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Broad-Leaved Weeds in Chickpea (*Cicer arietinum* L.) As Affected By Plant Density and Lentagran Herbicide Application

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Research Article

Abstract

Broad-leaved weed in chickpea is one of the most important obstacles to product chickpea. Thus, in order to determine the best time of herbicide application and plant density to decrease weed population and increase yield of chickpea a field experiment was carried out at Naveh kesh Agricultural Jihad Center in Khorramabad, Iran on March 15, 2014. The experiment was carried out as split-plot based on randomized complete block design with four replications. Weed control was imposed at four levels – Lentagran herbicide application (15, 30 and 45 days after emergence) and control – as the main plot. Plant density was adopted at three row spaces – 20, 30 and 40 cm with 10 cm on-row spacing – as the sub plot. The results showed that plant density and Lentagran herbicide application significantly affected grain yield, weed weight and weed number. The highest and lowest grain yields were obtained by 30 and 40 cm row spacing respectively. Lentagran herbicide application at 30 days after emergence had the highest grain yield. The highest weed weight and weed number were shown in row spacing of 40 cm. The best combination treatments were found by row spacing of 30 cm and Lentagran herbicide application at 30 days after emergence, so that they could have the highest grain yield and lowest weed weight and weed number.

Keywords: Chickpea; Lentagran; Plant density; Weed.

1. Introduction

Weeds impose a serious problem in the production of winter legumes because they can compete for resources such as light, nutrients, water and space. Broad-leaved weeds control are a major production problem in winter legumes due to the absence of selective herbicides for these crops [1], thus weeds can directly result in decrease legumes yield [2]. Over the last decades herbicides have simplified weed control and have been extensively used, replacing cultural weed control methods in several regions [3].

Chickpea (*Cicer arietinum* L.) is an annual grain legume that is used extensively for human consumption. Iran with a harvested area of 550000 ha (the fourth country in the world) and average chickpea farm yield of 536.4 kg ha^{-1} is the sixth largest producer in the world [4]. Presence of weed is the most important factor to decrease average yield in this region (536.4 kg ha^{-1}). In chickpea, which is poor competitor, weed competition can result in deficient establishment [5].

Lentagran is contact herbicide for broad leaved weed control that containing 450 g kg^{-1} pyridate [6]. It is the most common post-emergence herbicide (in Iran) that has been applying for control of broad-leaved weeds and chickpea has also resisted to this herbicide [7]. In chickpea, optimum plant density fluctuates – from 25 to 40 plants per square meter. High density is recommended for favourable environment (high precipitation and fertile soils) and low density is advised for undesirable environment [8]. Saxena, [9] reported that in chickpea, the best plant density was 33 plants per square meter. Kanouni and Nemati Fard [10] concluded that autumn sowing with 35 plant m^{-2} (80 kg ha^{-1}) could be recommended as the suitable package for autumn sowing of chickpea in rainfed conditions in Iran. Shrestha [11] reported that in planting soybean with low row spacing, dry matter of weeds were about 75% lower than high row spacing. Akbari et al. [7] conducted an experiment on chickpea and reported that yield and yield components of chickpea were decreased by increasing row distance, but weed biomass was increased by increasing row distance. They also showed that the lowest weed biomass was associated with Lentagran herbicide application.

With respect to environmental problems associated with applying the herbicides, it is essential that we use herbicides appropriately in order to improve food safety. The aim of this study was to determine the best time of herbicide application and plant density to decrease weed population and increase yield of chickpea.

2. Methods

2.1 Region of experiment

This study was conducted at the Naveh kesh Agricultural Jihad Center in Khorramabad, Iran on March 15, 2014, with Latitude 33˚30´ N, Longitude 48˚18´ E and Altitude 1125 m, where average annual rainfall was 455.1 mm.

2.2 Experimental design and agronomic applications

Present experiment was carried out as split-plot based on randomized complete block design with four replications. Weed control was imposed at four levels; (a) Lentagran herbicide application within 15 days after emergence (H1); Lentagran herbicide application within 30 days after emergence (H2); Lentagran herbicide application within 45 days after emergence (H3); control or without Lentagran herbicide application (H4) as the main plot. Plant density was adopted at three row spaces; (a) 20 cm, 50 plants m^{-2} (D1); (b) 30 cm, 33 plants m^{-2} (D2); (c) 40 cm, 25 plants m^{-2} (D3) – with 10 cm on-row spacing – as the sub plot. According to the soil testing (Table 1), nitrogen and phosphate were determined by 25 kg ha^{-1} urea and 100 kg ha^{-1} ammonium phosphate.

Table 1. Chemical characteristics of substrate soil

Depth (cm)	pH	SP (%)	O. C (%)	P mg kg^{-1}	K mg kg^{-1}
0-30	7.8	42	1.02	4.6	335

2.3 Statistical analysis

The recorded data were statistically analysed using the software SAS 9.2. Mean comparisons were calculated using Duncan's Multiple Range Test at $P \leq 0.05$.

3. Results and Discussion

The results of variance analysis showed that (Table 2) plant density, Lentagran herbicide application and plant density in Lentagran herbicide application interactions significantly affected grain yield (GY), weed weight (WW) and weed number (WN) at $P \leq 0.01$. The results of mean comparisons showed that the highest GY (154.6 g m^{-2}) was found at 30 cm row spacing. The lowest GY (128.4 g m^{-2}) was observed at 40 cm row spacing. Lentagran herbicide application at 30 days after emergence had the highest GY. Also the results of treatment interactions showed that the highest grain yield (195.8 g m^{-2}) was obtained by row spacing of 30 cm and Lentagran herbicide application at 30 days after emergence (Table 3A & 3B). Singh et al. [12] expressed that individual plant performance of chickpea showed less flexibility and increase of individual plant yield could not compensate the low number of plant per square meter in low plant density. High plant density can cause competition between vegetative and generative organs that it leads to decrease grain yield. This is in agreement with the conclusion of Saxena, [9] and Kanouni and Nemati Fard [10] that the best plant density was obtained by 33-35 plants per square meter.

Table 2. Analysis of variance for grain yield, weed weight and weed number

S.O.V	df	MS		
		Grain yield	Weed weight	Weed number
Replication	3	186.762	145.703	6.354
Herbicide (H)	3	19805.311**	7302.629**	689.049**
Error (a)	9	177.220	37.415	13.002
Plant density (D)	2	2810.691**	1128.034**	78.605**
H × D	6	2184.220**	264.375**	21.651**
Error (b)	24	175.165	66.197	4.892
C.V. (%)		9.28	21.74	15.70

**: Significant at $P \leq 0.01$, and ns: Non- significant

Table 3A. Mean comparisons of grain yield (GY), weed weight (WW) and weed number (WN)

Factor	**GY** (g m^{-2})	**WW** (g m^{-2})	WN
Herbicide			
H_1	163.2 ab	27.57 c	11.3 b
H_2	170.1 a	8.99 d	6.51 c
H_3	154.7 b	46.89 b	14.11 b
H_4	82.4 c	66.25 a	24.43 a
Plant density			
D_1	144.9 b	31.44 b	12 c
D_2	154.6 a	33.76 b	13.85 b
D_3	128.4 c	47.07 a	16.42 a

Table 3B. Mean comparisons of grain yield (GY), weed weight (WW) and weed number (WN) as affected by two-way interaction effects

Factor		**GY** (g m^{-2})	**WW** (g m^{-2})	**WN**
H_1	D_1	165.5 bc	21.6 cd	10.9 d
	D_2	165.4 bc	27.4 bc	10.5 de
	D_3	137.1 de	33.8 bc	12.6 d
H_2	D_1	181.7 ab	6.09 e	5.9 f
	D_2	195.8 a	7.43 e	7.31 ef
	D_3	179.3 ab	13.5 de	6.31 f
H_3	D_1	149.3 cde	33.9 bc	12 d
	D_2	156.8 cd	36.6 b	12.7 d
	D_3	133.1 ef	70.2 a	17.6 c
H_4	D_1	68.89 g	62.4 a	19.3 c
	D_2	114.4 f	65.5 a	24.9 b
	D_3	63.9 g	70.8 a	29.2 a

The same letters within each column indicate no significant difference among treatments ($P \leq 0.05$). H_1, H_2 and H_3 are Lentagran herbicide application within 15, 30 and 45 days after emergence respectively. H_4 is control. D_1, D_2 and D_3 are 20, 30 and 40 cm row spacing respectively.

Higher densities and better crop nutrition are ways to control weed growth. Lower row spacing leads to crop use higher light, water and nutrition, whereby plant can dominate weeds. This agronomic management can cause diminish weed growth. The results in present study are in agreement with the conclusion of Shrestha [11] and Akbari et al. [7]. Timing of the application is critical for effective weed control. The rate and timing of application are based on weed size and climatic conditions. Weeds can usually be controlled with a lower application rate when they are small and tender [13]. In this study weeds encountered with the best conditions for growing when Lentagran was applied at 30 days after emergence. Thus, according to the function of pyridate – active ingredient of Lentagran that it cause to inhibit photosynthesis by oxidizing chlorophyll and leading to buildup of toxic materials [14] – the greatest effect was observed at this time.

4. Conclusions

Grain yield, weed weight and weed number significantly affected by plant density and Lentagran herbicide application. On the one hand, the lowest density (25 plants per square meter) leads to the lowest grain yield and the highest weed population. On the other hand, the highest density (50 plants per square meter) could not cause the highest grain yield, whereas the highest grain yield was obtained by moderate plant density (33 plants per square meter). Lentagran herbicide application at 30 days after emergence had the best result for increasing grain yield and decreasing weed population.

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