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EFFECT OF THIAMINE CONCENTRATION AND SPRAYING DATE ON GROWTH AND YIELD OF TWO CULTIVARS OF MUNG BEAN

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Abstract

A field experiment was conducted during the spring and autumn seasons of 2019 in a private field in the Al- Mussaib project region, north of Babylon province. To study the effect of thiamine concentration and thiamine spray dates on growth and yield of two types of mung bean. The experiment was conducted according to the arrangement of split split plots and distributed the treatments using the randomized complete block design (RCBD) with three replicates. Where the cultivars (local and Uzbekistan) that were obtained from the local markets occupied the main plots. As for the secondary plots, the three spraying stages (a stage after 30 days of emergence, a stage after 45 days of emergence and a stage after 60 days of emergence) and the sub secondary plots included thiamine concentrations and were as follows (spraying with distilled water only and 100 $mg.L^{-1}$ and 200 $mg.L^{-1}$ and 300 $mg.L^{-1}$). The results of the statistical analysis of the data were as follows: The local cultivar excelled on the Uzbekistan cultivar in the plant height, the number of branches per plant, the number of leaves, the average fresh weight, the average dry weight. While the first spray date significantly increased in plant height, the third date has excelled in the number of leaves, stem diameter, fresh weight and dry weight. The fourth concentration 300 ppm excelled in number of branches, number of leaves, stem diameter, soft weight and dry weight. The results also showed the excelled of the interaction treatments between the cultivars and dates in the studied traits, where the interaction treatments the local cultivar with the first date has excelled in plant height, the interaction treatment between the local variety with the third date has excelled in fresh weight, dry weight. While the interaction treatment between the local cultivar with the fourth concentration 300 ppm has excelled in plant height, the number of branches of the autumn season, fresh weight, dry weight, of the spring season. While the bi-interaction between the dates and concentrations significantly increased in the studied traits, where the first date with the fourth concentration 300 ppm gave in plant height, the number of branches of the autumn season, the treatment third date with the fourth concentration 300 ppm has excelled in the number of leaves, fresh weight, dry weight for the spring season. The triple interaction between the cultivar, dates and concentrations was significant, the triple interaction the local cultivar with the first date with the fourth concentration 300 ppm has excelled in plant height, the triple combination excelled the local cultivar with the third date and the fourth concentration 300 ppm has excelled in the fresh weight of the autumn season, the dry weight of the spring season.

Keywords: thiamine, Mung bean, spray dates

Introduction

Vigna radiata L is an important legume crop for food and feed and is a crop with a wide environmental range and cultivated in South and East Asia, the tropics, subtropics, Africa, western India, North America and Australia (Unice and Wax, 1981). It is also characterized by its short growth period and can be cultivated after the harvest of wheat and barley (Al-Dabbagh and Al-Dulaimi, 2017). mung bean is used for green feed and straw, and to improve soil properties, especially in reclaimed land. While it provided synthesis, it can be used as a cover crop to conserve soil due to its rapid growth (Savage, 1990). The advantages of protein are that it is rich in the amino acid lysine, which many grain lack, and the way to eat different mung bean seeds (Al-Fartousi, 2005). It is necessary to think about solving the problem of plant nutrition and that relying on chemical fertilizers alone has negative effects on the environment and animal health in addition to indirect effects on human health and on long-term prices and difficulty in obtaining them. So thinking about new ways to increase yield per unit area has become important, and from these methods the use of thiamine (1Vit. B) is important in metabolic processes and is an important cofactor in the Thiamine Pyrophosphate cycle (Hamada and Khulaef, 2000; Kozik, 2008, Bedour and Rawia, 2011) also improves vegetative growth characteristics (Cox 2010, Rana *et al*., 2014). Because of the importance of this topic, This study was conducted to know the effect of thiamine concentrations and dates of spray on growth and yield of two cultivars. The research aims to Response of cultivars in terms of growth and yield. The effect of spraying stage on the growth and yield of mung bean, The effect of thiamine concentrations on the growth and yield of mung bean. The effect of bi-interaction between cultivars and spraying stages on the growth and yield of mung bean. bi-interaction response between classes and concentrations in growth and yield of mung bean. The effect of bi-interaction between spraying stages and concentrations on the growth and yield of mung bean. The effect of triple interaction between cultivars, spraying stages and thiamine concentrations on growth and yield of mung bean.

Materials and Methods

A field experiment was conducted during the spring and autumn season of 2019 in a private field in the Al-Mussaib project region, north of Babylon province, To study the effect of thiamine concentration and thiamine spray dates on growth and yield of two types of mung bean. The experiment was conducted according to the arrangement of split split plots and distributed the treatments using the randomized complete block design (RCBD) with three replicates. Where the cultivars (local and Uzbekistan) that were obtained from the local markets occupied the main plots. As for the secondary plots, the three spraying stages (a stage after 30 days of emergence, a stage after 45 days of

emergence and a stage after 60 days of emergence) and the sub secondary plots included thiamine concentrations and were as follows (spraying with distilled water only and 100 mg.L^{-1} and 200 mg.L^{-1} and 300 mg.L^{-1}). The land of the experiment plowed two perpendicular plowings, then it was smoothing, leveling and then divided into experimental units with dimensions of 2.5 x 3 m² to be the area of the experimental unit 7.5 m^2 follow the cultivation system on lines, the experimental unit contained 4 lines with a length of 2.5 m and the distance between one line and another 60 cm and between pit and another on the line 25 cm. The plots were separated by a distance of 1.5 m wide to prevent spray interaction. The experiment area was fertilized with triple superphosphate fertilizer (P_2O_5 46%) at a level of 75 kg. h^{-1} P before cultivation and nitrogen fertilizer was added in the form of urea (N 46%) at the level of 40 kg. h^{-1} N two weeks after cultivation (Unice, 1993). Each level of the vitamin is sprayed until complete wetness on the leaves of plants early in the morning using a 16-liter big back sprayer with the use of a diffuse substance (dishwashing solution) for the spray solution by 3 cm³ per 20 liters to reduce the surface tension of the water and to ensure complete wetness of the two-season to increase the efficiency of the spray solution in Penetration of the outer surface of the leaf. Thiamine was prepared in a concentration of (100, 200 and 300 mg.L^{-1})and prepared by taking (1) g containing (1) g of active substance and dissolved in a liter of distilled water to obtain the stock base solution and store the solution with a dark bottle in a dark place and take (100 ml) of the base solution and complete the volume to (1000 mL) in order to obtain a concentration (100 mg / L) and spray it on the vegetative part of the plant. In the same process, the other two concentrations were prepared. The height of the plant was measured by a tape measure (cm) and according to the length of the five plants at the end of the growing season, the average number of branches on the main stem of the harvested plants was calculated for each experimental unit, the number of leaves was calculated, the average of five plants randomly taken from the middle lines of each experimental unit, The stem diameter was calculated at the center of the plant and as an average of five random plants from the middle lines of the experimental unit using the micro Vernier, the fresh weight was calculated by weighing an average of five plants per experimental unit at harvest with a sensitive balance immediately after the harvest. A dry weight was calculated based on the random selection of 5 plants from each experimental unit, well dried and extracting their weight.

Results and Discussion

Plant height

The results in Table (1) for the analysis of variance showed a great difference in the plant height at 0.05 for the genotypes in this trait. The local cultivar of the spring and autumn season excelled and gave the highest average of plant height amounted to (73.09 and 118.43 cm), respectively. The Uzbekistani cultivar gave the lowest average of plant height amounted to 68.44 and 112.93 cm², respectively. The reason is due to the difference in genetic variation between the mung bean species. These results agree with Hussain *et al*. (2011) that there are significant differences between the cultivars of the mung bean crop, as the local cultivar gave the highest average of traits in comparison to other cultivars. It is noted from Table (1) that there were significantly excelled in the spraying dates, where the first date excelled in the rest of the dates by giving it the highest average of the spring and autumn season amounted to (76.12 and 120.17 cm) respectively , while the third date gave the lowest average in this trait amounted to (65.50 and 110.78 cm) respectively. This result agrees with Ali et al (2014) that the best spraying stage nutrients on the mung bean crop is the flowering stage that gave the highest average of plant height and number of branches. As for the concentrations, it was significant for both season, where the fourth concentration 300 ppm excelled on the rest of the concentrations, which gave an average amounted to(77.08 and 121.77 cm) for both seasons respectively, and the first concentration (0 ppm) gave lowest average amounted to (66.02 and 109.12 cm) for the two-season respectively. The reason for this is due to the role of thiamine by increasing the plant height to the interaction that takes place between the added thiamine and nitrogen that increases the plant height (Bonner and Greene 1939). As for the bi-interaction between the cultivars and dates, it was significant, where the interaction treatment between the local cultivar with the first date gave the highest average of the plant height amounted to (78.32 and 122.96 cm) for the two-season respectively, while the interaction treatment was the Uzbekistan cultivar with the third stage gave the lowest average amounted to (62.82 and 108.03 cm) for the two-season respectively. As for the bi-interaction between the local cultivar and the fourth concentration, 300 ppm gave the highest average amounted to (79.30 and 124.60 cm) for the two-season, respectively, while the treatment between the Uzbekistan cultivar with the first concentration zero gave the lowest average amounted to (63.37 and 106.51 cm) for the two two-season respectively. There was also significant interaction between dates and concentrations, as the treatments between the first date with the fourth concentration 300 ppm gave higher average amounted to (82.97 and 126.00 cm) for the two-season respectively, while the treatments between the third date with the first concentrations zero gave the lowest average amounted to (60.67 and 104.57 cm) For the two-season respectively. the results in Table (1)indicate that the triple interaction between the cultivar and spray dates and added concentrations was significant excelled for both spring and autumn season 2019, where the triple interaction of the local cultivar and the first date and fourth concentration 300 ppm gave the highest average amounted to (85.67 and 129.00 cm) for the two-season respectively, while the triple interaction of the Uzbekistan cultivar, the third date, and the first concentration zero gave the lowest average amounted to(56.57 and 102.07 cm) for the two-season respectively.

Number of branches (branche.plant^{-1})

Table (2) shows that there was significantly different in the average of the genotypes in this trait, where the local

cultivar excelled for two spring and autumn season and which gave the highest average number of branches (4.75 and 6.05 branche.plant^{-1}), respectively, the Uzbekistan cultivar gave the lowest average number of branches that reached (3.73 and 4.60 branche.plant^{-1}) respectively. This result agrees with Abdul Ghafour and Al-Jumaili (2016) when using two cultivars of mung bean in plant traits, the result a significant difference between them in some traits, where the local cultivar gave higher average than the Indian cultivar in some of them. Table (2) indicate there were no statistically significant differences in the dates of the spring season, but in the autumn season, there was a significantly different as the first date the rest of the dates by giving it the highest average (5.92 branche.plant^{-1}) and a third date was given the lowest average (4.62 branche.plant^{-1}). As for concentrations, they were of importance for both season, where the fourth concentration 300 ppm excelled on the other concentrations, as it gave an average (5.13), and this does not differ from the third concentration, 200 ppm, which gave the highest average amounted to (4.78 branche.plant^{-1}) for the spring season. As for t autumn season, the fourth concentration 300 was significant and gave the highest average was (6.84 branche.plant^{-1}), while the first concentration gave zero, which is the lowest average, amounted to (2.93 and 3.95 cm), respectively. As for the bi-interaction between the cultivar and the dates, they were not significant in relation to the spring and autumn season.

As for the bi-interaction between the cultivars and concentrations, they were not significant in relation to the spring season, while the autumn season was excelled to interaction treatments between the local cultivar with the fourth concentration 300 ppm which gave the highest average amounted to (7.65 branche.plant^{-1}), while the interaction treatments the Uzbek variety with the first focus zero between gave the lowest average amounted to (106.51 branche.plant^{-1}). There was also an interaction between dates and concentrations, which was not significant for a spring season, where the autumn season was significant, where interaction treatment between the first date with the fourth concentration 300 ppm gave average amounted to (7.68 branche.plant^{-1}), while treatment the date and the third with the first concentrations zero gave the lowest average amounted to (3.38 branche.plant^{-1}). Table (2) indicates that the triple interaction between the cultivars, spray dates and added concentrations was not significant for both spring and autumn seasons 2019.

Number of leaves (leaf.plant^{-1})

Table (3) showed that there is a big difference in the modified genotypes in this trait, where a local cultivars of spring and autumn season was distinguished and gave the highest average number of leaves amounted to (47.16 and 63.58 leaf.plant^{-1}), respectively, and the Uzbekistan cultivar obtained the lowest average number of leaves amounted to(40.73 and 60.44 leaf.plant^{-1}) For two consecutive seasons. The reason for this is that the advantage of the local cultivar in this trait is that it gave the highest average of plant length and the increase in the number of branches. Table (3) showed that there were statistically significant differences in dates, where the third date was distinguished from the rest of the dates by giving them the highest average amounted to (50.12 and 67.25 leaf.plant^{-1}) the spring and autumn season respectively, while the first date was given the lowest average in this trait (37.62 and 57.08 leaf.plant^{-1}) For the two seasons respectively. As for the concentrations, they were of significance for both seasons, where the fourth concentration 300 ppm was significantly excelled on the rest of the concentrations which gave an average amounted to (54.06 and 71.67 leaf.plant^{-1}) for both seasons, and the first concentration zero gave the lowest average amounted to (32.78 and 53.17 leaf.plant^{-1}) for to season respectively. One of the reasons for the fourth concentration advantage of thiamine is to increase cell division that increases nutrient absorption, including nitrogen in the leaves, and to stay on effective leaf area for a longer period because of its resistance to inappropriate environmental conditions (Houry, 2017). As for the bi-interaction between cultivar and dates, that they were not significant for the spring and autumn season.

As for bi-interaction between the cultivar and concentrations were not significant for the spring and autumn season. There was also an interaction between dates and concentrations that were important for spring and autumn season, which gave the interaction between the third date and a fourth concentration 300 ppm which is the highest average amounted to (62.10 and 78.33 leaf.plant^{-1}) for to season respectively, while the interaction between the first date and the first concentration zero gave lowest average amounted to (27.60 and 50.33 leaf.plant^{-1}) for two consecutive season. Table (3) indicates that the triple interaction between the cultivar, spray dates and added concentrations was not significant for both spring and autumn seasons 2019.

Stem diameter (cm)

Table (4) showed that there was no significant difference in the average of genotypes in these traits. Table (4) indicates that there was a significant difference in dates in the spring and autumn season of the third date was distinguished and gave the highest average amounted to 6.19 cm and did not differ from the second date that gave (6.04 cm) spring season, As for the autumn season, the third date was excelled and gave the highest average amounted to (6.42 cm). The first dates were given the lowest average amounted to (5.58 and 5.76 cm), respectively. the concentrations were significant for both the two-season, where the fourth concentration 300 ppm was excelled on the all concentrations and gave an average amounted to (6.63 and 6.84 cm) for the two-season respectively, and the first concentration zero gave the lowest average amounted to (5.21 and 5.41 cm) for the two-season, As for the bi-interaction between the cultivar and dates were not significant for the spring and autumn season.

As for the intersection of the two between the cultivars and concentrations, they were not significant in spring and autumn season. There was also the interaction between dates and concentrations that were not significant excelled in spring and autumn season. Table (4) indicates that the triple

interaction between the cultivars, spray dates and added concentrations was not significant for both spring and autumn seasons 2019.

Average fresh weight (g)

Table (5) that there are significant differences between the treatments in the average weight of the genotypes, spray dates, concentrations, and bi and triple interactions between the three factors studied for the spring and autumn 2019. Table (5) indicates that there was a significant difference in the average of genotypes in this trait, where the local cultivars of spring and autumn season and gave the highest average of fresh weight amounted to (0.423 and 0.719 g), respectively. The Uzbekistani cultivars gave the lowest average fresh weight of (0.307 and 0.606 g) for the two-season respectively. These results agree with Ahmed *et al*. (2004) that the genetic variation between the mung bean varieties used has a very large role, As the differences between the varieties in the traits are relatively large and the suitability of the cultivars to the factors surrounding it. Table (5) that there were significant differences for the dates, where the third date excelled the rest of the dates by giving it the highest average of (0.490 and 0.764 grams. Plant^{-1}) for the spring and autumn season respectively, while the first date was given the lowest average in this trait of (0.258 and 0.568 g), for the two-season respectively.

As for the concentrations, it was significant for both season, where the fourth concentration 300 ppm excelled on the rest of the concentrations, which gave an average of (0.495 and 0.824 g) for both seasons respectively, and the first concentrations gave zero the lowest average amounted to (0.224 and 0.513 g) For the two-season respectively. As for the bi-interaction between the cultivars and the dates, the local cultivar with the third date was significant excelled which gave the highest average of fresh weight amounted to(0.590 and 0.824 g) for the two-season respectively, while the interaction treatment Uzbekistan cultivar with the first stage reached (0.241 and 0.509 g) for the two-season, respectively.

As for the bi-interaction between the local cultivar with the fourth concentration, 300 ppm gave the highest average amounted to (0.552 and 0.891 g) for the two-season, respectively, while the Uzbekistan cultivar with the first concentration zero gave the value amounted to (0.164 and 0.459 g). For the two-season respectively. interaction between dates and concentrations also showed significant excelled, and the interaction the third date with a concentration of 300 ppm gave higher average amounted to (0.638 and 0.927 g) for the two-season respectively, while the interaction gave the first date with the first concentration zero gave the lowest average was (0.154 and 0.420 g) for the two-season respectively. Table (5) indicates that the triple interaction between the cultivars, spray dates and added concentrations was not significant for the spring season and was significant for the autumn season, where the triple interaction of the local cultivars and the third date and concentration 300 ppm gave the highest average reached (0.996 g), While the triple interaction of the Uzbekistani cultivars, the first date and the first concentration zero, gave the lowest average (0.356 g).

Average dry weight (g)

Table (6) showed that there were significant differences between the arithmetic averages in the average dry weight of the genotypes, spray dates, concentrations, and bi and triple interactions between the three factors studies for the spring and autumn 2019. Table (6) indicates a significant difference in the average genotypes in this trait, where the local cultivar of spring and autumn season excelled and gave the highest average dry weight amounted to (0.231 and 0.436 g) respectively and the Uzbekistan cultivar gave the lowest average dry weight amounted to (0.179 and 0.386 g) for both seasons, respectively. Table (6) showed that there were significant differences for the dates, where the third date excelled on the rest of the dates by giving it the highest average of amounted to (0.251 and 0.457 g) for the spring and autumn season respectively, while the first date was given the lowest average in this trait amounted to(0.176 and 0.379 g) for both season respectively. As for the concentrations, it was significant for both season, where the fourth concentration 300 ppm excelled on the other concentrations, where it gave an average of (0.353 and 0.550 g) for both seasons respectively and the first concentration zero gave the lowest average amounted to (0.048 and 0.270 g) for both seasons respectively. As for the bi interaction between the cultivars and the dates, it was significant, as the interaction treatments between the local cultivar with the third date was excelled which gave the highest average dry weight amounted to (0.296 and 0.512 g) for the two-season respectively, while the combination of the Uzbekistan cultivar with the first stage amounted to (0.163 and 0.368 g) for both seasons, respectively. As for the bi- interaction between the local cultivar with the fourth concentration300 ppm gave the highest average amounted to (0.388 and 0.584 g) for the both season respectively, while the interaction treatments between the Uzbekistan cultivar with the first concentration zero gave the highest average amounted to (0.025 and 0.252 g), It also showed significant interaction between dates and concentrations, where the treatment the third date with the fourth concentration 300 ppm gave the higher average amounted to (0.406 and 0.623 g) for the both season respectively, where the interaction treatment between the first dates and the first concentration zero gave the lowest average amounted to (0.020 and 0.258 g) for the both season respectively. Table (6)indicates that the triple interaction between the varieties, spray dates and added concentrations was significant for both spring and autumn season 2019, where the triple interaction of the local cultivar, the third date and the fourth concentration 300 ppm gave the highest average amounted to (0.476 and 0.681 g) for the both season, while the triple interaction of the Uzbekistani cultivar, the first date and the first concentration zero gave the lowest average amounted to (0.012g) for the spring season and gave the interaction the Uzbekistani cultivar, the third date and the first concentrations zero, gave the lowest average amounted to (0.246 g).

Table 1 : Response of cultivars, spraying dates, thiamine concentration and interaction between them in the average height of the plant (cm) for the spring and autumn season 2019

cultivars *spraying dates	**The Autumn season 2019**				**cultivars *spraying dates**	**The spring season 2019**					
	Thiamine concentration					**Thiamine concentration**				**spraying dates**	**cultivars**
	300 ppm	**200 ppm**	**100 ppm**	**control**		**300 ppm**	**200 ppm**	**100 ppm**	**control**		
122.96	129.00	124.93	121.33	116.57	78.32	85.67	79.17	75.70	72.73	first	**Local**
118.80	125.27	121.77	116.60	111.57	72.77	78.23	73.43	70.90	68.50	second	
113.53	119.53	115.97	111.57	107.07	68.18	74.00	68.87	65.10	64.77	third	
117.38	123.00	119.27	115.67	111.57	73.92	80.27	75.27	71.53	68.63	first	**Uzbekistan**
113.38	119.93	116.43	111.27	105.90	68.57	73.90	69.23	66.27	64.90	second	
108.03	113.87	110.30	105.90	102.07	62.82	70.40	64.37	59.97	56.57	third	
0.495	1.618				1.030	1.893					%5 **l.s.d**
cultivars					**cultivars**						
118.43	124.60	120.89	116.50	111.73	73.09	79.30	73.82	70.57	68.67	**Local**	**Cultivars* concentration**
112.93	118.93	115.33	110.94	106.51	68.44	74.86	69.62	65.92	63.37	**Uzbekistan**	
0.621	0.951				0.943	1.066					%5 **l.s.d**
spraying dates					**spraying dates**						
120.17	126.00	122.10	118.50	114.07	76.12	82.97	77.22	73.62	70.68	first	**spraying dates* concentration**
116.09	122.60	119.10	113.93	108.73	70.67	76.07	71.33	68.58	66.70	second	
110.78	116.70	113.13	108.73	104.57	65.50	72.20	66.62	62.53	60.67	third	
0.295	1.136				0.812	1.368					%5 **l.s.d**
	121.77	118.11	113.72	109.12		77.08	71.72	**68.24**	66.02		**Average of concentration**
0.739					0.783						%5 **l.s.d**

Table 2 : Response of cultivars, spraying dates, thiamine concentration and interaction between them in the Number of branches(branches.plant^{-1}) in for the spring and autumn seasons 2019

cultivars *spraying dates	**The Autumn season 2019**				**cultivars *spraying dates**	**The spring season 2019**					
	Thiamine concentration					**Thiamine concentration**				**spraying dates**	**cultivars**
	300 ppm	**200 ppm**	**100 ppm**	**control**		**300 ppm**	**200 ppm**	**100 ppm**	**control**		
6.53	8.33	7.23	5.70	4.86	4.66	4.80	5.60	4.66	3.60	first	**Local**
6.25	7.70	6.76	5.70	4.86	4.53	5.66	5.20	4.46	2.80	second	
5.35	6.93	5.83	5.06	3.60	5.05	6.26	5.46	4.66	3.80	third	
5.31	7.03	5.70	4.70	3.83	3.23	4.13	3.33	3.20	2.26	first	**Uzbekistan**
4.58	6.00	4.86	4.10	3.36	3.68	4.66	4.20	3.53	2.33	second	
3.90	5.06	4.00	3.36	3.16	4.28	5.26	4.93	4.13	2.80	third	
N . S	**N . S**				**N . S**	**N . S**					%5 **l.s.d**
cultivars					**cultivars**						
6.05	7.65	6.61	5.48	4.44	4.75	5.57	5.42	4.60	3.40	**Local**	**Cultivars* concentration**
4.60	6.03	4.85	4.05	3.456	3.73	4.68	4.15	3.62	2.46	**Uzbekistan**	
0.624	0.789				**N . S**	1.066					%5 **l.s.d**
spraying dates					**spraying dates**						
5.92	7.68	6.46	5.20	4.35	3.95	4.46	4.46	3.93	2.93	first	**spraying dates* concentration**
5.42	6.85	5.81	4.90	4.11	4.10	5.16	4.70	4.00	2.56	second	
4.62	6.00	4.91	4.21	3.38	4.66	5.76	5.20	4.40	3.30	third	
0.338	0.652				**N . S**	**N . S**					%5 **l.s.d**
	6.84	5.73	4.77	3.95		5.13	4.78	**4.11**	2.93		**Average of concentration**
0.390					0.492						%5 **l.s.d**

Table 3 : Response of cultivars, spraying dates, thiamine concentration and interaction between them in the Number of leaves (leaf.plant^{-1}) in for the spring and autumn seasons 2019

cultivars *spraying dates	The Autumn season 2019				The spring season 2019					
	Thiamine concentration				cultivars *spraying dates	Thiamine concentration			spraying dates	cultivars
	300 ppm	200 ppm	100 ppm	control		300 ppm	200 ppm	100 ppm	control	
58.67	66.33	60.67	55.67	52.00	40.47	50.00	45.67	35.93	30.27	first	Local
63.42	73.33	65.67	59.67	55.00	47.40	57.40	50.27	46.87	35.07	second	
68.67	79.33	73.33	64.33	57.67	53.62	66.67	56.13	52.07	39.60	third	
55.50	63.33	57.33	52.33	48.67	34.77	45.33	39.27	29.53	24.93	first	Uzbekistan
60.00	70.33	62.33	56.00	51.33	40.82	47.40	43.20	41.80	30.87	second	
65.83	77.33	70.33	61.33	54.33	46.62	57.53	48.47	44.53	35.93	third	
N.S	**N . S**				**N . S**	**N . S**					%5 **l.s.d**
cultivars					**cultivars**						
63.58	73.00	66.56	59.89	54.89	47.16	57.02	50.69	44.96	34.98	**Local**	**Cultivars* concentration**
60.44	70.33	63.44	56.56	51.44	40.73	50.09	43.64	38.62	30.58	**Uzbekistan**	
0.316	**N . S**				2.826	**N . S**					%5 **l.s.d**
spraying dates					**spraying dates**						
57.08	64.83	59.17	54.00	50.33	37.62	47.67	42.47	32.73	27.60	first	**spraying dates* concentration**
61.71	71.83	64.00	57.83	53.17	44.11	52.40	46.73	44.33	32.97	second	
67.25	78.33	71.83	62.83	56.00	50.12	62.10	52.30	48.30	37.77	third	
1.183	2.134				3.746	4.856					%5 **l.s.d**
	71.67	65.00	58.22	53.17		54.06	47.17	**41.79**	32.78		**Average of concentration**
1.251					2.337						%5 **l.s.d**

Table 4 : Response of cultivars, spraying dates, thiamine concentration and interaction between them in the Stem diameter (cm) in for the spring and autumn seasons 2019.

cultivars *spraying dates	The Autumn season 2019				The spring season 2019					
	Thiamine concentration				cultivars *spraying dates	Thiamine concentration			spraying dates	cultivars
	300 ppm	200 ppm	100 ppm	control		300 ppm	200 ppm	100 ppm	control	
5.66	6.33	5.53	5.73	5.06	5.66	6.33	5.53	5.73	5.06	first	Local
6.08	6.80	6.26	6.00	5.26	6.08	6.80	6.26	6.00	5.26	second	
6.21	6.60	6.33	6.26	5.66	6.21	6.60	6.33	6.26	5.66	third	
5.50	6.33	5.40	5.53	4.73	5.50	6.33	5.40	5.53	4.73	first	Uzbekistan
6.00	6.73	6.40	5.80	5.06	6.00	6.73	6.40	5.80	5.06	second	
6.16	7.00	6.13	6.06	5.45	6.16	7.00	6.13	6.06	5.45	third	
N . S	**N . S**				**N . S**	**N . S**					%5 **l.s.d**
cultivars					**cultivars**						
6.19	6.81	6.23	6.20	5.52	5.98	6.57	6.04	6.00	5.33	**Local**	**Cultivars* concentration**
6.08	6.87	6.16	5.98	5.30	5.88	6.68	5.97	5.80	5.08	**Uzbekistan**	
N . S	**N . S**				**N . S**	**N . S**					%5 **l.s.d**
spraying dates					**spraying dates**						
5.76	6.51	5.63	5.81	5.08	5.58	6.33	5.46	5.63	4.90	first	**spraying dates* concentration**
6.22	6.93	6.51	6.10	5.36	6.04	6.76	6.33	5.90	5.16	second	
6.42	7.08	6.45	6.36	5.78	6.19	6.80	6.23	6.16	5.56	third	
0.196	**N . S**				0.211	**N . S**					%5 **l.s.d**
	6.84	6.20	6.09	5.41		6.63	6.01	**5.90**	5.21		**Average of concentration**
0.220					0.216						%5 **l.s.d**

Table 5 : Response of cultivars, spraying dates, thiamine concentration and interaction between them in the Average fresh weight (g) in for the spring and autumn seasons 2019

cultivars *spraying dates	The Autumn season 2019				The spring season 2019						
	Thiamine concentration				cultivars *spraying dates	Thiamine concentration				spraying dates	cultivars
	300 ppm	200 ppm	100 ppm	control		300 ppm	200 ppm	100 ppm	control		
0.627	0.815	0.667	0.542	0.484	0.275	0.354	0.325	0.251	0.171	first	**Local**
0.707	0.861	0.773	0.646	0.549	0.404	0.565	0.450	0.359	0.245	second	
0.824	0.996	0.856	0.773	0.670	0.590	0.737	0.647	0.541	0.437	third	
0.509	0.665	0.555	0.460	0.356	0.241	0.320	0.289	0.217	0.137	first	**Uzbekistan**
0.604	0.750	0.641	0.564	0.462	0.291	0.452	0.338	0.245	0.128	second	
0.705	0.859	0.752	0.650	0.560	0.389	0.540	0.447	0.344	0.226	third	
0.0148	0.0345				0.0646	**N . S**					%5 **l.s.d**
cultivars					**cultivars**						
0.719	0.891	0.765	0.654	0.568	0.423	0.552	0.474	0.383	0.284	**Local**	**Cultivars* concentration**
0.606	0.758	0.649	0.558	0.459	0.307	0.437	0.358	0.268	0.164	**Uzbekistan**	
0.0127	0.0194				0.0713	0.0617					%5 **l.s.d**
spraying dates					**spraying dates**						
0.568	0.740	0.611	0.501	0.420	0.258	0.337	0.307	0.234	0.154	first	**spraying dates* concentration**
0.656	0.806	0.707	0.605	0.505	0.348	0.509	0.394	0.302	0.186	second	
0.764	0.927	0.804	0.711	0.615	0.490	0.638	0.547	0.442	0.331	third	
0.0119	0.0248				0.0095	0.0172					%5 **l.s.d**
	0.824	0.707	0.606	0.513		0.495	0.416	**0.326**	0.224		**Average of concentration**
0.0150					0.0101						%5 **l.s.d**

Table 6 : Response of cultivars, spraying dates, thiamine concentration and interaction between them in the Average dry weight (g) in for the spring and autumn seasons 2019

cultivars *spraying dates	The Autumn season 2019				The spring season 2019						
	Thiamine concentration				cultivars *spraying dates	Thiamine concentration				spraying dates	cultivars
	300 ppm	200 ppm	100 ppm	control		300 ppm	200 ppm	100 ppm	control		
0.389	0.515	0.453	0.331	0.258	0.189	0.324	0.243	0.160	0.027	first	**Local**
0.405	0.557	0.448	0.363	0.252	0.209	0.364	0.260	0.151	0.062	second	
0.512	0.681	0.570	0.446	0.353	0.296	0.476	0.345	0.236	0.125	third	
0.368	0.472	0.404	0.340	0.258	0.163	0.307	0.221	0.112	0.012	first	**Uzbekistan**
0.388	0.511	0.446	0.343	0.253	0.168	0.311	0.214	0.127	0.019	second	
0.401	0.565	0.454	0.341	0.246	0.207	0.335	0.280	0.169	0.044	third	
0.0248	0.0410				0.0416	**N . S**					%5 **l.s.d**
cultivars					**cultivars**						
0.436	0.584	0.491	0.380	0.287	0.231	0.388	0.283	0.182	0.071	**Local**	**Cultivars* concentration**
0.386	0.516	0.435	0.341	0.252	0.179	0.318	0.238	0.136	0.025	**Uzbekistan**	
0.0049	0.0202				0.0027	0.0185					%5 **l.s.d**
spraying dates					**spraying dates**						
0.379	0.493	0.429	0.336	0.258	0.176	0.316	0.232	0.136	0.020	first	**spraying dates* concentration**
0.396	0.534	0.447	0.353	0.252	0.188	0.337	0.237	0.139	0.041	second	
0.457	0.623	0.512	0.393	0.299	0.251	0.406	0.313	0.202	0.084	third	
0.0215	0.0311				0.0259	0.0326					%5 **l.s.d**
	0.550	0.463	0.361	0.270		0.353	0.261	**0.159**	0.048		**Average of concentration**
0.0164					0.0151						%5 **l.s.d**

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