Study of Economic-Ecological Results of Cold Resistance Sort of the Lentil World Collection under Highlands of Islamic Republic of Iran

Seyed Saeid Hojjat
Ferdowsi University Of Mashhad
sdhojjati@yahoo.com

Abstract

The purpose of this research was to determine the impact Planting winter morphological, phenological, agronomic and physiological parameters taken from the local and the global collection accessions of lentil (Lens culinaris Medikus) to identify and sample the recommended cold-resistant varieties for cultivation in cold regions of Iran mountainous conditions and the definition of phenophases, where its impact is more pronounced, affecting crop yields. Thirty lentil genotypes accessions of Mashhad Lentil Collection (MLC) were evaluated at Chenaran, Iran with three planting dates [Oct., Nov. (fall) and Mar. (spring) during 2009-011 growing seasons]. For all experimental year as a control has been chosen local (Iranian) cultivar «Ziba». According to the fall plantings data, the length of growth duration of samples in fall plantings were 2.3 times higher than spring planting, and also in the first planting that was 5, 25 and 255 percent more than 2nd and 3rd planting dates, respectively. The height of fall plants were more than spring plants and in the first year fall planting genotypes were about 38% taller than the same planting. The number of pod per plant in fall planting was 2 times higher than spring planting. More than 22% of accessions had 125 pods per plant in 1st and 2nd planting in this years. In the 2009-11 growing seasons the yield of lentil genotypes in fall planting were more than 4 and about 2 times of spring planting, respectively. It seems that the improvement of seed yield in the fall planting were due to suitable winter survival of plants fallowed by better usage of rainfall and escaping from drought and heat stress of the end of spring. Results showed that there were some cold tolerant accessions in MLC and it is possible to provide cold tolerant cultivars for fall planting in Chenaran conditions.

Keywords: Lentil, Lentil Adaptations**,** winter survival, Highland, Chenaran,

Introduction

Lentil (*Lens culinaris* Medikus) is the oldest pulse crop with remains found alongside human habitation up to 13,000 years BC. The history of lentil is as old as Agriculture (Helbaek 1963). It is an important source of protein, carbohydrate and minerals. Its capability to fix atmospheric N has long been recognized. The lentil is 28 percent protein second only to soybeans as a source of usable protein. Lentil is an excellent source of vitamin A and provides fiber, potassium, B vitamins, and iron. The average yield of lentil in South Asia (699 kg/ha) is 24% lower than the world average (1053 kg/ha) (FAO, 2007). The reasons for low yield are occurrence of various biotic, abiotic and edaphic factors at different growth stages (Ali *et al*., 2000; Haqqani *et al*., 2000; Matiur Rahman *et al*., 2000; Pandey *et al*., 2000). Iran is mountainous; more than half of the country is at altitudes between 1,000 – 2,000 metres and 16% is above 2,000 metres. Topography generally affects climate and soils and plays a considerable role in the differentiation and distribution of climates and vegetation zones. Lentil is an important grain legume in Iran. Iran grows lentil on about 220,000 ha, but with a very low productivity of 502 kg/ha (FAO, 2008). This scenario can be attributed to the cultivation of low-yielding spring type landraces, poor agronomy, and lack of quality seed. This study aimed was conducted to evaluate the Lentil genotypes for Adaptations to Highland Winter-Sown Environments in northeastern Iran.

Material and Methods

In order to evaluation of cold tolerance of lentil germplasm an experiment was conducted with 30 accessions of Mashhad Lentil Collection (MLC) at the Experimental Field of Chenaran (36° 39' 5" N / 59° 7' 29" E) in, Razavi Khorasan Province in north eastern Iran, with three planting dates [Oct., Nov. (fall) and Mar. (spring) during 2009-011 growing seasons]. The trials were conducted in randomized complete block designs with three replications. The accessions were sown manually in 2-row plots 2m long with an average of 50 to 60 plants in each row and with 30 cm inter-row spacing.In 2009, the lowest temperature was in February of -10 ° C, in December 2010 - 7,2 ° C, in January 2011 - 13 ° C. The soil test area is well endowed with potassium, but poor in nitrogen and phosphate. Since lentils responsive to nitrogen and phosphorus fertilizers, the week before sowing were introduced nitrogen (urea) and phosphorus (triple super phosphate) fertilizer dose N30P50. Winter hardiness was measured, emerged plants were counted in each plot before the onset of severe winter cold (November); then the number of survived plants were counted after winter. The frost resistance determined from the following scale Singh et al (Singh et al., 1989).1 = 100% survival (highly tolerant); 2 = 67-99% (tolerant); 3=34-66 % (medium tolerant); 4=1-33% (susceptible); 5 = 0% (highly susceptible). Following characters were measured during growth, as described by Erskine & Witcombe (1984): time to 50% flowering (days),

time to 90% pod maturity (days), plant height (cm). At maturity, five plants were selected at random from each accession and measurements made of plant height, plant canopy width, height of the lowest pod, length of the internodes, number of branches, biological, weight of pods per plant, number of pods and seed per plant and grain yield per plant. The data were statistically analyzed by using 'MSTATC' (Michigan State University, East Lansing, MI) computer package. Pearson's correlation coefficients were calculated to determine the relationships between yield and yield components.

Results

Screening Lentil For Cold Hardiness at High Altitude Chenaran: These frost studied accessions are given in Table 2. It should be noted that the minimum temperature in the winter in 2009-11. respectively in November was -3; -0,2; -7 º C, December - 5; -7,2; -9 º C, January - 7; -5; -13 º C in February - 10, -5; -10 º C. As we see, in Chenarana observed very cold with average monthly minimum temperature from December to March, below zero. In the early stage of vegetative growth in December and to the flowering phenophase in April 2009 was 35, in 2010 - 38 and 2011 - 43 frosty day with the presence of snow cover. All plants are susceptible to frost killed. These tables show that in the first year of the study (2009) of 30 selected accessions of 100% of plants have survived the winter, only 10% (MLC-16, MLC-75 and MLC-83), 7 to 28 pcs. dead plants - 53.3% and from 31 to 40 units. In Chenaran (2009-2011) dead plants 36.7% accessions. In the second year of research (2010) of 24 selected for hardiness and yield of lentil accessions of 100% of plants have survived the winter, only 12.5% (MLC-16, MLC-69 and MLC-83), 4 to 25 pieces. dead plants - 54.2% and from 32 to 37 pcs. dead plants - 33.3% accessions. In the third year of study (2011) of 7 selected for hardiness and yield of accessions 100% of plants have survived the winter, only 42.9% (MLC-16, MLC-69 and MLC-83) from 3 to 12 units. dead plants - 57.1% accessions. In the third year of studies was relatively cold winter, so 100% of the surviving plants were observed in only 3 accessions. Results of the evaluation study frost accessions in 2009 showed that of the selected accessions of lentil compared to cultivated variety «Ziba» (control - 27-32 dead plants) have a higher cold resistance 15 accessions (7-25 dead plants) in 2010 . - 13 (4-25 dead plants), and in 2011 - all 7 accessions (3-12 dead plants) (Table 1). In 2009, the largest number of deaths from frost was observed in accessions MLC-31 - 40 plants in 2010 - the accessions MLC-12 and MLC-35 - 37 dead plants and in 2011 - the MLC-15 - 12 plants. For 2009-2011. All seven selected accessions had better scores than the control (63 pcs., or 68.5% of the surviving plants). Variety sample MLC-15 compared to the control was at 18 units., Or 37.9% more than the surviving plants; MLC-17 - 15 plants, or 51.7%; MLC-44 - 23 plants, or 79.3%; MLC -47 - 19 plants, or 65.5%, and MLC-69 - 17 plants, or

by 58.6%, while the accessions MLC-16 and MLC-83 had no dead plants. Thus, over the years of research the best frost differs chilis accessions MLC-16 and MLC-83, in which the dead plants were noted. High frost resistance of selected accessions resulting in higher carbohydrate content in leaves and other plant tissues as a result of sudden changes in temperature - 8-15 ° C during the day and at night - 0 ° C. Carbohydrates accumulated during the day plants are not able to fully use the form of green mass and respiration, in this regard, especially because of the low temperatures at night plant growth slows.

Morphological parameters : Lentils - annual herb, weakly or strongly pubescent plant from 15 to 75 cm in height. Lentil has an extensive root system, evenly and densely penetrating the upper layers of the soil, and deep penetration (up to 1 m) taproot. Height of plants under the influence of the external environment in the same species provides significant variations depending on the temperature, precipitation and soil. Variability in plant height ranges from 15 to 75 cm high is considered to be 50-75 cm, 30-50 cm and intermediate stunted (dwarf) 15-30 cm higher growth (50-70 cm) has a large seed lentil, and lower growth (up to 50 cm) - pea lentils. The number of branches in various forms of lentils varies from 3 to 15. In humid climates, the highest branching. Morphological parameters of the studied accessions we examined to ascertain whether they are suitable for mechanical harvesting, as Chenarane seeded lentils in large areas. Therefore, the selection of cold-resistant accessions of lentil plants with a height not less than 25-30 cm facilitates mechanical harvesting from large areas. Pergovanni (Piergiovanni, 2000) in his research notes that the height of the plants should be from 28 to 41 cm Chauhan and Singh (Chauhan and Singh, 1998), Bieger and Sakar (Bicer and Şakar, 2004) note that the difference in plant height is due to climatic conditions and genetic factors accessions. However, plant height is inherited moderate and weak, and environmental conditions have a huge impact on plant height. The results of studies on selected morphological parameters of frost-resistant lentil accessions are given in Table 2. According to the table, plants sown in autumn 2009 has a height from 25.4 to 45.4 cm Maximum height distinguished accessions MLC-83 and MLC-93 - 45.2 and 45.4 cm, minimum - MLC-71 - 25.4 cm Plants sown in the autumn, were higher than those planted in the spring, which is due to the presence of moisture in the soil and lengthening the period of absorption of nutrients from the soil by plants. In 2010, selected for their hardiness and 24 in 2011 - seven accessions of lentil sown in the autumn, had a greater height than the accessions of spring planting. In 2009, selected accessions autumn sowing matches the requirements of mechanical harvesting in 2010, Accessions MLC-13 and MLC-18 showed slightly lower height - 24.4 cm and were culled from other accessions Rejected by frost. In 2011, all 7 of the most cold-resistant accessions were high enough for mechanical harvesting. According

to average data, the most frost accessions MLC-16 and MLC-83 exceed the height of the autumn sowing similar accessions of spring planting at 6.7 and 17.5 cm or 27.8 and 61.6%, respectively. Lentil plants at spring sowing from low herbage (21-25 cm), which makes mechanical harvesting and results in loss of most of the crops, as almost becomes impossible to mow in rolls for further collection and thrashing two-phase method of harvesting. When harvesting a crop-phase method at low herbage lost most of the crop. To average data, the height selected by frost seven accessions ranged from 30.8-45.9 cm, which is higher than the control «Ziba» at 0.6-15.7 cm, except accessions MLC-69, which gives the control to 2.8 cm, but compared to it has a high tillering and provides a high seed yield. According to the results of three years of research the maximum number of branches had accessions MLC-47 - 2.3 pc., Minimum - the MLC-17 - 1.6 pc. All of the selected accessions by frost in the number of branches exceeded the control at 0.3-1.0 pc., Or 23.1 and 76.9%. Length (height) of the plants is not a decisive factor in increasing grain yield, but the sign of a leguminous plant associated with the location of beans on stem height and they're laying varies according to cultivated varieties, farming techniques and the evolving weather during the growing season. Found that if the budding precedes wet period, it formed a tall plant with a high sill most productive fruit. In a relatively thickened crops had higher inception beans. All investigated accessions autumn sowing in the number of branches exceeded accessions of spring planting, which indicates that the autumn sowing lentils promotes better plant growth and development in the highland areas Chenarana.

Phenological indicators: The cultivation of all cultures need to know its biological ingularity. Growing period lentils depends on the weather. Seedling emergence varies according to different conditions from 8-12 days. Period from germination to flowering beginning ranges from 29 to 51 days, which is flowering in some forms of lentils comes on 3 weeks later than the earlier. Full growing season varies even more - from 70 to 105 days. The growing season for small seeds lentils is more precocious than large seeds symbol. Since lentils grown in the highland areas with a cold climate, then we are very interested in how it runs the vegetation in the autumn and spring sowing and planting dates as reflected in its yield. Amicable shoot is an indicator of the adaptation culture, depending on seeding rate, their germination, moisture topsoil, seedbed preparation and seed, and many other factors. In all the years of research in the laboratory and in the field was determined by germination of lentils, which in 2009-11. In the field, on the germination of seeds has significant influence moisture in the soil, especially in the 0-10 cm layer. In years with a mean air temperature of 14-15 º C simultaneous sprouts with lentils appeared on the 10-12th day after sowing, at lower temperatures (8-9 º C), seed germination and seedling

formation was delayed. They note that in the autumn sowing lentils is not always assured of amicable shoots and high safety of plants at the end of the growing season. The results of our observations are listed in Table 5 show that in 2009 during seed germination of selected accessions by frost in autumn sowing lasted 10-15 days, in 2010 - 10-15 in 2011 - 10-12 days when the spring sowing it lasted, respectively, 6.9, 9.7, 9.7 days, ie fall. Germination period lengthened to 4-6, 3-6; 3 days. This lengthening of the period of seed germination in the autumn sowing due climatic conditions - less atmospheric precipitation (fall - 3-12 mm, spring - 30-34 mm), because the temperature conditions were almost identical, and the gradual shortening of the daylight hours. The lentils typical diurnal rhythm of blossoming, flowering intensity also depends on the number of sunny days. The plants bloom autumn sowing begins in mid-April and May, and at spring planting - in the middle of May and June, that is, month in advance. Flowering period in the studied accessions autumn sowing in 2009 lasted for 162-185 days when the spring - 60-67 days, in 2010, respectively, 162-189 and 64-71 days in 2011 - 169-192 and 65 - for 69 days. Lengthening the period of flowering in autumn sowing accessions in 2011 to 7 days due to relatively high temperatures and the presence of precipitation. In 2009, 2010 and 2011. The maximum number of days from germination to 50% flowering accessions scored MLC-83 - 185, 189 and 192 days. Since the month of April the weather is warm, the average temperature of 17-18 º C, the soil moisture is sufficient, and in May the average temperature rises to 21-24 º C, the same amount of precipitation decreases (15-20 mm), the phenophase of flowering plants in the fall lentils planting takes place in more favorable conditions. Full maturation of lentils in the autumn sowing begins in May, when the spring sowing - in late June and early July - during the onset of hot weather - 29-30 º C with a minimum amount of precipitation (1.5-8 mm). As a result, the yield of autumn sowing lentils higher yield of the spring sowing. Of the studied accessions of lentil in 2009 the long period of germination and 90% maturation distinguished accessions MLC-16; MLC-83 and MLC-86 - 209, 208 and 208 days, respectively, in 2010-11. - MLC-16 and MLC-83 - for 209 and 208 days (table 3). It should be noted Chenarane in early spring and early summer is often a sharp rise in temperature, resulting in rapid drying of the top layer of soil, so plants autumn sowing, growing season ends his one month earlier, provided the available soil moisture from melting snow and provide a pretty decent compared to plants spring planting, seed yield. Compared with the control variety «Ziba» in 2009 with autumn sowing selected for hardiness and yield of lentil accessions are faster flowering stage - for 1-13 days, except accessions MLC-83, which ends its bloom 10 days later, and phase and 90% of maturing pods - for 1-19 days, in 2010, respectively, on days 1-21, except accessions MLC-83, which ends its flowering period of 15 days

and 3-22 days later, and in 2011 - for 3-10 days, except accessions MLC-83, which ends its flowering period by 13 days and 1-14 days later. Compared to other accessions MLC-16 and MLC-83 had a longer growing season, resulting in and provided by comparison, to obtain high yields. Thus, the length of the growing season lentils to a large extent depends on the temperature, rainfall, relative humidity and moisture in the soil. The higher the average temperature, the shorter the phenophases of plant growth and development, and as a result of the growing season. So, in a relatively high average daily temperatures longest period of vegetation distinguished accessions MLC-16 and MLC-83.

Effect of different sowing dates on yield and yield components of lentil genotypes: The structural elements of the crop selected for hardiness accessions of lentil To determine the effectiveness of the studied accessions growing at high altitudes is necessary to study their productivity and structural elements of the crop. To determine the seed crop accessions studied in the laboratory we have determined the number of pods and seeds per plant and weight of 100 seeds, results are presented in Table 6. The results show that the tested accessions lentils differ in the structural elements of the crop as a result, they differ in the level of productivity (Annex - if you have pictures with the accessions of seeds). Provides a data lentil yield by years of research, according to which the optimal harvest provided frost-resistant sample MLC-16 - 24.3 kg / ha and greater control of 16.3 t / ha, or 203.8% (table 8, 10). The remaining 6 selected for hardiness accessions yield increase was 14,0-16,0 kg / ha, or 175-200%, with a high yield of them showed Variety sample MLC-44 - 16 kg / ha. Thus, the average data 3-year study yield in 7 selected accessions was 22,0-24,3 c / ha in the control accessions - 8.0 t / ha, they surpassed control. They yield increase was 14,0-16,3 kg / ha, or 175 and 203.8%. According to a three-year field research, as well as a result of work experience found that seven selected frost-resistant accessions of lentil will provide the high-yield than local varieties cultivated in the area and, therefore, recommended to us cultivation in highland areas Chenarana.

CONCLUSIONS

Counting the lentil plant density before harvesting showed that early sowing (October), contribute to a better survival of plants (68,5-69,5%). The lowest survival rate of plants to harvest in November marked the date of sowing. The longest duration of the growing season for plants lentils years of research was noted when sown in late October decade and averaged 189 days. Sowing in later periods (spring planting) leads to a reduction in the growing season for 110 - 120 days. The length of the growing season to a large extent influenced by weather conditions: air temperature increase and

decrease in precipitation leads to a reduction in the length of the growing season. Observations of the growth processes lentils showed that most were tall plant varieties, planting winter (43.9 cm), the most undersized, spring planting (38.8 cm). When sowing lentils during the third week in March is a decrease in plant height at 5 - 6 cm with a height of plants closely related to the height of the attachment of the lower rate of bean, the value of which varies from 14.1 to 21 cm depending on the sowing date and weather conditions. Found that the major structural elements of the crop for the studied varieties of lentils are a number of pods per plant, number of seeds per plant and weight of 100 seeds. Weight of 100 seeds - the most stable element of yield structure. When planting winter peas yield variability can exceed 40%. Found that the optimal time of sowing of peas is the second decade of October. For based on the results obtained during the 3-year study, we recommend: Iran's offer to farmers of all studied varieties of lentils in a mountainous area, and planting winter regions of Iran cultivate imported accessions "MLC16", thanks to a good crop which will be possible to reduce the protein needs of a growing population of Iran. Recommended for cultivation in the highlands region Chenaran lentils MLC16 designs with complex agronomic traits (stable from year to year yield and resistance to winter). The optimum period for planting lentils in Chenaran mountainous area in mid October. Continue research on the physiological nature of frost and cold plants, the biochemical processes occurring in them in low temperature and direction of change in the nature of the plants - increasing resistance to cold.

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Table 1. Assessment of frost studied accessions lentil

Genotypes		2009 г.					2010 г.				
		Number of plants		Dead plants		Scale	Number of plants		Dead plants		Scale
		autumn	spring	No. of	%		autumn	spring	No. of	%	
«Ziba» - control		92	60	32	34.8	3	92	65	27	29.3	2
1.	**MLC-12**	95	82	13	13.7	2	97	60	37	38.1	3
2.	**MLC-13**	92	67	25	27.2	2	95	60	35	36.8	3
3.	**MLC-15**	93	85	8	8.6	2	94	80	14	14.9	2
4.	**MLC-16**	96	96	-	-	1	96	96	-	-	1
5.	**MLC-17**	96	80	16	16.7	2	93	76	17	18.3	2
6.	**MLC-18**	90	62	28	31.1	2	95	70	25	26.3	2
7.	**MLC-19**	90	75	15	16.7	2	90	77	13	14.4	2
8.	**MLC-23**	92	60	32	34.8	3	94	60	34	36.2	3
9.	**MLC-31**	95	55	40	42.1	3	96	63	33	34.4	3
10.	**MLC-35**	90	58	32	35.6	3	97	60	37	38.1	3
11.	**MLC-44**	98	88	10	10.2	2	95	90	5	5.3	2
12.	**MLC-45**	96	63	33	34.4	3	96	60	36	37.5	3
13.	**MLC-47**	95	82	13	13.7	2	95	88	7	7.4	2
14.	**MLC-48**	99	88	11	11.1	2	98	88	10	10.2	2
15.	**MLC-50**	96	62	34	35.4	3	-	-	-	-	-
16.	**MLC-51**	94	85	9	9.6	2	92	85	7	7.6	2
17.	**MLC-63**	95	62	33	34.7	3	95	80	25	26.3	2
18.	**MLC-68**	96	62	34	35.4	3	-	-	-	-	-
19.	**MLC-69**	95	70	25	26.3	2	93	93	-	-	1
20.	**MLC-71**	93	83	10	10.8	2	91	81	10	10.9	2
21.	**MLC-75**	98	98	-	-	1	95	85	10	10.5	2
22.	**MLC-80**	97	89	8	8.2	2	94	61	33	35.1	3
23.	**MLC-81**	95	83	12	12.6	2	95	76	19	20.0	2
24.	**MLC-83**	98	98	-	-	1	97	97	-	-	1
25.	**MLC-86**	90	59	31	34.4	3	-	-	-	-	-
26.	**MLC-88**	95	62	33	34.7	3	-	-	-	-	-
27.	**MLC-92**	96	62	34	35.4	3	-	-	-	-	-
28.	**MLC-93**	99	92	7	7.1	2	96	92	4	4.2	2
29.	**MLC-97**	94	78	16	17.0	2	95	63	32	33.7	3
30.	**MLC-99**	97	63	34	35.1	3	-	-	-	-	-

Table 1 continue

Genotypes		2009 г.					2010 г.				
		Number of plants		Dead plants		Scale	Number of plants		Dead plants		Scale
		autumn	spring	No. of	%		autumn	spring	No. of	%	
«Ziba» - control		92	65	27	29.3	2	92	63	29	31.5	2
1.	**MLC-12**	-	-	-	-	-	-	-	-	-	-
2.	**MLC-13**	-	-	-	-	-	-	-	-	-	-
3.	**MLC-15**	92	80	12	13.0	2	93	82	11	11.8	2
4.	**MLC-16**	95	95	-	-	1	96	96	-	-	1
5.	**MLC-17**	93	85	8	8.6	2	94	80	14	14.9	2
6.	**MLC-18**	-	-	-	-	-	-	-	-	-	-
7.	**MLC-19**	-	-	-	-	-	-	-	-	-	-
8.	**MLC-23**	-	-	-	-	-	-	-	-	-	-
9.	**MLC-31**	-	-	-	-	-	-	-	-	-	-
10.	**MLC-35**	-	-	-	-	-	-	-	-	-	-
11.	**MLC-44**	93	90	3	3.2	2	95	89	6	6.3	2
12.	**MLC-45**	-	-	-	-	-	-	-	-	-	-
13.	**MLC-47**	95	86	9	9.5	2	95	85	10	10.5	2
14.	**MLC-48**	-	-	-	-	-	-	-	-	-	-
15.	**MLC-50**	-	-	-	-	-	-	-	-	-	-
16.	**MLC-51**	-	-	-	-	-	-	-	-	-	-
17.	**MLC-63**	-	-	-	-	-	-	-	-	-	-
18.	**MLC-68**	-	-	-	-	-	-	-	-	-	-
19.	**MLC-69**	93	93	-	-	1	94	82	12	12.8	2
20.	**MLC-71**	-	-	-	-	-	-	-	-	-	-
21.	**MLC-75**	-	-	-	-	-	-	-	-	-	-
22.	**MLC-80**	-	-	-	-	-	-	-	-	-	-
23.	**MLC-81**	-	-	-	-	-	-	-	-	-	-
24.	**MLC-83**	97	97	-	-	1	97	97	-	-	1
25.	**MLC-86**	-	-	-	-	-	-	-	-	-	-
26.	**MLC-88**	-	-	-	-	-	-	-	-	-	-
27.	**MLC-92**	-	-	-	-	-	-	-	-	-	-
28.	**MLC-93**	-	-	-	-	-	-	-	-	-	-
29.	**MLC-97**	-	-	-	-	-	-	-	-	-	-
30.	**MLC-99**	-	-	-	-	-	-	-	-	-	-

Table 2. Effect of different sowing dates on morphological parameters of lentil genotypes

Genotypes		2009 г.				2010 г.			
		Plant height, см		Number of branches.		Plant height, см		Number of branches.	
		Autumn	Spring	Autumn	Spring	Autumn	Spring	Autumn	Spring
1		2	3	4	5	6	7	8	9
«Ziba» - control		30.8	20.2	1.2	1.0	27.2	20	1.4	1.3
1.	**MLC-12**	35.4	24.3	1.5	1.0	29.3	24	1.4	1.1
2.	**MLC-13**	32.3	30.2	2.4	1.5	24.4	22	1.5	1.5
3.	**MLC-15**	33.4	30.4	2.8	1.1	32.3	27	1.9	1.6
4.	**MLC-16**	30.3	22.6	1.6	1.5	29.5	27	2.3	1.2
5.	**MLC-17**	31.5	23.5	1.3	1.2	35.3	26	2.2	1.9
6.	**MLC-18**	32.2	23.4	1.3	1.0	24.4	22	1.8	1.6
7.	**MLC-19**	39.3	20.4	3.1	1.7	25.5	25	1.4	1.4
8.	**MLC-23**	33.2	23.3	1.2	1.0	30.6	25	1.8	1.4
9.	**MLC-31**	35.4	25.4	2.5	2.4	32.4	26	2.4	1.5
10.	**MLC-35**	42.5	21.6	2.3	2.1	28.3	24	2.8	2.7
11.	**MLC-44**	44.4	25.4	2.2	2.1	40.4	30	2.1	1.3
12.	**MLC-45**	34.5	24.5	2.2	1.0	28.5	24	1.8	1.4
13.	**MLC-47**	33.6	26.4	2.9	2.0	29.6	23	1.8	1.6
14.	**MLC-48**	35.5	27.6	1.3	1.3	30.4	25	1.4	1.2
15.	**MLC-50**	35.4	21.4	1.6	1.5	-	-	-	-
16.	**MLC-51**	27.2	24.5	1.6	1.3	29.5	22	2.3	1.3
17.	**MLC-63**	28.3	24.4	1.4	1.2	31.4	27	1.5	1.3
18.	**MLC-68**	34.2	32.5	2.3	2.0	-	-	-	-
19.	**MLC-69**	26.6	21.2	1.5	1.4	27.2	22.2	2.4	2.2
20.	**MLC-71**	25.4	23.6	2.5	1.4	33.3	23.3	2.4	1.3
21.	**MLC-75**	28.5	24.5	1.4	1.3	28.4	22.4	1.4	1.1
22.	**MLC-80**	33.4	23.4	1.3	1.2	34.5	27.5	1.3	1.2
23.	**MLC-81**	32.6	22.6	2.2	1.1	32.3	25.6	2.2	2.1
24.	**MLC-83**	45.2	29.2	2.2	2.0	38.6	24.4	1.9	1.4
25.	**MLC-86**	34.5	30.4	1.4	1.2	-	-	-	-
26.	**MLC-88**	26.4	24.3	1.3	1.1	-	-	-	-
27.	**MLC-92**	29.3	22.2	1.2	1.1	-	-	-	-
28.	**MLC-93**	45.4	34.4	1.5	1.2	36.4	25.6	2.0	1.3
29.	**MLC-97**	30.6	22.5	2.1	1.9	35.5	22.4	2.8	2.1
30.	**MLC-99**	32.5	26.6	1.3	1.0	-	-	-	-
Average		33.6	25.2	1.85	1.43	31.2	24.7	1.95	1.53
σ		5.35	3.51	0.57	0.41	4.16	2.11	0.45	0.4
Cv (%)		15.9	13.9	31	28.5	13.4	8.54	22.9	26

Table 2 continue

Genotypes		2011 г.				2009-2011 гг.			
		Plant height, см		Number of branches.		Plant height, см		Number of branches.	
		Autumn	Spring	Autumn	Spring	Autumn	Spring	Autumn	Spring
1		10	11	10	11	10	11	10	11
«Ziba» - control		32.6	28.2	32.6	28.2	32.6	28.2	32.6	28.2
1.	**MLC-12**	-	-	-	-	-	-	-	-
2.	**MLC-13**	-	-	-	-	-	-	-	-
3.	**MLC-15**	35.4	30.4	35.4	30.4	35.4	30.4	35.4	30.4
4.	**MLC-16**	32.6	22.3	32.6	22.3	32.6	22.3	32.6	22.3
5.	**MLC-17**	34.4	26.4	34.4	26.4	34.4	26.4	34.4	26.4
6.	**MLC-18**	-	-	-	-	-	-	-	-
7.	**MLC-19**	-	-	-	-	-	-	-	-
8.	**MLC-23**	-	-	-	-	-	-	-	-
9.	**MLC-31**	-	-	-	-	-	-	-	-
10.	**MLC-35**	-	-	-	-	-	-	-	-
11.	**MLC-44**	37.2	27.5	37.2	27.5	37.2	27.5	37.2	27.5
12.	**MLC-45**	-	-	-	-	-	-	-	-
13.	**MLC-47**	40.5	30.6	40.5	30.6	40.5	30.6	40.5	30.6
14.	**MLC-48**	-	-	-	-	-	-	-	-
15.	**MLC-50**	-	-	-	-	-	-	-	-
16.	**MLC-51**	-	-	-	-	-	-	-	-
17.	**MLC-63**	-	-	-	-	-	-	-	-
18.	**MLC-68**	-	-	-	-	-	-	-	-
19.	**MLC-69**	28.4	23.2	28.4	23.2	28.4	23.2	28.4	23.2
20.	**MLC-71**	-	-	-	-	-	-	-	-
21.	**MLC-75**	-	-	-	-	-	-	-	-
22.	**MLC-80**	-	-	-	-	-	-	-	-
23.	**MLC-81**	-	-	-	-	-	-	-	-
24.	**MLC-83**	53.8	31.6	53.8	31.6	53.8	31.6	53.8	31.6
25.	**MLC-86**	-	-	-	-	-	-	-	-
26.	**MLC-88**	-	-	-	-	-	-	-	-
27.	**MLC-92**	-	-	-	-	-	-	-	-
28.	**MLC-93**	-	-	-	-	-	-	-	-
29.	**MLC-97**	-	-	-	-	-	-	-	-
30.	**MLC-99**	-	-	-	-	-	-	-	-
Average		37.5	27.4	37.5	27.4	37.5	27.4	37.5	27.4
σ		8.12	3.69	8.12	3.69	8.12	3.69	8.12	3.69
Cv (%)		21.7	13.4	21.7	13.4	21.7	13.4	21.7	13.4

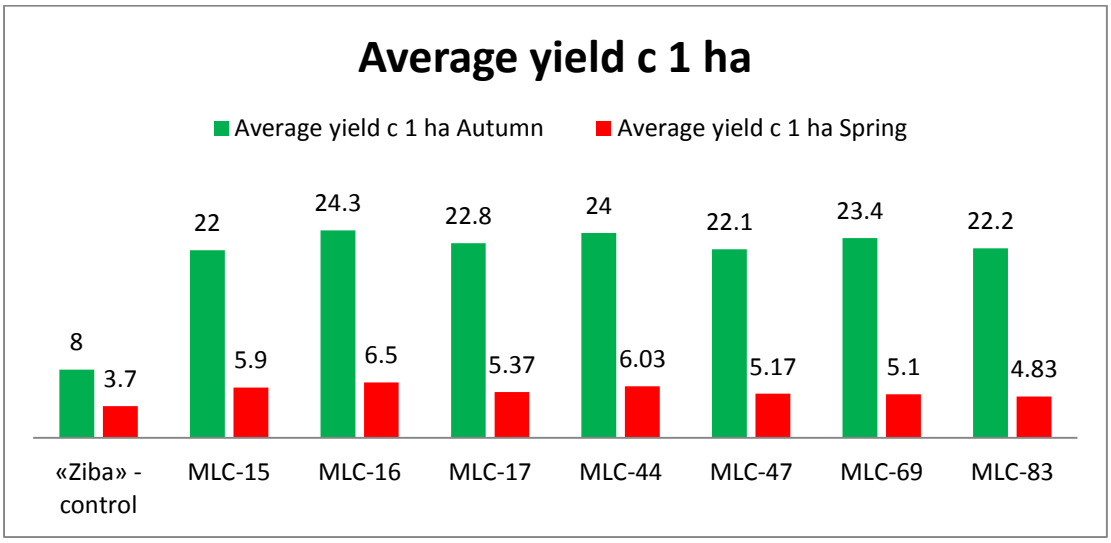

Figure. 1. Effect of different sowing dates on yield of lentil genotypes