

Effect of Harvesting Date on Yield and Quality of Lettuce

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ABSTRACT

In reason to investigate the effect of different harvesting date and varieties on yield and quality of lettuce the experiment was conducted at the University of Guilan's Campus Agriculture Faculty with four local cultivars from Romaine (Baboli), Butter head (Mahalli), and Ice berg typ lettuce (Astaneh and Kochesfahan). Plants were harvested 100, 107 and 114 days after transplanting. A randomized complete block design with three replications was used. ANOVA determined that cultivar and harvesting date and their interaction had significant effect on root and leaves fresh and dry weight, total soluble solid and titrable acidity. cultivar and harvesting date also had significant effect of vitamin c and yield but their interaction was not significant. Results indicate that the delaying in harvest when the lettuce reaches to its maximum yield decreases their quality. It seems that 107 days after transplanting when plants reach to their maximum growth is suitable date to harvest them. Delaying to harvest decrease plants quality without any significant increasing in yield.

Key words: Variety, Vit. C, TSS, TA, Dry matter

Introduction

Lettuce is a cool-season crop that grows best on well-drained soils. Most lettuce (*Lactuca sativa* L.) cultivars have a growing season of about three months [6].

Once-over harvesting is essential for efficiency. Therefore, it is important that the crop matures uniformly. Many attempts have been made to predict harvest date for lettuce with a fixed number of day-degrees between transplanting and date of harvest [7,4,10,11]. But there are not any report about harvesting date on yield and quality of lettuce. The delaying in harvest increased production cost and occupation the land for more time without any benefit. In other hands premature harvesting of many vegetable decrease their yield and quality as reviewed by Kader [5]. So the determining suitable harvesting time for each cultivar is very important. Kürklü *et al.*

[5] indicate that after nearly significant time the difference between the plants grown became smaller on both fresh and dry weight. Kallio *et al.* [3] showed that there is a clear decreasing trend in the vitamin C content in berry juice by delaying in harvest. Rousi and Aulin [9] reported a decreasing trend in vitamin C content similarly.

The objective of the present study was to investigate the effects of different harvest date and varieties on yield and quality of lettuce. Our results were expected to be useful for assessing the optimal harvesting date for each tested variety. In fact our research was conducted on selecting suitable harvesting time when both yield and quality are in maximum.

Materials and methods

The experiment was conducted at the University

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of Guilan's Campus Agriculture Faculty in Rasht Iran (altitude 7 m below mean sea level, 37°16'N, 51°32'E) in winter 2011 in cold greenhouse. The soil was a sandy loam, pH 6.4, containing total N (2.2%), total C (1.5%), a C/N ratio of 0.68; there were 4500, 1900, and 4000 mg Ca, P, and K per kg of soil dry matter, respectively, and an electrolytic conductivity (EC) of 0.08 ds·cm⁻¹.

Soil was prepared by plowing and disking. Seeds of popular local cultivars from Romaine lettuce, cv. Baboli, Butter head lettuce, cv. mahalli, Ice berg lettuce cv. Astaneh and cv. Kochesfahan were sown on 20 October 2010 into greenhouse trays containing sand and peat (1:1 v/v). After sowing, seedlings were transferred to potting medium containing peat and cattle manure (1:1 v/v) and irrigated when it was necessary. Seedlings were transplanted on 11 November, with a distance of 0.25 × 0.25 m between rows and plants. Each plot area was 10 m² and contained 40 plants. A randomized complete block design with three replications was used. Treatments were three harvesting time included 100, 107 and 114 days after transplanting. Plants were harvested manually on 19 February, 26 February and 5 March.

For yield estimation all plant were weighted and to determine other factors 3 heads of lettuce of each plot were measured. Roots were removed from plants then plant and root weight were recorded separately. Chopped leaves and root were placed in a forced air drying oven at 75°C for 72 hours for dry matter determination. Ascorbic acid was determined according to the 2,6-dichlorophenolindophenol dye method [8]. Fresh fruit samples (10 g) were extracted by grinding in a mortar and pestle and 3% metaphosphoric acid (v/v) as a protective agent. The extract was made up to a volume of 100 mL and centrifuged at 3,000 g for 15 min at room temperature. Ten-mL were titrated against 2,6-dichlorophenolindophenol dye which had been standardized against standard ascorbic acid. Results were expressed as mg/100 g on a fresh weight (FW) basis. Total soluble solid contents (TSS) were determined by extracting with pressure between fingers and placing one drop of juice from each fruit into a refractometer (Atago HSR-500, Tokyo, Japan). Titrable acidity (TA) was measured by the titrimetric method [1].

Response data were subjected to ANOVA in SAS (ver. 9.1, SAS Institute, Inc., Cary, N.C.). Means were separated using Tukey's test.

Results and discussion

ANOVA determined that cultivar and harvesting date and their interaction had significant effect on most traits (Table 1).

The interaction between variety and harvesting date on root fresh weight indicated that the highest

root fresh weight was obtained in Romaine lettuce cv. Baboli harvested 114 days after transplanting and the lowest value was for Iceberg lettuce cv. Kochesfahan and cv. Astaneh in all harvesting date (table 2). Root dry matter was highest in Romaine lettuce cv. Baboli and Butter head lettuce cv. Mahalli harvested at 26 February. Romaine lettuce cv. Baboli root dry matter was also in highest level when harvested 114 days after transplanting (table 2). The highest root dry matter for all cultivars obtain when harvested 107 days after transplanting while leaf fresh weight increased when leaves more time in land.

The interaction between variety and harvesting date on leave fresh weight indicated that the highest leave fresh weight was obtained in Iceberg lettuce cv. Astaneh and butter head lettuce cv. Mahalli harvested 114 days after transplanting while the highest leave fresh weight in iceberg lettuce cv. Kochesfahan was obtained when harvested 107 days after transplanting (table 2). Romaine lettuce cv. Baboli leave fresh weight doesn't change in different harvesting date. Cultivars leave dry matter doesn't show any significant differences when harvested 100 days after transplanting. 107 and 114 days after transplanting romaine lettuce cv. Baboli leaves dry matter had significant differences with other one and had the lowest value while other cultivars leaves dry matter was similar (table 2).

The interaction between variety and harvesting date on total soluble solid indicated that the highest total soluble solid was obtained in Iceberg lettuce cv. Kochesfahan and Romaine lettuce cv. Baboli harvested 100 days after transplanting. By delaying in harvesting time the total soluble solid decreased in all cultivars (table 2).

The interaction between variety and harvesting date on titrable acidity indicated that the highest titrable acidity was obtained in Iceberg lettuce cv. Kochesfahan harvested 107 and 114 days after transplanting while 100 days after transplanting the titrable acidity in Romaine lettuce cv. Baboli was at highest level.

The interaction between variety and harvesting date on vitamin c and yield was not significant so we are able to select suitable harvesting date for all cultivars. In this reason mean separation indicated that the vitamin c decreased 114 days after transplanting (figure 1). The romaine lettuce cv. Baboli had the highest vitamin c and butter head lettuce cv. Mahalli had the lowest vitamin c (figure 2). 100 days after transplanting the yield was at the lowest level but their increasing after 114 days after transplanting was not different from 107 days after transplanting (figure 3) so 107 days after transplanting is suitable date for lettuce genotype harvesting due to highest yield. Iceberg lettuce cv. Kochesfahan was different from butter head lettuce

Table 1: ANOVA table effects of treatments on measured characteristics.

S.O.V	DF	Means of square				
		Vit. C	TA	TSS	Leaves dry weight	Leaves fresh weight
Harvesting time (HT)	2	71.97**	0.02**	8.73**	0.022ns	25.24**
Variety (V)	3	285.72**	0.01**	1.48**	0.34**	103.85**
HT*V	6	5.46ns	0.043**	0.67**	0.076*	26.07**
error	24	3.84	0	0.032	0.024	3.41
CV (%)		10.45	11.51	15.75	12.4	9.74

Table 1: Continue.

S.O.V	DF	Means of square		
		Root Dry weight	Root Fresh weight	Yield
Harvesting time (HT)	2	158.22**	1361.7**	243.04**
Variety (V)	3	366.36**	5848.1**	213.78**
HT*V	6	26.01*	390.36**	10.43ns
error	24	6.27	57.14	26.48
CV (%)		14.41	9.22	15.54

Table 2: Influence of different harvesting time and cultivar interaction on measured characteristics.

Harvesting date	variety	Means of square					
		Root Fresh weight (g)	Root Dry weight (g)	Leaves fresh weight (g)	Leaves dry weight (g)	TSS (%)	TA (%)
19 February	Ice berg lettuce cv. Astaneh	16 f	2.02 e	12.8 abc	0.85 ab	1.5 b	0.19 bcd
	Ice berg lettuce cv. Kochehfahan	12.42 f	1.85 e	9.46 bcd	0.72 ab	2.3 a	0.17 cd
	Romain lettuce cv. Baboli	45.8 cd	8.93 bc	5.34 d	0.44 bc	2.4 a	0.44 a
	Butter head lettuce cv. Mahalli	37.26 cde	6.74 cd	6.01 d	0.44 bc	0.5 cd	0.21 bc
26 February	Ice berg lettuce cv. Astaneh	26.3 def	6.51 cd	12.98 abc	0.9 a	0.26 de	0.25 b
	Ice berg lettuce cv. Kochehfahan	17.21 f	3.85 cde	11.78 abc	0.83 ab	0.86 bc	0.39 a
	Romain lettuce cv. Baboli	70.93 ab	23.63 a	5.34 d	0.28 c	0.066 fg	0.13 d
	Butter head lettuce cv. Mahalli	45.45 cd	14.13 ab	6.1 d	0.43 bc	0.13 ef	0.13 d
5 March	Ice berg lettuce cv. Astaneh	18.31 f	1.99 e	15.91 a	0.57 abc	0 g	0.13 d
	Ice berg lettuce cv. Kochehfahan	22.22 ef	2.81 de	8.83 cd	0.56 abc	0.36 de	0.26 b
	Romain lettuce cv. Baboli	98.1 a	17.14 a	5.25 d	0.29 c	0 g	0.12 d
	Butter head lettuce cv. Mahalli	57.79 bc	7.4 bcd	15.33 ab	0.72 ab	0 g	0.17 cd

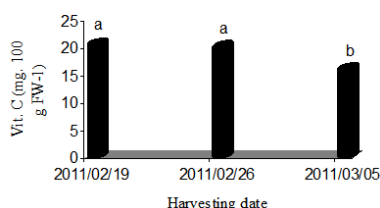


Fig. 1: Effect of harvesting time on Vit. C in lettuce leaves.

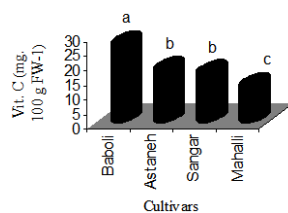


Fig. 2: Effect of cultivars on Vit. C in lettuce leaves.

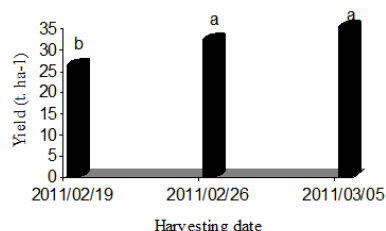


Fig. 3: Effect of harvesting time on lettuce yield.

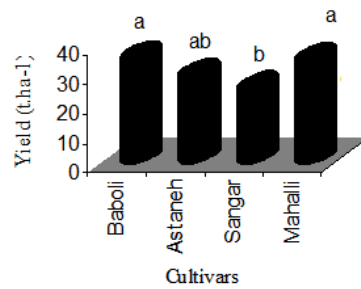


Fig. 4: Effect of cultivars on lettuce yield.

cv. Mahalli and romaine lettuce cv. Baboli but two ice berg lettuce cultivars (Astaneh and Kochesfahan) don't show any significant differences. Kallio *et al.* [3] and Rousi and Aulin [9] had a similar reports in decreasing in the vitamin C content in berry juice by delaying in harvest.

The delaying in harvest when the lettuce reaches to its maximum yield decreases their quality as mentioned previously by Kader [2] for different vegetables. It seems that 107 days after transplanting when plants reach to their maximum growth is suitable time to harvest them. Delaying to harvest decrease plants quality without any significant increasing in yield. Kürklü *et al.* [5] indicate that after nearly significant time the difference between the plants grown became smaller on both fresh and dry weight.

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