significant.

Table 1. Mean squares for studied traits in lentil and weeds biomass.

SOV	df	Stem height	Number of secondary branches	Number of pods per plant	100 seed weight	Seed yield	Weeds biomass
Replicate	2	5.007	4.75	85.028	0.484	0.004	0.484
Sowing date	1	2.25	1.778	406.69	0.001	2.47**	1.734
Ea	2	5.688	1.361	33.36	0.129	0.005	0.321
Spraying time	1	87.111*	25.0001**	1.361	0.09	0.068ns	0.034
Sowing date× Spraying time	1	10.028	0.4444	148.028*	0.36	0.128*	1.48
Herbicide dose	2	8.215	0.083	30.778	0.241	0.657**	0.409
Sowing date× Herbicide dose	2	5.896	3.694	80.778*	0.231	0.573**	0.045
Spraying time× Herbicide dose	2	11.799	1.75	25.444	0.37	0.043	1.825*
Sowing date× Spraying time× Herbicide dose	2	0.257	0.361	54.111	0.063	0.004	0.252*
Eb	20	11.697	1.789	24.761	0.285	0.027	0.315
CV (%)	-	14.8	25.89	21.3	8.33	18.43	26.93

*, ** mean significant difference at 5% and 1% probability levels, respectively.

Mean comparison

Lentil plants sprayed in 4-6 weed leaves stage had nearly 3 cm higher height than those treated in 2-4 leaves stage. Mean comparisons revealed that secondary branches in lentil plants better developed up to 6 branch in spraying time of 4-6 weed leaves stage, but only 4 branch from spraying time of 2-4 weed leaves stage.

There is no significant difference between spraying times of linuron on number of pods per plant of lentil in early sown (5th March) and 30 days later (5th April) dates. Completely developed pods per plant were averaged 26.5 and 20 pods in 5th March and 5th April (Figure 1). Muehlbauer (2002) reported that in expected sowing of lentil yield could be improved 20-30% due to seedlings better establishment and yield attributes increase.

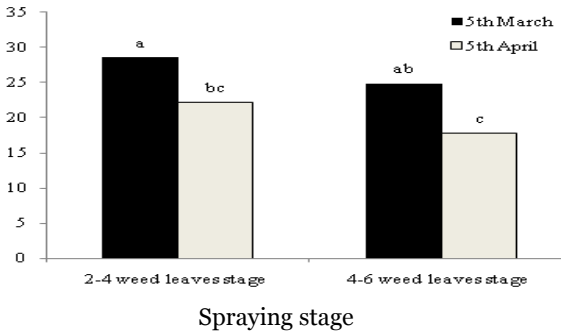

Fig. 1. Interaction of sowing date and spraying time on number of pods per plant.

Based on means of data obtained, when lentil cultivated on5th March and sprayed with lorox on 4-6 weed leaves stage, grain yield increased up to 1578 kg ha^{-1}, but in those seeds sown on the same time and sprayed with lorox on 2-4 weed leaves stage yield reduced to 1157 kg ha^{-1}. Whereas, in late sown lentils on 5th April at both spraying times yield reduced significantly (Figure 2). Weeds compete with crop plants for environmental resources like nutrients, water and light. They, thus, significantly reduce crop yield, impair crop quality and bring about substantial financial loss to the farmer. On a global basis, weeds are considered to be responsible for about 10% reduction of crop yield (Froud-Williams 2002).

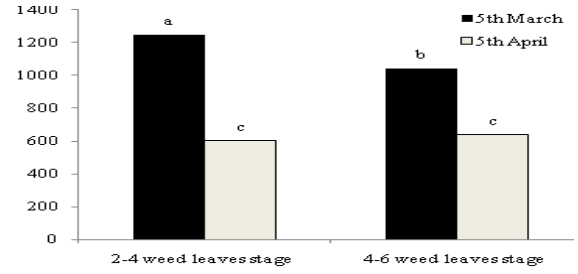

Fig. 2. Interaction of sowing date and spraying time on grain yield.

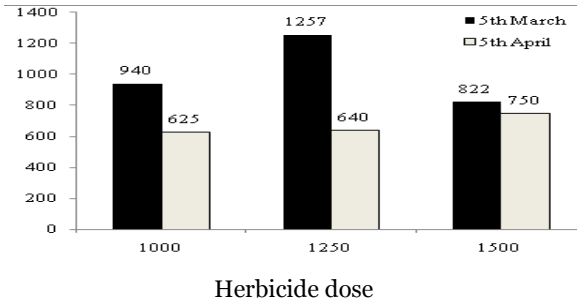

Fig. 3. Interaction of sowing date and herbicide dose on grain yield.

In late sown lentils weeds did not suitably controlled. But in early sown crop farmers could decrease weeds damage by application of 1250 cc ha^{-1} linuron (Figure 3). This study resulted that in early sown lentils herbicide application can be economized. The efficacy of any herbicide depends predominately on the dose used (Steckel *et al.*, 1997) and in many instances the same is also decisive for its selectivity. Registered herbicide doses are set to achieve upper limits of weed control under varying compositions, densities, weed growth stages and environmental conditions, and there may be an overestimation of the dose required to get adequate control (Zhang *et al.*, 2000).

In our experiment weeds above ground biomass ranged from 2.1 g m^{-2} in 5th April sowing time and 4-6 weed leaves stage up to 0.62 g m^{-2} in 5th March sowing time and 2-4 weed leaves stage (Figure 4). In a study performed by Gensen (2011) effects of herbicide application treatments on studied variables were significant. In weedy plots, differential weeds biomass between before and after spraying was positive and nearly 61%, and weeds had dry weight of 530 g m^{-2}. It seems that early sowings could be effective in weeds control in lentil fields. Mousavi (2005) in an evaluation of some post emergence herbicides resulted that only Metribuzine spraying could control 60% of weeds flora.

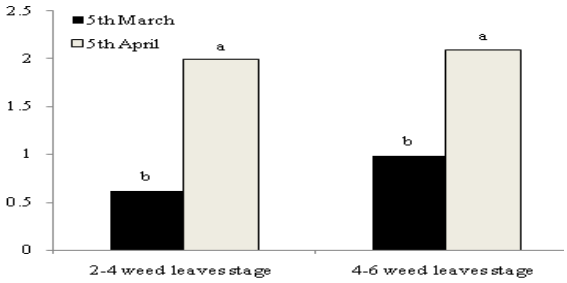

Fig. 4. Interaction of sowing date and spraying time on weeds biomass.

Success of a herbicide application is dependent upon weed species, the timeliness and thoroughness of application, conditions at the time of application, herbicide rate and crop management after the application. Application of herbicides in proper dose would reduce off-target movement of herbicide, and maximize weed control (Al-Khatib, 2011).

Conclusion

The efficacy of any herbicide depends predominately on the dose used. This study resulted that in early sown lentils herbicide application can be economized.

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