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Responds of Leek *(Allium porrum* L.*)* to various weed management

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The vast plateau of Iran is center ship of many cultivated and weeds. Three Leek varieties viz. Rasmi, and American, two chemical treatments (Terflan; 2.5 and pendimethaline; 3.0 L ha^{-1}) and two manual weeding treatments (Single hoeing 25 days and Double hoeing 25 & 50 days after transplanting) alongwith a weedy check were compared for weed control and their effect on the yield and yield components of Leek. Varieties were assigned to the main-plots while weed control treatments were kept into subplots. Each sub-plot size was of 1.5 x 1.5 m^2 having the distance of 30 cm and 10 cm between rows and plants, respectively. American showed the best results in all the parameters including number of leaves $plant^{-1}$, length of leaves, number of bulbs $plots^{-1}$, bulb diameter, weight of bulbs and bulb yield (t ha^{-1}). Herbicides significantly controlled the weeds. However, pendimethaline; 3 L ha^{-1} treated plots gave the highest yield (40.28 t ha^{-1}) as well as weight of bulbs (127.9 g). Our findings reveal that American variety is suitable for the area under the climatic conditions of Tehran, whereas pendimethaline proved to be the best herbicide in controlling weeds in Leek. Therefore, it is recommended to have a combination of American and pendimethaline for the higher yield of Leek for Tehran.

Key words: Leek, weed control methods, Terflan, pendimethaline

Introduction

Iran is an agricultural country with its economy being greatly dependent upon agriculture. Although, the major contributors to the national economy are the major crops such as cotton, rice and wheat yet the production of minor crops like Leek (*Allium purrum* L.) also has a pronounced impact on the economy of the country (Sadeghi and Ashrafi, 2008). Leek belongs to the lily family or Alliaceae and is a condiment crop and consumed as a fresh in salads as well as used in dishes as a spice. Besides providing nutrition, it imparts acceptable flavor to our dishes (Ashrafi *et al*., 2009; Sadeghi and Ashrafi, 2008). The yield of Leek in our country is very low as compared to other

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agricultural countries. One of the most important reasons for the poor yield of Leeks is the excessive weed competition. The most comprehensive definition of weed is the plant whose virtues have not been discovered so far. Weed control is unavoidable for successful production of the Leek crop and production losses increased with weed infestation. Weed control constitutes one of the principal costs of production in Leeks (Nyland, *et al*., 1958; Sadeghi and Ashrafi, 2008). Orkwor *et al*. (1983) reported that Chlorthal dimethyl @ 12 kg ha^{-1}, flurodifen @ 1.5 and 3 kg ha^{-1} and oxadiazon @ 1 and 2 kg ha^{-1} all applied prior to transplanting gave excellent weed control for at least 12 weeks and resulted in Leek yield comparable with hoe weeding. Herbicides applied after transplanting were not so satisfactory. Orkwor (1983) reported that weed infestation significantly reduced crop vigor, leaf production and bulb diameter and consequently bulb yield in Leeks. Patel *et al*. (1986) reported that Fluchloralin @ 1.35 kg ha^{-1} plus one hand weeding gave the highest additional income compared with no weeding. The cost benefit ratio was highest with 0.5 kg oxidiazon ha^{-1}. Rajendra *et al*. (1986) concluded that nitrofen @ 1 g ha^{-1} applied pre-planting gave good weed control and highest yields of 282.41 g ha^{-1} compared with 193.21 g ha^{-1} in the control. Nitrofen treatment was at par with 2-hand weeding and it was more economical. Plots hand weeded 3 and 4 times yielded 302.79 and 309.26 g ha^{-1}, respectively. The critical weed competition was up to 40 days after transplanting. Porwal and Singh (1993) observed that the pre-emergence application of oxadiazon (1.0 kg ha^{-1}) followed by manual weeding 45 days after transplanting showed the maximum weed-control efficiency of 77.0% compared with 60.5% with oxadiazon alone, and also increased the bulb yield by 81.4-254.9% over weedy check. Warade *et al*. (1995) obtained highest yields of 11.83 t ha^{-1} and largest bulbs were achieved with 0.5 kg fluchloralin, followed by 0.75 kg fluchloralin. The highest return of Rs.35499/- and best benefit cost ratio (25.46) were also achieved with 0.5 kg fluchloralin. Sadeghi and Ashrafi, 2008; Verma and Singh (1997) reported higher plant height, leaves $plant^{-1}$, fresh and dry weight of plant (g $plant^{-1}$), bulb diameter, marketable bulb yield and poor percentage of bolting recorded under weed free plot, followed by pendimethalin at 1.5 kg ha^{-1} and at higher fertility.

Materials and methods

The research project on Integrated Weed Management in Different Varieties of Leek (*Allium purrum* L.) was carried out at the Horticultural Research Area, Faculty of Agriculture, Gomal University, Dera Ismail Khan, during the growing season 2001-2002. The experiment was laid out in split plot design with three replications, allotting the varieties (Rasmi, and American) into

main plots while weeding methods into sub plots. The sub-plots consisted of herbicide treatments viz. Weedy Check (Control), Single Hoeing (25 Days after Sowing), Double Hoeing (25 and 50 Days after Sowing), Terflan (Trifloralin) @ 2.5 L ha^{-1} and pendimethaline @ 3.0 L ha^{-1}. Each sub-plot size was of 1.5 x 1.5 m^2 having the distance of 30 cm and 10 cm between rows and plants, respectively. Terflan was applied in post emergence of weeds whereas pendimethaline was sprayed immediately after transplanting. First hand weeding was applied 25 days after transplanting while the second hand weeding was applied with 25 days interval. Data were recorded on bolting $plot^{-1}$ (%), weed density m^{-2}, fresh weeds biomass (g $plot^{-1}$), dry weeds biomass (g $plot^{-1}$), number of leaves $plant^{-1}$, number of bulbs $plot^{-1}$, diameter of bulbs (cm), weight of bulb (g) and bulb yield (t ha^{-1}). Data were subjected to ANOVA and the significant means were separated as outlined by Steel and Torrie (1984).

Results and discussion

Weed density 25 days after transplanting (m^{-2})

Table 1 shows weed density was not affected significantly in case of three Leek varieties. However, lesser number of weeds (191.2 m^{-2}) was counted in the plots where variety was sown which were very closely followed by American and Rasmi with 191.3 and 191.9 weeds m^{-2}, respectively. Whereas, different weeding methods gave significant results for the weed density. Lower weed count was recorded in herbicides treated plots where 120.9 and 125.3 weeds m^{-2} were recorded in pendimethaline and Terflan treated plots, respectively. Statistically both the treatments were at par with each other. Maximum number of weeds per m^2 were counted as 296.7 from weedy check plots. This might be due to the application of herbicides.

Fresh weed biomass (g)

The data showed that different Leek varieties differed non-significantly (Table 1). However, maximum weight of weeds was measured from plots where Rasmi was sown with 321.90 g weeds biomass $plot^{-1}$, as the minimum. Different weed control methods showed a significant variation. Control plots having no weed control produced the maximum weed weight i.e. 461g followed by double and single hoeing treatments with 442.40 and 350.20 g respectively. All these three treatments were statistically at par with each other. Pendimethaline showed the minimum weight of the weeds (66.52 g). The results are in accordance with the findings of Verma and Singh (1997) who stated that pendimethaline controlled the weeds biomass.

Table 1. Weeds density, fresh weed biomass (g), dry weed biomass (g), number of leaves plant^{-1} and leaf length (cm) of three Leek varieties as affected by various weed control methods.

Weeding Methods	Varieties		Weed Management Mean
	Rasmi	American	
Weeds Density 25 Days after Sowing			
Control (No Weeding)	303.33 NS	288.33	296.67 a
Single Hoeing (25 DAS)	201.67	215.00	209.44 b
Double Hoeing (25,50 DAS)	209.33	210.33	204.89 b
Terflan (1 L ha^{-1})	125.00	123.33	125.33 c
Pendimethaline (1.25 L ha^{-1})	120.00	119.33	120.89 c
Varietal Means	191.87 NS	191.27	
Fresh Weed Biomass (g)			
Control (No Weeding)	575.90 NS	284.37	461.00 a
Single Hoeing (25 DAT)	441.90	310.67	350.20 a
Double Hoeing (25,50 DAT)	365.90	606.20	442.40 a
Terflan (1 L ha^{-1})	147.23	138.10	135.10 b
Pendimethaline (1.25 L ha^{-1})	078.61	074.28	066.52 b
Varietal Mean	321.90 NS	282.70	
Dry Weed Biomass (g)			
Control (No Weeding)	25.40 NS	64.07	38.97 a
Single Hoeing (25 DAT)	35.93	63.80	42.81 a
Double Hoeing (25,50 DAT)	47.50	44.37	37.89 a
Terflan (1 L ha^{-1})	28.73	37.37	27.87 b
Pendimethaline (1.25 L ha^{-1})	23.27	35.90	23.98 c
Varietal Mean	32.18 b	48.30 a	
Number of Leaves per Plant			
Control (No Weeding)	08.23 NS	08.07	08.04 c
Single Hoeing (25 D DAT)	08.70	10.23	09.03 bc
Double Hoeing (25,50 DAT)	09.03	11.73	10.01 b
Terflan (1 L ha^{-1})	09.26	08.57	08.56 c
Pendimethaline (1.25 L ha^{-1})	12.00	13.00	11.57 a
Varietal Mean	09.45 b	10.32 a	
Leaf Length (cm)			
Control (No Weeding)	38.50 e	48.77 bcd	41.12 d
Single Hoeing (25 DAT)	49.33 bcd	51.73 ab	45.74 bc
Double Hoeing (25,50 DAT)	49.50 bcd	53.37 a	47.18 b
Terflan(1 L ha^{-1})	45.93 d	49.90 abc	44.47 c
Pendimethaline (1.25 L ha^{-1})	48.43 bcd	53.27 a	49.42 a
Varietal Mean	46.34 b	51.41 a	

Any two mean(s) in their respective group not sharing a common letter(s) are significant at 5% probability. NS = Non-significant DAT= Days after transplanting.

Dry weeds biomass (g)

Dry weed biomass was significantly affected by the three Leek varieties. The plots of Rasmi variety produced the maximum dry weed biomass i.e. 48.30 g. Different weed control practices showed the significant variations for the said parameter. The minimum dry weed biomass (23.98 g) was observed in pendimethaline treated plots. The plots with Single Hoeing gave the maximum dry weed biomass i.e. 42.81 g followed by control plots (38.97 g). Statistically the results of Control, Single Hoeing and Double Hoeing were comparable with one another (Table 1). Verma and Singh (1997) also reported that chemicals controlled the fresh as well as dry weed biomass.

Number of leaves per plant

The results on leaves per plant revealed the significant differences for both factors. Maximum leaves plant^{-1} (10.32) were obtained in American variety while gave the lowest leaves plant^{-1} i.e. 8.56. This might be due to the varietal characteristics of the concerned cultivar. Different weed control methods also showed significant variations. Maximum number of leaves plant^{-1} was recorded as 11.57 from pendimethaline treated plots. While the lowest leaves plant^{-1} producing treatment was Control (8.04) where no weeding was done (Table 1). Disappearance of weeds resulted in the better fertilizer use efficiency by the plant and in this way the plants accumulated more food and increased the number of leaves compared to the treatments where hoeing was given.

Leaf length (cm)

Similar trend was observed as it was recorded for the number of leaves. Both the factors and their interaction showed significant differences. Maximum length of leaves (51.41 cm) was obtained from American cm length. The plants of various varieties utilized the plant food nutrients easily without any competition which resulted in better length of leaves. Whereas, pendimethaline treated plots gave the longest leaves of Leek i.e. 49.42 cm against the control plots which produced minimum leaf length (41.12 cm). Interaction of both factors also revealed significant variations. American with the treatment of Single Hoeing and pendimethaline gave the longest leaf length viz. 53.37 cm and 53.27 cm, also non-significant with each other (Table 1). Verma and Singh (1997) also reported the same findings during their field trial.

Number of bulbs per plot

Leek bulbs are the economical and most important commodity. Both factors showed the significant behavior with regards to number of bulbs plot^{-1}. However, American showed the best results by producing 67.55 bulbs plot^{-1}. As the plots treated with pendimethaline remained free of weeds, they produced more number of bulbs (69.78) without any difficulty and deficiency of nutrients. Statistically the results of pendimethaline (69.78 bulbs plot^{-1}), Double Hoeing (67.89 bulbs plot^{-1}) and Single Hoeing (66.78 bulbs plot^{-1}) were non-significant among one another, and remained at par with each other. Minimum bulbs plot^{-1} (62.00) was recorded in the Control plots (Table 2). These findings go in accordance with those of Porwal and Singh (1993) who stated that weeds control treatments reduced the weeds density and enhanced the bulb yield.

Diameter of bulbs (cm)

Table 2 depicted that different varieties of Leek significantly affected the diameter of Leek bulbs. American was the maximum bulb diameter producing variety giving 6.49 cm wide bulbs. Various weed control measures also significantly affected the bulb diameter. The plots treated with pendimethaline and hand weeding (Hoeing) increased the bulb diameter of Leek. Pendimethaline treated plots produced 6.63 cm wide bulbs showing the maximum bulb diameter. Minimum bulb size was noted as 5.96 cm from weedy check plots where the weed control practices were not applied. Pendimethaline and Single Hoeing practice gave at par findings and also remained non-significant with each other. Chemically treated plots remained non-competitive with weeds throughout the growing season which resulted more wide Leek bulbs.

Weight of bulbs (g)

The three Leek cultivars differed significantly for the weight of bulbs (Table 2). American produced the maximum weighing bulbs (122.30 g) whereas the lowest weight of bulbs was recorded as 105.30 g from. Different weed control practices also affected significantly the weight of Leek bulbs. Plots treated with pendimethaline showed maximum bulb weight i.e. 127.90 g as against the minimum of 105.10 g (Control) which was very closely followed by Terflan treated plots with 106.20 g bulb weight. The results coincide with the findings of Dunan *et al*. (1996).

Table 2. Number of bulbs plot^{-1}, diameter of bulbs (cm), weight of bulbs (g) and yield (t ha^{-1}) of three Leek varieties as affected by various weed control methods.

Weeding Methods	Varieties		Weed Management Mean
	Rasmi	American	
	Number of bulbs plot^{-1}		
Control (No Weeding)	62.33 NS	63.67	62.00 c
Single Hoeing (25 DAT)	67.00	68.00	66.78 ab
Double Hoeing (25,50 DAT)	67.33	69.00	67.89 a
Terflan(1 L ha^{-1})	64.00	64.67	64.11 bc
Pendimethaline (1.25 L ha^{-1})	71.00	72.33	69.78 a
Varietal Mean	66.33 ab	67.53 a	
	Diameter of the Bulbs (cm)		
Control (No Weeding)	5.93 NS	6.20	5.96 c
Single Hoeing (25 DAT)	6.37	6.57	6.46 ab
Double Hoeing (25,50 DAT)	6.40	6.50	6.40 b
Terflan(1 L ha^{-1})	6.03	6.43	6.12 c
Pendimethaline (1.25 L ha^{-1})	6.63	6.73	6.63 a
Varietal Mean	6.27 ab	6.49 a	
	Weight of Bulbs (g)		
Control (No Weeding)	105.30 NS	115.70	105.10 c
Single Hoeing (25 DAT)	115.70	123.00	113.30 b
Double Hoeing (25,50 DAT)	121.30	124.70	118.60 b
Terflan(1 L ha^{-1})	116.30	119.00	106.20 c
Pendimethaline (1.25 L ha^{-1})	128.00	129.30	127.90 a
Varietal Mean	115.30 b	122.30 a	
	Bulb Yield (t ha^{-1})		
Control (No Weeding)	29.43 NS	32.64	29.08 c
Single Hoeing (25 DAT)	34.43	37.18	33.69 b
Double Hoeing (25,50 DAT)	36.31	38.24	35.77 b
Terflan(1 L ha^{-1})	30.28	34.19	29.73 c
Pendimethaline (1.25 L ha^{-1})	40.39	41.54	40.28 a
Varietal Mean	34.17 a	36.76 a	

Any two mean (s) in their respective group not sharing a common letter (s) are significant at 5% probability.
NS = Non-Significant DAT = Days after transplanting

Bulb yield (t ha^{-1})

The three varieties significantly affected the Leek bulb yield. American was the highest yield producing variety with 36.76 t ha^{-1} yield. Pre-emergence application of pendimethaline boosted up the Leek bulb yield. Whereas, pendimethaline treated plot produced maximum yield of 40.08 t ha^{-1} while the minimum of 29.08 t ha^{-1} from the weedy check plots (Table 2). These results are also supported by the findings of Warade *et al*. (1995) and Shimi and Moghadam (1996) who stated that herbicides application significantly increased the bulb yield of Leek.

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