



*Original article*

## Investigation of quality and quantity of Chinese lantern (*Physalis alkekengi* L.) in response to different irrigation and animal manure levels

A. Asgari<sup>1\*</sup>, P. Rezvani Moghaddam<sup>2</sup>, A.R. Koocheki<sup>2</sup>

1. Ph.D Graduated of Agroecology, Ferdowsi University of Mashhad; Assistant Prof. University of Hormozgan, Iran

2. Faculty member, Department of Agronomy, Faculty of Agriculture, Ferdowsi University of Mashhad, Mashhad, Iran

Received 14 March 2020; Accepted 6 June 2020

### *Extended abstract*

#### **Introduction**

*Physalis alkekengi* is a well-known medicinal plant in Europe and Asia and especially in the northeastern of China. It is an economically valuable plant that can tolerate drought, waterlogging, and warm and cold temperatures. All parts of *P. alkekengi* could be used as medicine. *P. alkekengi* is a rich source of complex antioxidants, which has been suggested for the treatment of several diseases such as inflammation and rheumatism. The availability of water is the primary constraint on food production in arid and semi-arid regions. Trends of water availability indicated that agricultural activities are approaching a “water crisis” in the Middle East and North Africa. In Iran, water is a scarce resource due to the high variability of rainfall. Water stress effects on growth and yield are species is well known. Optimizing irrigation management, together with the appropriate crops, is suitable in these regions. So the aims of this study were to the effect of different irrigation levels and manure amount on yield, yield components, and fruit quality of *Physalis alkekengi*.

#### **Material and methods**

In order to investigate the effects of irrigation and animal manure levels on yield and yield components of Chinese lantern (*Physalis alkekengi* L.), a split-plot experiment was conducted based on randomized complete block design with three replications at the research field of the faculty of agriculture, Ferdowsi University of Mashhad, Iran at 2016. The experimental treatments were all combination of irrigation levels (60, 80 and 100 percent of water requirement) and four levels of animal manure (0, 10, 20 and 30 t.ha<sup>-1</sup>). Final seed yield and yield components were measured from 1 m of each plot. Characters consisted of weight of fruit per plant, number of fruit per plant, fruit weight, number of seed per fruit, 1000 seed weight, plant height, alkaloid, biological yield, and fruit yield. Data from the experiment were analyzed statistically using SAS software (Ver. 9.2). Least significant difference (LSD) test were also performed for the comparison of means. The critical difference at P = 0.05 was used to test the difference between means of individual treatments.

\*Correspondent author: Askan Asgari; E-Mail: [a.asgari@Hormozgan.ac.ir](mailto:a.asgari@Hormozgan.ac.ir).

## Result

Our results indicated that, irrigation levels had a significant effect on all studied traits except fruit number and single fruit weight. Also, the impact of animal manure was significant on all characteristics, except 1000 seed weight. The interactions between irrigation and animal manure were significant on fruit yield, biological yield, harvest index, and fruit weight per plant. The highest fruit weight per plant (101 and 102 gr respectively) and fruit yield (8 and 8.2 t.ha<sup>-1</sup> respectively) were observed in 100 percent water requirement with use of 20 and 30 t.ha<sup>-1</sup> animal manure. The highest alkaloid percent was observed in 80 percent water requirement (0.4 percent) and 30 t.ha<sup>-1</sup> animal manure level (0.37 percent).

## Conclusions

Based on the results of this study, irrigation levels and manure levels had a significant effect on measured traits. The best of results was observed in irrigation of 80% and 100% of water requirement. On the other hand, the application of manure, especially 20 and 30 t.ha<sup>-1</sup>, improved the studied traits compared to 0 and 10 ton. According to the results of this research and considering the optimal use of resources, the most suitable method for the planting of this plant was considered by using 80 percent water requirement and 20 t.ha<sup>-1</sup> animal manure.

**Keywords:** Alkaloid, Biological yield, Cow manure, Fruit yield, Harvest index

**Table 1. Characteristics of the soil and manure of experimental**

	Texture	pH	EC	N	P	K
			ds/m <sup>-1</sup>	%	-----mg/kg-----	
Soil	Loamy-Silt	7.8	1.9	0.13	20	220
Manure		6.5	7.1	0.35	310	1600

**Table 2. Analysis of variance for the effect of irrigation levels and manure on studied characteristics of physalis alkekengi**

S.O.V	df	Weight of fruit per plant	Biological yield	Fruit yield	No. of fruit per plant	Fruit weight
Block	2	32.6 <sup>ns</sup>	1.11 <sup>ns</sup>	0.2 <sup>ns</sup>	115.8 <sup>ns</sup>	0.001 <sup>ns</sup>
Irrigation	2	4158.5 <sup>**</sup>	68 <sup>**</sup>	26.6 <sup>**</sup>	5094.6 <sup>**</sup>	0.022 <sup>ns</sup>
Error a	4	24.1	0.33	0.15	89.7	0.003
Manure (M)	3	4442.5 <sup>**</sup>	74.3 <sup>**</sup>	28.4 <sup>**</sup>	3013 <sup>**</sup>	0.114 <sup>**</sup>
I × M	6	178 <sup>*</sup>	3.6 <sup>**</sup>	1.1 <sup>*</sup>	190.2 <sup>ns</sup>	0.002 <sup>ns</sup>
Error b	18	44.9	0.89	0.28	224.7	0.008
CV (%)	-	10.7	9.1	10.6	19.4	11.6

Table 2. Continued

S.O.V	df	No. of seed per fruit	seed-1000 weight	Plant height	Fruit harvest index	Alkaloid
Block	2	100 <sup>ns</sup>	0.007 <sup>ns</sup>	52.7 <sup>ns</sup>	2.1 <sup>ns</sup>	0.0001 <sup>ns</sup>
Irrigation (I)	2	266.5 <sup>ns</sup>	1.95 <sup>**</sup>	1517 <sup>**</sup>	183 <sup>**</sup>	0.0576 <sup>**</sup>
Error a	4	40.6	0.049	38.4	4.1	0.0003
Manure (M)	3	2701.5 <sup>**</sup>	0.055 <sup>ns</sup>	947.9 <sup>**</sup>	180.3 <sup>**</sup>	0.0245 <sup>**</sup>
I × M	6	100 <sup>ns</sup>	0.028 <sup>ns</sup>	54.8 <sup>ns</sup>	15.9 <sup>*</sup>	0.0018 <sup>ns</sup>
Error b	18	100	0.03	68	4.7	0.0015
CV (%)	-	11.8	9.7	16.3	4.6	11.71

ns, \* and \*\*: Non-significant and significant at 5% and 1% probability levels, respectively

Table 3. Mean comparison for the interaction of irrigation levels and manure on studied characteristics of *Physalis alkekengi*

Irrigation levels	Manure	Weight of fruit per plant	Biological yield	Fruit yield	Fruit harvest Index
		gr	t.ha <sup>-1</sup>	t.ha <sup>-1</sup>	%
60	0	25.33 <sup>h</sup>	5.38 <sup>g</sup>	2.02 <sup>h</sup>	37.59 <sup>f</sup>
	10	34.83 <sup>gh</sup>	7.24 <sup>f</sup>	2.78 <sup>hg</sup>	38.53 <sup>ef</sup>
	20	52.5 <sup>ef</sup>	8.9 <sup>de</sup>	4.2 <sup>ef</sup>	47.23 <sup>bc</sup>
	30	54.67 <sup>c</sup>	9.01 <sup>cde</sup>	4.37 <sup>c</sup>	48.53 <sup>bc</sup>
80	0	38.67 <sup>g</sup>	7.45 <sup>ef</sup>	3.09 <sup>g</sup>	41.79 <sup>de</sup>
	10	56 <sup>de</sup>	9.92 <sup>cd</sup>	4.48 <sup>de</sup>	45.15 <sup>cd</sup>
	20	81.17 <sup>c</sup>	13.3 <sup>b</sup>	6.49 <sup>c</sup>	48.71 <sup>bc</sup>
	30	91.17 <sup>bc</sup>	14.3 <sup>b</sup>	7.29 <sup>bc</sup>	50.92 <sup>b</sup>
100	0	43.16 <sup>fg</sup>	7.61 <sup>ef</sup>	3.45 <sup>fg</sup>	45.25 <sup>cd</sup>
	10	66.16 <sup>d</sup>	10.56 <sup>c</sup>	5.29 <sup>d</sup>	50.19 <sup>b</sup>
	20	101 <sup>ab</sup>	14.24 <sup>b</sup>	8.08 <sup>ab</sup>	56.73 <sup>a</sup>
	30	102.67 <sup>a</sup>	16.1 <sup>a</sup>	8.21 <sup>a</sup>	50.93 <sup>b</sup>

Means with the same letters are not significantly different using least significant difference (LSD) test at 5% probability level

Table 4. Mean comparison for the effect of irrigation levels and manure on studied characteristics of *Physalis alkekengi*

Treatment	No. of fruit per plant	Fruit weight	No. of seed per fruit	seed-1000 weight	Plant height	Alkaloid
<b>Irrigation levels (%)</b>		gr		gr	cm	%
60	55.78 <sup>c</sup>	0.74 <sup>a</sup>	82.33 <sup>a</sup>	1.25 <sup>c</sup>	38 <sup>b</sup>	0.34 <sup>b</sup>
80	79.08 <sup>b</sup>	0.83 <sup>a</sup>	81.41 <sup>a</sup>	1.95 <sup>b</sup>	53.58 <sup>a</sup>	0.40 <sup>a</sup>
100	96.83 <sup>a</sup>	0.79 <sup>a</sup>	90 <sup>a</sup>	2.21 <sup>a</sup>	59.83 <sup>a</sup>	0.26 <sup>c</sup>
<b>Manure (t.ha<sup>-1</sup>)</b>						
0	54.66 <sup>c</sup>	0.65 <sup>c</sup>	61.77 <sup>c</sup>	1.81 <sup>a</sup>	37.66 <sup>c</sup>	0.25 <sup>b</sup>
10	70 <sup>b</sup>	0.74 <sup>b</sup>	80.44 <sup>b</sup>	1.69 <sup>a</sup>	46.77 <sup>b</sup>	0.34 <sup>a</sup>
20	92.33 <sup>a</sup>	0.85 <sup>a</sup>	98.44 <sup>a</sup>	1.87 <sup>a</sup>	57.66 <sup>a</sup>	0.36 <sup>a</sup>
30	91.88 <sup>a</sup>	0.9 <sup>a</sup>	97.66 <sup>a</sup>	1.82 <sup>a</sup>	59.77 <sup>a</sup>	0.37 <sup>a</sup>