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EFFECT OF SOWING DATE AND FOLIAR SPRAY OF LUPINE SEED EXTRACT ON FOLIAGE YIELD, CHEMICAL COMPOSITION, SEED YIELD AND SEED QUALITY OF SPINACH (*Spinacia oleracea* L.) AS WELL AS ASSOCIATED WEEDS

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ABSTRACT

Two field experiments were performed at the Baramoon Experimental Station, Dakahlia Governorate, Egypt, during the two seasons of 2009/2010 and 2010/2011 to study the effect of two sowing dates (15 Oct. and 15 Nov.) and foliar application with lupine seed extract at various concentrations of 0, 5, 10, 15% as well as their interaction on foliage yield, chemical composition, seed yield and seed quality of spinach plants cv. Dokki as well as associated weeds. A split plot design with three replicates was used. The obtained results revealed that sowing spinach on mid-October resulted in marked increases in plant height, number of leaves per plant, foliage fresh weight per plant, total yield per fedden, dry matter percentage of leaves, nitrate content of leaves, seed production and its quality as well as associated weeds fresh weight, compared with that sown on mid-November in both seasons. Results also cleared that foliar application with the relatively high used concentration of 15 % lupine seed extract had significant promotion for most of the studied characters except associated weeds fresh weight, dry matter percentage of leaves and nitrate content of leaves which were significantly decreased as compared with the control treatment in both seasons. The interaction effect of sowing date and foliar lupine seed extract exhibited significant effect on all studied traits in both seasons. Generally, it could be concluded that sowing spinach cv. Dokki in mid October interacting with application of lupine seed extract at 15% concentration was found to be the best management system for increasing foliage yield, its quality, seed yield and seed quality under the environmental conditions of Dakhlia district. Moreover, applying lupine seed extract could be considered a powerful and environmental friendly approach to improve plant growth, quality and production, and it might open the door for new strategy for controlling the weeds in spinach fields.

Keywords: *Spinacia oleracea*, Spinach, sowing date, lupine seed extract, weeds

INTRODUCTION

Spinach (*Spinacia oleracea,* L.) is one of the popular leafy vegetable crops in Egypt. It has a high nutritional value, it is rich in iron, vitamin A and folic acid contents, but unfortunately it also contains a relatively large amount of nitrate (Roy and Chakrabarti, 2003). This causes various health related problems in humans. Thus reducing nitrate content in spinach can decrease risk of human illness (Santamaria, 2006).

There are numerous factors affecting the productivity and quality of spinach plants. Environmental factors greatly affect plant growth, quality and yield. Sowing date is one of the most important limiting factors that influence

on plant growth and production. Sowing date depends on the onset of significant rainfall, temperature and humidity of the region. Decreasing spinach yield in delayed sowing date after October has been reported by many workers (Waseem *et al*., 2000; Waseem and Nadeem, 2001; Ramadan, 2004; Ibrahim *et al*., 2010). High NO_3^- contents in spinach were found with low light intensities, low soil-moisture contents, high temperatures, amount of N added and the amount of N available in the soil (Breimer, 1981). Long days especially coupled with higher temperatures above 25 ºC cause the plant to bolt and flower, which is detrimental to production of spinach crop (Changhoo *et al.,* 2001; Hata *et al.,* 2006).

Moreover, weeds are considered a significant problem, especially in spinach fields, because they tend to decrease crop yields and quality by weed competition for nutrients, water and light than by any other factor. Thus, the current trend of weed control is to find a non-chemical and eco-friendly solution to minimize perceived hazardous impacts from herbicides in agricultural production. Use extracts of many species within *leguminosae* family as foliar spray for weed suppression and enhancing crop yields is reported in recent studies. Lupine extract have been reported to be rich source of protein, alkaloids, minerals, phytate, phenolic compounds and other natural material of plant origin (Gulewicz *et al*., 2002; Przybylak *et al*., 2005; Muzquiz *et al*.,2011). The extract obtained from lupine has beneficial effect on the growth and yield of various plants (Barczak, 2002 ; Wysocki *et al*., 2001; Barczak and Nowak, 2005; Messiha, 2005). Spraying plants with lupine extract affects not only yield but also their chemical composition; in particular it may reduce nitrates content (Barczak 2002, Barczak and Nowak 2004; Barczak and Nowak, 2005). Moreover, spraying plants with lupine extract decreased weeds growth (Messiha, 2005). It is well known that the weeds interfere with crops causing serious impacts through either competition (for light, water, nutrients and space) and/or allelopathy. In this respect, lupine extract could inhibit small-seeded weed growth due to the allelopathic effects of plant tissue (Price et al., 2008). The allelopathic effect of various natural compounds on the growth and development of various plants may be inhibitory or stimulatory depending on their concentration in the surrounding medium and their physiological activity within plants (El-Dally and Soliman, 1997; Messiha, 2005). However, the effective concentration of its spraying in spinach fields is not determined yet.

Thus, the present work aimed to study the effect of sowing date, foliar spray of lupine seed extract and their combination on foliage yield, chemical composition, seed yield and seed quality of spinach as well as associated weeds.

MATERIALS AND METHODS

Two field experiments were conducted in a clay loam soil at Baramoon Experimental Farm, Dakahlia Governorate during 2009/2010 and 2010/2011 seasons, using the spinach cultivar "Dokki" to achieve the study objectives. Climatic conditions during the growing periods are presented in Table 1.

Table 1: Monthly means of climatic factors for Mansoura region in 2009/2010 and 2010/2011 seasons.

Duration	Air temperature (°C)				Relative humidity (%)				Photo-period length (hr)
	2009/2010		2010/2011		2009/2010		2010/2011		
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	
Oct.	25.8	17.1	29.3	20.4	91.7	34.2	84.7	43.1	11:27
Nov.	21.9	13.0	26.1	17.4	94.5	42.0	84.2	41.3	10:38
Dec.	18.7	11.5	20.8	10.8	90.2	47.6	85.0	44.7	10:13
Jan.	20.0	10.7	18.4	10.9	93.6	49.2	85.8	50.8	10:25
Feb.	22.3	11.8	20.3	11.4	93.4	46.1	85.5	51.2	11:08
Mar.	24.6	13.6	21.9	11.6	93.1	42.4	85.7	45.4	11:57
Apr.	26.8	14.4	25.1	13.0	89.8	41.4	85.4	44.9	12:53
May	30.0	17.5	27.9	18.2	83.3	39.8	87.2	43.9	13:39

The source of this data is Ministry of Agriculture and reclamation of soils, Agriculture Research Center, central management of Agriculture guideline, bulletin of agricultural meteorological data.

A split plot design based on randomized complete blocks with three replicates was used. Two sowing dates (15 Oct. and 15 Nov.) were assigned to main plots. The sub-plots were devoted to four levels of lupine seed extract concentrations (0, 5, 10 and 15 %). Each experimental sub-plot consisted of 6 rows. Each row was 4 m long and 60 cm width. Seeds were sown in hills 10 cm apart on one side of the ridges.

The air dried seeds of lupine (cv. Giza 1) were ground and sieved through 2 mm mesh screen, then100 g of powder soaked in distilled water in a ratio of 1:10 w/v (lupine powder to water) for 24 hours at room temperature. The macerated material was squeezed through double cheesecloth sheets. The fresh extract was applied just after preparation at the respective rates from the original one.

Foliar spray treatments were carried out three times (at 15 days after sowing then every 7 days). The control plants were sprayed with distilled water. The plants were sprayed until drop-off by using a hand-sprayer.

The experimental soil was fertilized with calcium superphosphate (15.5% P_2O_5) at the rate of 200 Kg/fed. during seed bed preparation. Nitrogen fertilizer in the form of ammonium sulfate (20.6% N) at a rate of 50 kg N/fed. was applied in two equal portions, before the first and second irrigation. Potassium sulfate (48% K_2O) at the rate of 50 kg /fed. was applied before the second irrigation.

Associated weeds were hand pulled from one square meter of each subplot at 45 days after spinach sowing and weighed. The other common agricultural practices for growing spinach were followed according to the recommendations of Ministry of Agriculture.

At the marketable stage (60 days after sowing), 12 plants were chosen at random from each plot, where the following records were obtained: a) Plant height (cm), b) Number of leaves per plant, c) Foliage fresh weight per plant (g), d) Total chlorophyll according to AOAC (1990). Leaves samples were weighted and then oven-dried at 60 ˚C for 72 hours. Thereafter, their dry weights were recorded to calculate their dry matter percentages. NO_3^- was extracted from leaves using 2% acetic acid and determined according to

Singh (1988). Moreover, plants of the three rows from each experimental plot were harvested and weighed then the total yield per fedden was calculated.

At the seed harvest stage, samples of 6 female plants were taken at random from each plot to determine seed stalk height and number of branches per plant. Moreover, all plants of each experimental plot were harvested, kept under shade to dry and the seeds were extracted manually then seed yield/fed. was calculated. Seed quality characteristics expressed on weight of 100 seeds (seed index), germination percentage and germination rate were determined according to ISTA (1993). Fifty seeds were selected at random from each treatment and were germinated on two layers of Whatman No. 1 filter paper in 15 cm diameter Petri dishes, the seed was considered germinated when the shoot attained a length of 5 mm.

Data were analyzed statistically by using analysis of variance technique and least significant difference (LSD) at 5% probability was applied to compare the differences among the treatment means according to Snedecor and Cochran (1982).

RESULTS AND DISCUSSION

Associated weeds:

In both growing seasons, the dominant weeds were sweet clover (*Melilotus indical*), wild beet (*Beta vulgaris*), dentated dock (*Rumex dentatus*) and some other rare weeds such as small nettle (*Urens Urtica*).

Data presented in Table 2 show that increasing of associated weeds fresh weight was observed with early sowing date (15 Oct.) than the late sowing one (15 Nov.) in both years of the study. This may be due to the favorable temperature during October as compared to November (Table 1) which enhanced associated weeds germination and growth.

The effect of lupine seed extract at different concentrations on associated weeds fresh weight is shown in Table 2. It was found that lower concentration of lupine seed extract (5%) caused significant increase over the control treatment. On the contrary, treatment with 15 % lupine seed extract concentration caused significant decrease in associated weeds fresh weight in comparison with control treatment. However, associated weeds fresh weight was not significantly affected with 10% lupine seed extract concentration in comparison with control treatment. These results were true in both seasons. Such results might suggest that lupine seed extract contain some phenolic compounds and/ or certain soluble allelochemicals, which are considered the key factor of allelopathic activity in lupine seed extract for suppressing growth and development of weeds in many crops (El-Dally and Soliman, 1997; Gulewicz *et al*., 2002; Messiha, 2005; Przybylak *et al*., 2005; Muzquiz *et al*.,2011).

The interaction between the dates of sowing and addition of various concentrations of lupine seed extract had significant effects on associated weeds fresh weight in both seasons (Table 2). When sowing dates were kept constant and lupine seed extract concentrations varied, it was observed that weeds fresh weight increased significantly from the control to 5% lupine seed

extract concentration, further increase to 10% lupine seed extract concentration had no effect on weeds fresh weight. However, further increase in lupine seed extract concentration to 15% decreased significantly associated weeds fresh weight. In general, delaying sowing date significantly reduced associated weeds fresh weight in all lupine seed extract treatments. These results were true in both seasons.

Table 2: Effect of spinach sowing date (A), foliar spray of lupine seed extract (B) and their interaction on associated weeds fresh weight during 2009/2010 and 2010/2011 seasons.

Season	Sowing date	Lupine seed extract concentrations (%)				
		0	5	10	15	Mean
2009/2010	15 Oct.	335	367	338	303	336
	15 Nov.	266	297	271	235	267
	Mean	301	332	305	269	
LSD (5%):		A: 28	B: 21		A×B: 14	
2010/2011	15 Oct.	344	377	346	310	344
	15 Nov.	272	302	277	239	273
	Mean	308	340	312	275	
LSD (5%):		A: 26	B: 20		A×B:12	

Fresh yield and its components:

Data in Table 3 show that delay of the sowing date from 15 October to 15 November resulted in significant reduction of plant height, number of leaves per plant and foliage fresh weight per plant as well as total yield per fedden. Similar results were recorded in both seasons. These results may be due to the favorable climatic condition existing during October as compared to November (Table 2) which enhanced plant vegetative growth, that led to an increase in both fresh weights of growing plants and their total yield. In this respect, Changhoo *et al.* (2001) found that a longer photoperiod during transplant production had distinct effects on number of spinach leaves per plant at harvest. These results are in line with those obtained by Waseem *et al.* (2000), Waseem and Nadeem (2001), Ramadan (2004), Lefsrud *et al*. (2005), Nxawe *et al.* (2009), Citak and Sonmez (2010) and Ibrahim *et al.* (2010). Although, Abd El-Fattah *et al.* (2003) reported that sowing spinach seeds early in October significantly increased plant height compared with the late sowing date (15 Nov.), and no significant differences were detected in number of spinach leaves and yield of fresh leaves due to sowing date.

Data in Table 3 indicate that foliar application with lupine seed extract at any of the three assigned concentrations (5, 10 and 15 %) had significant effect on plant height, number of leaves per plant, foliage fresh weight per plant and total yield per fedden compared with the control treatment in both the 2009/10 and 2010/11 seasons. The maximum increase in any of the studied characters was achieved when plants were sprayed with lupine seed extract at 15 % concentration. In this respect, the lowest fresh weights of weeds under the treatments of the highest lupine seed extract concentration (Table 2) is reflected to the increase in fresh biomass of whole spinach plants. This means that the least competition between growing weeds and spinach plants due to the foliar with lupine seed extract may encourage

spinach plants to grow well. Similar observation was reported by Barczak (2002), Wysocki *et al*., (2001) and Messiha (2005).

Concerning the interaction effect between the sowing dates and lupine seed extract concentrations, results in Table (3) indicate that foliar application with lupine extract at 15% concentration under early sowing date (15 Oct.) recorded the highest values of spinach fresh yield and its components in both seasons, while, the lowest values were recorded under the late sowing date (15 Nov.) where no lupine seed extract was sprayed in comparison with other treatments in both seasons. These pronounced positive effects on the spinach fresh yield and its components parameters may be attributed to prevalence of favorable climatic factors such as temperature during October as compared to November (Table 1), and lupine seed extract worked more efficiently at high concentration on decreasing weeds fresh weight (Table 2) that led to least competition between growing weeds and spinach plants, and it provide the plant full chance to develop well canopy and biomass and increased its capacity to absorb enough water and nutrients which ultimately resulted in increasing yield and its components.

Table 3: Effect of sowing date, foliar spray of lupine seed extract (LSE) and their interaction on spinach fresh yield and its components during 2009/2010 and 2010/2011 seasons.

Treatments		Plant height (cm)		No. leaves/ plant		Foliage fresh weight/ plant (g)		Total fresh yield (ton/ fed.)	
Sowing date	LSE Conc. (%)	2009/ 2010	2010/ 2011	2009/ 2010	2010/ 2011	2009/ 2010	2010/ 2011	2009/ 2010	2010/ 2011
15 Oct.		44.0	45.8	11.3	11.5	67.7	69.0	8.466	8.691
15 Nov.		29.4	31.8	9.3	9.4	52.4	54.0	6.830	7.013
LSD (5%)		1.6	1.8	0.4	0.4	2.1	2.4	0.223	0.196
	0	31.6	33.4	9.3	9.6	51.2	52.9	6.730	7.021
	5	35.6	37.6	9.9	10.2	57.1	58.6	7.350	7.616
	10	37.7	39.9	10.7	10.8	62.8	64.0	7.970	8.157
	15	41.9	44.4	11.3	11.4	69.3	70.7	8.542	8.612
LSD (5%)		2.8	2.5	0.6	0.5	3.6	3.2	0.335	0.324
15 Oct.	0	39.7	41.7	10.2	10.5	58.4	59.8	7.566	7.860
	5	43.8	45.6	10.9	11.2	64.5	65.7	8.187	8.348
	10	44.1	45.8	11.7	11.9	70.7	71.6	8.813	9.051
	15	48.4	49.9	12.3	12.4	77.3	79	9.298	9.503
15 Nov.	0	23.5	25	8.4	8.6	43.9	45.9	5.894	6.182
	5	27.3	29.6	8.9	9.1	49.7	51.5	6.512	6.884
	10	31.2	33.9	9.6	9.7	54.8	56.3	7.127	7.263
	15	35.4	38.8	10.2	10.3	61.2	62.4	7.785	7.721
LSD (5%)		4.0	3.7	0.9	0.8	5.8	6.1	0.592	0.574

Chemical composition of spinach leaves:

Data presented in Table 4 reveal that sowing date had a significant effect on dry matter percentage, total chlorophyll content and nitrate content in spinach leaves in both seasons of study. The highest values of dry matter percentage and nitrate content were achieved with sowing spinach on mid October as compared with mid November. Whereas, the highest values of total chlorophyll content was achieved with planting spinach on mid November. These results were true in both seasons. The obtained data might

be ascribed to the seasonal environmental conditions during the growing period (Table 1) such as temperature, relative humidity, day length and light intensity. In this respect, Lefsrud *et al.* (2005) found that the dry matter percentage in spinach leaves increased as the air temperatures increased from 10 to 25 °C while chlorophyll content in spinach leaves was decreases. Conte *et al.* (2008) found that chlorophyll content in spinach leaves had slight changes due to variability in climatic conditions. Moreover, high nitrate contents in spinach leaves were found with high temperatures (Breimer, 1981). These results are in line with those obtained by Ramadan (2004) and Ibrahim *et al.* (2010) who found that spinach plants sown on 15 October had the highest dry matter percentage and nitrate content in leaves compared to 15 November.

Table 4: Effect of sowing date, foliar spray of lupine seed extract (LSE) and their interaction on dry matter percentage, total chlorophyll content and nitrate content in spinach leaves during 2009/2010 and 2010/2011 seasons.

Treatments		DM percentage (%)		Total Chl. content (mg/100 g fresh wt)		NO_3 accumulation (mg/kg dry wt)	
Sowing date	LSE Conc. (%)	2009/ 2010	2010/ 2011	2009/ 2010	2010/ 2011	2009/ 2010	2010/ 2011
15 Oct.		10.6	10.6	124.6	123.3	496	457
15 Nov.		10.3	10.3	135.1	133.5	419	388
LSD (5%)		0.2	0.1	1.8	1.7	15	14
	0	10.9	10.7	121.2	120.2	514	470
	5	10.5	10.5	127.0	125.6	477	440
	10	10.4	10.3	132.8	131.1	437	403
	15	10.1	10.1	138.5	136.7	403	378
LSD (5%)		0.3	0.2	3.2	2.9	28	24
15 Oct.	0	11.1	10.9	115.1	114.2	560	512
	5	10.6	10.7	121.5	120.3	518	476
	10	10.5	10.4	127.8	126.3	472	433
	15	10.2	10.2	134.0	132.3	434	406
15 Nov.	0	10.6	10.5	127.3	126.1	468	427
	5	10.4	10.3	132.5	130.8	435	404
	10	10.2	10.2	137.8	135.9	401	372
	15	9.9	10	142.9	141	372	350
LSD (5%)		0.3	0.3	5.1	4.7	40	35

It is evident from the data in Table 4 that the effect of different lupine seed extract concentrations on dry matter percentage, total chlorophyll content and nitrate content in spinach leaves was significant in both seasons. The highest total chlorophyll content was observed in the foliar application with lupine extract especially at 15% concentration compared to the control treatment in both seasons. However, dry matter percentage and nitrate content in spinach leaves were detected in lower values in all lupine extract concentrations in both seasons. Similar results were obtained by Barczak (2002) on leek, Barczak and Nowak (2004) on carrot and Barczak and Nowak (2005) on cauliflower and lettuce.

Data presented in Table 4 indicate that the interaction between sowing date and the spraying of various levels of lupine seed extract had significant

effects on all studied traits of chemical composition of spinach leaves in both seasons. The second date of sowing (15 Nov.) combined with various lupine seed extract treatments had a positive effect on total chlorophyll content, and had a negative effect on dry matter percentage and nitrate content. The highest mean values of total chlorophyll content were recorded with the application of 15% lupine extract concentration at second date. While, the highest mean values of dry matter percentage and nitrate content were recorded with control treatment (untreated plants) at first date of sowing (15 Oct.). These results were true in both seasons. The obtained results may be attributed to the effect of seasonal environmental conditions during the growing period, in addition to, the effect of lupine seed extract on fertilizer use efficiency and plant metabolism, especially photosynthesis, assimilate formation and translocation, cell division and elongation *etc,* thus resulting in spinach leaves quality.

Seed yield and its components:

The presented data in Table 5 show that sowing spinach plants at the late date (15 Nov.) significantly decreased the seed yield and its components as compared with that sown at early date (15 Oct.) in both seasons. This might be due to the longer time available for the early sown crop to utilize available growth resources (light, nutrients, moisture *etc*) to produce and partition more assimilates for better vegetative growth (Table 3), and this led to the production of higher seed yield and its components than the late sown plants in both seasons. In this respect, Changhoo *et al.* (2001) and Hata *et al.* (2006) found that a longer photoperiod during transplant production enhances floral development and increases bolting percentage. On the other hand, high temperature during the blooming stage (Table 1) of later planting may be reducing seed yield by causing floret abortion. Moreover, these results are in agreement with those obtained by Abd El-Fattah *et al*. (2003) who reported that sowing spinach seeds early in October significantly increased seed yield and its components compared with the late planting date (in December).

Data collected in Table 5 also show that the application of the higher level of lupine seed extract was more effective than the lower one in inducing marked increments in seed yield and its components in both seasons. This increase in seed yield may be due to better associated weed management (Table 2), better vegetative growth of spinach plants (Table 3), more number of branches (Table 5), and heavier seeds (Table 6). In support of this, Cheema *et al.* (2001) reported that sprays of sorghum water extract increased grain yield of spring mungbean

Regarding the interaction between dates of sowing and addition of various concentrations of lupine seed extract (Table 5), the results indicated that the first date of sowing (15 Oct.) combined with various lupine seed extract treatments had positive effects on producing higher seed yield and its components. The highest mean values were recorded with the first date of sowing at higher lupine seed extract levels. Meanwhile, the lowest values were recorded with the second date (15 Nov.) at untreated plants in comparison with other interaction treatments. These results were similar in the two seasons of the study. These results may be attributed to the high capacity of spinach plants planted on the first date (15 Oct.) and sprayed with

lupine seed extract at 15% concentration in building metabolites, which induced more growth parameters (Table 3), in turn, enhanced the whole metabolic activities, hence, these might be increased seed stalk height, number of branches per plant and seed weight, and consequently, increased seed yield per fedden.

Table 5: Effect of sowing date, foliar spray of lupine seed extract (LSE) and their interactions on spinach seed yield and its components during 2009/2010 and 2010/2011 seasons.

Treatments		Seed stalk height (cm)		No. branches / plant		Seed yield (kg/fed.)	
Sowing date	LSE Conc. (%)	2009/ 2010	2010/ 2011	2009/ 2010	2010/ 2011	2009/ 2010	2010/ 2011
15 Oct.		118	121	11.3	11.2	404	409
15 Nov.		106	109	10.4	10.5	350	358
LSD (5%)		4	3	0.2	0.2	7	6
	0	96	100	10.5	10.6	345	353
	5	107	111	10.7	10.9	367	374
	10	119	121	11.0	11.1	389	395
	15	128	129	11.2	11.1	409	413
LSD (5%)		6	6	0.3	0.3	12	10
15 Oct.	0	100	104	10.9	10.8	371	378
	5	113	117	11.1	11.2	393	398
	10	125	127	11.4	11.4	416	420
	15	135	136	11.6	11.5	437	439
15 Nov.	0	91	96	10.1	10.2	318	328
	5	101	105	10.3	10.4	340	349
	10	112	114	10.5	10.6	362	369
	15	121	121	10.7	10.7	381	387
LSD (5%)		8	9	0.4	0.4	18	16

Seed quality:

Data presented in Table 6 show that sowing date had significant effects on seed index, germination percentage and germination rate in both seasons. The highest values for these parameters were increased markedly with first date of sowing (15 Oct.) compared to the second one (15 Nov.) during both seasons. For seed index, it can suggested that, the early sowing date might be promote early pegging and hence longer fruity period, this will enable more seeds to develop well, thus resulting in a heaver seed. On the other hand, the low quality at delayed sowings might be due to poor development of seed and the higher temperature prevailed in later sowing (Table 1). These results were in agreement with Abd El-Fattah *et al*., (2003) who reported that sowing spinach seeds early in October significantly increased seed quality compared with the late planting date (in December).

The lupine seed extract applied at various three levels to spinach plants caused increments in the seed quality characters (Table 6). Applied higher level was more effective than the low level for seed index, germination percentage and germination rate comparing with control treatment (without lupine seed extract) in both seasons. There were no significant differences in germination rate among the three levels of lupine seed extract in both seasons. These results may be due to the suppressive effect of lupine seed

extract that possibly helped more material availability for plant growth and more material availability for plant growth and development, more photosynthetic area and more translocation of photosynthesis towards reproductive parts (Kahnt and Hijazi, 1991; Barczak, 2002; Barczak and Nowak, 2004) that ultimately increased seed weight, which interpreted the increasing in seed quality.

Data listed in Table (6) show that the interaction between sowing date and the spraying of various levels of lupine seed extract had significant effects on all studied traits of spinach seed quality (seed index, germination percentage and germination rate) in both seasons. Plants sowed at first date (15 Oct.) and treated with higher does of lupine seed extract produced the highest seed quality characters in both seasons, while the lowest values were obtained from untreated plants at the second date of sowing (15 Nov.) in both seasons. The increase in seed quality parameters due to certain changes in metabolisms during pollination, fertilization and seed development that may be cause greater accumulation of food reserves resulting in higher seed quality (Marschner, 1995). In this connection, Deleuran *et al.* (2005) pointed out that increase in the size of seed was beneficial in terms of seed quality.

Table 6: Effect of sowing date, foliar spray of lupine seed extract (LSE) and their interaction on spinach seed quality during 2009/2010 and 2010/2011 seasons.

Treatments		Seed index (g/100 seeds)		Germination %		Germination rate (day)	
Sowing date	LSE Conc. (%)	2009/ 2010	2010/ 2011	2009/ 2010	2010/ 2011	2009/ 2010	2010/ 2011
15 Oct.		1.09	1.11	80	81	7.5	7.7
15 Nov.		1.04	1.06	72	73	7.3	7.4
LSD (5%)		0.03	0.03	2	2	0.2	0.2
	0	1.01	1.03	72	72	7.2	7.3
	5	1.07	1.08	75	76	7.4	7.5
	10	1.10	1.10	77	79	7.6	7.7
	15	1.11	1.13	79	82	7.6	7.7
LSD (5%)		0.04	0.04	2	2	0.3	0.3
15 Oct.	0	1.03	1.05	76	76	7.3	7.4
	5	1.08	1.09	79	80	7.5	7.6
	10	1.12	1.12	81	83	7.7	7.8
	15	1.14	1.16	82	85	7.6	7.8
15 Nov.	0	0.98	1.00	68	67	7.0	7.1
	5	1.05	1.06	70	71	7.2	7.3
	10	1.07	1.08	73	75	7.4	7.5
	15	1.07	1.09	75	78	7.5	7.6
LSD (5%)		0.05	0.05	3	3	0.4	0.3

Conclusion

On the basis of above mentioned discussion it could be concluded that the early sowing date (mid October) was found to be better so as to maintain proper growing due to the suitable conditions for plant growth. Also, the foliar application of lupine seed extract could be a powerful and environmental friendly approach to improve the foliage yield, leaves quality, seed yield and seed quality of spinach plant, and could be used to control the associated

weeds. So, sowing spinach on mid October combined with foliar application with higher does of lupine seed extract (15%) is the best treatment that could be recommended for spinach production in Dakahlia province and other regions with similar agro-climate conditions.

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تأثير ميعاد الزراعة والرش الورقي بمستخلص بذور الترمس على المحصول الورقي والتركيب الكيمائي والمحصول البذري للسبانخ والحشائش المصاحبة

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****قسم بحوث مقاومة الحشائش فى المحاصيل البستانية وجوانب الطرق - المعمل المركزى لبحوث الحشائش - مركز البحوث الزراعية- الجيزة- مصر.**

أجريت تجربتان حقليتان في تربة طينية طميية بالمزرعة البحثية بالبرامون، بمحافظة الدقهلية، خلال الموسمين ٢٠١٠/٢٠٠٩ و٢٠١١/٢٠١٠م؛ لدراسة تأثير ميعادين لزراعة السبانخ صنف الدقي (١٥ أكتوبر و١٥ نوفمبر) والرش الورقي بالمستخلص المائي لبذور الترمس بتركيز (صفر، ٥، ١٠، ١٥%) وكذلك التفاعل بينهما على المحصول الورقي والتركيب الكيماوي والمحصول البذري وجودة بذور السبانخ. إستخدم تصميم القطع المنشقة مرة واحدة فى ثلاث مكررات. أوضحت النتائج أن الزراعة المبكرة في ١٥ أكتوبر أدت إلى حدوث زيادة معنوية في كل من : ارتفاع النبات وعدد الأوراق للنبات والوزن الطازج للمجموع الخضري للنبات والمحصول الخضري للفدان ونسبة المادة الجافة في الأوراق ومحتوى الأوراق من النترات والمحصول البذري ومكوناته وجودة بذور السبانخ وكذلك الوزن الطازج للحشائش المصاحبة في المتر المربع، وذلك بالمقارنة مع الزراعة في ١٥ نوفمبر، في كلا الموسمين. ومن ناحية أخري، أدى رش نباتات

السبانخ بالمستخلص المائي لبذور الترمس خصوصاً التركيز المرتفع (١٥%) إلى حدوث زيادة معنوية في معظم الصفات المدروسة، فيما عدا صفات الوزن الطازج للحشائش المصاحبة ونسبة المادة الجافة ومحتوى النترات في أوراق السبانخ التي انخفضت مع هذا التركيز مقارنة مع عدم الاضافة، وذلك في كلا الموسمين. ومن ناحية أخري أثر التفاعل بين عاملي الدراسة معنوياً على جميع الصفات المدروسة في كلا الموسمين. وخلصت الدراسة إلى أن زراعة نباتات السبانخ (صنف الدقي) في منتصف شهر اكتوبر مع رش النباتات بالمستخلص المائي لبذور الترمس (١:١٠ وزن/حجم) بتركيز ١٥% يمكن أن يزيد ويحسن كمية وجودة كل من المحصول الخضري والمحصول البذري، خاصة تحت الظروف المماثلة لظروف هذه الدراسة. كذلك استخدام المستخلص المائي لبذور الترمس يمكن أن يفتح المجال لاستراتيجية جديدة لمكافحة الحشائش في حقول السبانخ بطرق طبيعية صديقة للبيئة.

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