Effect of Adding Urea or Ammonium Sulphate on some Herbicides Efficiency in Controlling Weeds in Onion Plants

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Abstract: Two field experiments were conducted during two successive seasons of 2008/2009 and 2009/2010 at the Agricultural Experiments Station of the National Research Centre at Nobariya, Behaira Governorate, Egypt, to study the effect of adding urea or ammonium sulphate at 2% to herbicide solution on weed control efficiency in onion fields. Weed control treatments were as follows: Metosulam at 20 ml/fed or Clodinafop-propargyl at 70g/fed with or without addition of urea or ammonium sulphate (AMS) at 2% of herbicide solution in comparison to Metosulam at 40 ml/fed, Clodinafop- propargyl at 140g/ fed, Metosulam at 20 ml + Clodinafop- propargyl at 70 g / fed, two hand hoeing and unweeded check. All weed control treatments significantly depressed weed growth when compared to the unweeded one. Two hand hoeing showed the best control of broadleaved weeds in both seasons, followed by that of Metosulam at 40 ml, Metosulam + urea and Metosulam + AMS treatments, respectively. Clodinafop – propargyl at 140 g, Clodinafop – propargyl at 70 g, Clodinafop – propargyl + urea, Clodinafop – propargyl + AMS and Metosulam + Clodinafop – propargyl were very effective in controlling most grass weeds. Meanwhile, hand hoeing, Metosulam + Clodinafop – propargyl**,** Metosulam at 40 ml and Clodinafop – propargyl at 140 g /fed were the most effective in controlling onion weeds. All herbicidal treatments as well as hand hoeing markedly increased onion yield in both seasons. Maximum values of bulb length, diameter, weight and bulb yield (t/fed) were recorded from Metosulam + Clodinafop – propargyl, Metosulam at 20 ml and hand hoeing twice.
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1. Introduction:

Onion (*Allium cepa* L.) is one of the most important field and vegetable crops for both local or export market in Egypt. Weeds in transplanted onion fields not only compete with onion seedlings for growth factors but also act as hosts of insects and fungal diseases such as downy mildew that in turn infest onion plants (Ghalwash *et al.,* 2008). Unlike most crops, onion plants grow slowly and do not form a leaf canopy because of their upright growth habit. This character of onion makes competition with weeds very poor. Thus, onion is the least competitive crop against weeds (Karim *et al.,* 1998). Weed growth reduce the yield of transplanted onion by 26 – 48 % **(**Babiker and Ahmed, 1986**).**

Weed control in onion fields must be carried out, especially at the early developmental stages. Due to the severe shortage of hand labour with highly paid wages, hand weeding has become uneconomical processes. Consequently, chemical weed control would be a highly demanded alternative to decrease the cost and increase the economic return due to the increase in onion yield.

Effective weed control and high yield of onion were achieved by application of hand hoeing (Radwan and Hussein; 2001, El–Sayed *et al.,* 2002 and Ghalwash *et al.,* 2008), Clodinafop – propargyl (Khan *et al., 2005* and Ghalwash *et al*., 2008) and Metosulam (El-Metwally, 2002; Sharara *et al.,* 2006; Ghalwash et *al.,* 2008 and El-Metwally and Saudy, 2009**).** However, the recommended dose of herbicide is relatively high and hence its cost is high and too expensive under the Egyptian conditions. Recently, some evidences have been gathered that adding some additives, especially the nitrogenous fertilizers to herbicide solution could increase its activity, consequently the dose could be lowered and its cost price could be decreased. Moreover, lowering the dose of any herbicide is much appreciated from the point of view of minimizing pollution. In addition, Metwally and Hassan (2001) and El–Metwally (2002) recorded that using some herbicides with urea or ammonium sulphate had higher efficiency in controlling annual weeds and increased yield and its components of wheat or maize as compared with other treatments used.

Therefore, the objective of this work was to study the effect of adding urea or ammonium sulphate to herbicide solutions on weed control efficiency in onion crop.

2. Materials and methods

Two field experiments were carried out during the two successive seasons of 2008/2009 and 2009/2010 at the Experimental Station of the National Research Centre at Nobariya, Behaira Governorate, Egypt, to study the influence of adding urea or ammonium sulphate at 2% (equall 4kg/fed) of herbicide solutions on weed control efficiency in onion crops. The soil of the experiments was sandy, the mechanical analysis (Piper, 1950) and chemical analysis (Jackson, 1960) of the soil were carried out before sowing and presented in Table (1).

Table (1): Mechanical and chemical analysis of Nobariya soil before executing experiment.

Components		Value
Mechanical analysis	Sand %	75.6
	Silt %	17.4
	Clay %	5.5
	Texture class	Sandy
Chemical analysis	PH	7.9
	E.C.	0.11 mm hos/ cm
	CO_3	———
	HCO_3	2.5 meq / 100 g soil
	Cl^-	1.0 meq / 100 g soil
	Ca^{+2}	2.5 meq / 100 g soil
	Mg^{+2}	1.0 meq / 100 g soil
	Na	1.3 meq / 100 g soil
	K^+	0.05

m. equivalent / 100 g soil

A complete randomized blocks design with three replications was used in the two seasons. Weed control treatments were as follows:

1- Metosulam (N- 2,6 – dichloro – 3 –methyl phenyl) – 5.7 – dimethoxy – (1,2,4) Triazolo (1,5a) pyrimidine – 2- sulphona mide), known commercially as Sinal 10 Sc sprayed after 30 days from transplanting at the rate of 40 ml/ fed.
2- Metosulam at 20 ml/fed.
3- Metosulam at 20 ml + urea at 2%.
4- Metosulam at 20 ml +ammonium sulphate (AMS) at 2%.
5- Clodinafop – propargyl (Prop – 2 – ynyl – (R) – 2 – (4-(5–chloro– 3- fluoro pyridine – 2- yloxy) phenoxy) = propionate , known commercially as Topik 15 WP sprayed after 50 days from transplanting at the rate of 140g/fed.
6 - Clodinafop – propargyl at 70 g / fed.
7- Clodinafop – propargyl at 70 g + urea at 2%.
8- Clodinafop – propargyl at 70 g + AMS at 2%.
9- Metosulam at 20 ml + Clodinafop – propargyl at 70 g / fed.
10- Hand hoeing after 30 and 50 days from transplanting (DFT).
11- Unweeded check (control) without hoeing or herbicide.

The herbicides were applied with knapsack sprayer equipped with one nozzle boom and water volume was 200 L/ fed (fed=4200m^2). The drip irrigated was the irrigation system. Each treatment plot consisted of 3 lateral lines, each was 10 m long, 70 cm distances between drip lateral lines. The treatments plot area was 21 m^2. Onion plants were transplanted in two sides of drip lateral lines, 20 cm apart between the plants. Seedlings of onion cultivar (Giza 6) were transplanted at the last week of December in the two seasons. The previous summer crop in both seasons was peanut (*Arachis hypogaea L.*). All agronomic practices for growing onion were done as recommended.

Data recorded were:

A –Weeds:

Weeds were hand pulled randomly from one square meter from each plot after 75 and 110 days after transplanting and then were identified and classified to broadleaved, grasses and total weeds. Number and dry weight of each category was estimated.

B- Bulb characters and onion yield*:*

At harvest time, ten bulbs were chosen at random from each plot and the following data were recorded:

1- Bulb length 2 – Bulb diameter
3- Bulb weight 4- Bulb yield (t/fed)

C- Some chemical constituents of onion bulbs:

a- Nitrogen, phosphorus and potassium contents (NPK)

Nitrogen, phosphorus and potassium contents were determined in dried tissues of onion bulbs according to the official and modified methods of analysis (A.O.A.C., 1984).

b- Total carbohydrate contents

Total carbohydrates in onion bulbs were extracted according to Herbert *et al*. (1971) and estimated colourimetrically by the phenol-sulphoric acid method as described by Montogomery (1961).

Statistical analysis:

All data were statistically analyzed according to the technique of analysis of variance (ANOVA) of a randomized complete blocks design. Since the obtained results of the two seasons of experiment were with the same trend, combined analysis was followed for the two seasons (Little and Hills, 1978). Least significant difference (LSD) method was used to test the differences between treatment means at 5% level probability (Gomez and Gomez, 1984).

3. Results and Discussion:

Effect of different weed control treatments on:

A- Onion weeds:

The common weeds in both growing seasons of onion crop were:

Chenopodium album L.*; Ammi majus* L.*; Coronopus squamatus,* L. *Melilotus indicus* L. and *Centaurea calcitrapa* as broadleaf weeds, while the grassy weeds were *Avena fatua* L.*; Lolium multiforum* L. *and* L. The effect of different weed control treatments on number and dry weight of onion weeds after 75 and 110 days from transplanting are presented in Tables 2, 3 and 4.

1- Broadleaved weeds:

The results in Table 2 showed significant effects on number and dry weight of broadleaved weeds after 75 and 110 days from transplanting in both seasons. Hand hoeing exerted the highest reduction in number and dry weight of broadleaved weeds, followed by Metosulam at 40 ml, Metosulam + urea and Metosulam + ammonium sulphate treatments, respectively. These treatments decreased dry weight of broadleaved weeds than unweeded treatment by about 84.2, 60. 9, 59.6 and 59.1 % at 75 days and by 86.3, 66.7, 64.2 and 63.8 %, at 110 days from transplanting, respectively.

2- Grass weeds:

Number and dry weight of grass weeds were significantly decreased by different weed control treatments (Table 3). Clodinafop - propargyl at 140 and 70 g with or without urea, ammonium sulphate or Metosulam were very effective in controlling most grass weeds at 75 and 110 days from transplanting. These treatments decreased dry weight of grass weeds by 93.3, 91.1, 89.4, 89.2 and 86.6 % at 75 days and by 94.4, 91.8, 90.6, 89.7 and 89.6 %, at 110 days from transplanting.

3- Total weeds:

It is obvious from the results in Table (4) that weed control treatments revealed significant decrease on number and dry weight of total weeds. Hand hoeing twice, Metosulam + Clodinafop – propargyl, Metosulam at 40ml and Clodinafop – propargyl at 140 g /fed recorded the highest efficiency in decreasing total number of weeds at 75 and 110 days from transplanting. These treatments reduced number of total weeds than unweeded check by 84.3, 68.1, 59.1 and 53.8 %, at 75 days and by 83.3, 69.7, 60.8 and 55.6%, at 110 days from transplanting. Two hand hoeing, Metosulam + Clodinafop – propargyl, Clodinafop – propargyl at 140 and 70 g /fed treatments were very effective in controlling onion weeds when compared with other weed control treatments at 75 days from transplanting. These treatments reduced the total dry weight of weeds by 85.0, 67.5, 59.2 and 57.4 %, respectively, as compared to unweeded check. With regard to dry weight of total weeds at 110 days from transplanting, results in Table (4) cleared that the highest efficiency in decreasing dry weight of total weeds was obtained from plots treated with hand hoeing, Metosulam + Clodinafop – propargyl, Clodinafop – propargyl at 140 g, Metosulam at 40 ml and Clodinafop – propargyl at 70 g /fed + urea. These treatments decreased dry weight of total weeds than unweeded treatment by 84.2, 72.8, 62.00, 59.6 and 54.9 %, respectively at 110 days from transplanting.

Generally, results in Tables 2, 3 and 4 revealed that all herbicidal treatments used alone or mixed with urea or ammonium sulphate and hand hoeing decreased statistically the number and dry weight of broad leaved, grasses and total weeds grown with onion crop as compared with unweeded treatment. These results may be due to the inhibitory effect of herbicidal treatments on weeds growth. Two hand hoeing, Metosulam + Clodinafop – propargyl, Metosulam at 40 ml, Clodinafop – propargyl at 140 g and Metosulam + urea were the most effective for controlling the weeds. Also, Clodinafop – propargyl at 70 g, Clodinafop – propargyl + urea, Metosulam + ammonium sulphate, Metosulam + urea and Clodinafop – propargyl + ammonium sulphate treatments produced a promising effect against weed prevailing in onion fields compared with unweeded treatment. Such results may be due to that urea or ammonium sulphate had capacity to give synergistic effects with herbicides used that reflected by the higher reduction in weed growth. Similar results on the synergestic effect of herbicide and ammonium

sulphate on broad leaved weeds were obtained with Abouziena *et al.* (2009-a). In this connection, it is worthy to mention that Suwnnamek and Parker (1975) found that the synergistic mechanism of urea or ammonium sulphate when mixed with Glyphosate could be attributed to some degree of activation inside the weed plants. Abouziena *et al.* (2009-b) reported that adding AMS to the glyphosate solution increased absorption and translocation of glyphosate to 90 and 67%, respectively.Similar results were recorded by many investigators, who showed that effective control of weeds could be obtained with Metosulam(Sharara *et al.*,2006; Ghalwash *et al.*, 2008 and El-Metwally and Saudy, 2009), Clodinafop – propargyl (Saini and Angiras, 2005; El-Metwally and El- Rokiek,2007 and Ghalwash *et al.*, 2008) as well as hand hoeing twice (Ishwar *et al.*, 2000; Ved–Prakash *et al.*,2000; Kolhe, 2001 and Ghalwash *et al.*, 2008).

Table (2): Effect of herbicide treatments alone or mixed with urea or ammonium sulphate (AMS) on number and dry weight of broadleaved weeds after 75 and 110 days from transplanting (Combined analysis for 2008 / 2009 and 2009/2 010 seasons).

Treatments	At 75days from transplanting				At 110 days from transplanting			
	Number	% of reduction	Dry weight (g/ m^2)	% of reduction	Number	% of reduction	Dry weight (g/ m^2)	% of reduction
Metosulam at 40 ml / fed	39.0	62.9	102.0	60.9	50.4	64.9	150.6	66.7
Metosulam at 20 ml / fed	46.5	55.7	125.2	52.0	58.6	59.2	174.5	61.4
Metosulam at 20 ml / fed + urea at 2%.	42.0	60.0	105.4	59.6	53.4	62.8	161.8	64.2
Metosulam at 20 ml / fed + AMS at 2%.	44.3	57.8	106.7	59.1	53.8	62.6	163.8	63.8
Clodinafop – propargyl at 140 g / fed	71.2	32.2	173.1	33.6	92.7	35.5	266.2	41.2
Clodinafop – propargyl at 70 g / fed	73.8	29.7	176.8	32.2	102.2	28.9	311.2	31.2
Clodinafop – propargyl at 70 g / fed + urea at 2%	75.3	28.3	182.6	30.0	106.4	26.0	322.2	28.8
Clodinafop – propargyl at 70 g / fed + AMS at 2%	76.4	27.2	189.7	27.3	112.5	21.7	330.1	27.1
Metosulam at 20 ml / fed + Clodinafop – propargyl at 70 g / fed	45.4	56.8	122.0	53.2	56.8	60.5	171.8	62.0
Two hand hoeing	18.3	82.6	41.2	84.2	22.9	84.1	62.0	86.3
Unweeded check	105.0	—	260.8	—	143.7	—	452.5	—
LSD at 0.05	3.97	—	5.5	—	3.04	—	4.39	—

Table (3): Effect of herbicide treatments alone or mixed with urea or ammonium sulphate (AMS) on number and dry weight of grass after 75 and 110 days from transplanting. (Combined analysis for 2008 / 2009 and 2009 / 2010 seasons).

Treatments	At 75days from transplanting				At 110 days from transplanting			
	Number	% of reduction	Dry weight (g/ m^2)	% of reduction	Number	% of reduction	Dry weight (g/ m^2)	% of reduction
Metosulam at 40 ml / fed	27.4	52.1	115.2	40.9	37.1	53.5	149.5	48.5
Metosulam at 20 ml / fed	33.1	42.1	130.2	33.2	44.7	43.9	166.5	42.7
Metosulam at 20 ml / fed + urea at 2%	38.6	32.5	148.4	23.9	49.5	37.9	185.6	36.1
Metosulam at 20 ml / fed + AMS at 2%	39.0	31.8	151.7	22.2	56.5	29.1	198.5	31.6
Clodinafop – propargyl at 140 g / fed	3.7	93.5	13.0	93.3	6.6	91.7	16.4	94.4
Clodinafop – propargyl at 70 g / fed	4.9	91.4	17.4	91.1	7.4	90.7	23.7	91.8
Clodinafop – propargyl at 70 g / fed + urea at 2%	5.5	90.4	20.7	89.4	8.2	89.7	27.3	90.6
Clodinafop – propargyl at 70 g / fed + AMS at 2%	5.9	89.7	21.1	89.2	10.3	87.1	30.0	89.7
Metosulam at 20 ml / fed + Clodinafop – propargyl at 70 g / fed	6.3	89.0	26.2	86.6	11.0	86.2	30.2	89.6
Two hand hoeing	7.1	87.6	27.3	86.0	14.4	81.9	55.4	80.96
Unweeded (Control)	57.2	—	195.0	—	79.7	—	290.3	—
LSD at 0.05	1.90	—	4.47	—	3.66	—	2.12	—

Table (4): Effect of herbicide treatments alone or mixed with urea or ammonium sulphate on number and dry weight of total weeds after 75 and 110 days from transplanting. (Combined analysis for 2008 / 2009 and 2009 / 2010 seasons).

Treatments	At 75days from transplanting				At 110 days from transplanting			
	Number	% of reduction	Dry weight (g/ m^2)	% of reduction	Number	% of reduction	Dry weight (g/ m^2)	% of reduction
Metosulam at 40 ml / fed	66.4	59.1	217.2	52.4	87.5	60.8	300.1	59.6
Metosulam at 20 ml / fed	79.6	50.9	255.4	44.0	103.3	53.8	341.0	54.1
Metosulam at 20 ml / fed + urea at 2%	80.6	50.3	253.8	44.3	102.9	53.9	347.4	53.2
Metosulam at 20 ml / fed + AMS at 2%	83.3	48.6	258.4	43.3	110.3	50.6	362.3	51.2
Clodinafop – propargyl at 140 g / fed	74.9	53.8	186.1	59.2	99.3	55.6	282.6	62.0
Clodinafop – propargyl at 70 g / fed	78.7	51.5	194.2	57.4	109.6	50.9	334.9	54.9
Clodinafop – propargyl at 70 g / fed + urea at 2%	80.8	50.2	203.3	55.4	114.6	48.7	349.5	53.0
Clodinafop – propargyl at 70 g / fed + AMS at 2%	82.3	49.3	210.8	53.8	122.8	45.0	360.1	51.5
Metosulam at 20 ml / fed + Clodinafop – propargyl at 70 g / fed	51.7	68.1	148.2	67.5	67.8	69.7	202.0	72.8
Two hand hoeing	25.4	84.3	68.5	85.0	37.3	83.3	117.4	84.2
Unweeded (Control)	162.2	—	455.8	—	223.4	—	742.8	—
LSD at 0.05	3.87	—	3.34	—	3.29	—	4.09	—

B – Bulb criteria and onion:

1 – Bulb length:

Bulb length significantly influenced by the different weed control treatments in both seasons (Table 5). The highest values of bulb length were recorded with Metosulam + Clodinafop – propargyl, Metosulam at 20 ml, Metosulam + urea, hand hoeing and Clodinafop – propargyl at 140 g, respectively. On the other side, unweeded plots resulted in the lowest values of bulb length. Similar results were recorded by Rizk *et al.* (1995).

2 – Bulb diameter:

Results in Table (5) indicated that maximum bulb diameter was obtained from the application of Metosulam + Clodinafop – propargyl followed by Metosulam at 20 ml, hand hoeing twice, Metosulam + ammonium sulphate and Metosulam + urea. These treatments increased the bulb diameter by 43.3, 36.2, 31.2, 26.1 and 24.1 %, over unweeded check. These results are coincided with those reported by Ghosheh (2004) and Ghalwash *et al.* (2008).

3 – Bulb weight:

Controlling onion weeds with Metosulam + Clodinafop – propargyl recorded the highest values of bulb weight followed by Metosulam at 20 ml, hand hoeing twice, Metosulam + ammonium sulphate and Metosulam + urea, respectively (Table 5). Formentioned superior treatments increased bulb weight than unweeded treatment by 125.6, 100.0, 86.1, 77.0 and 70.3 %, respectively. Chemical and mechanical weed control treatments reduced weed competition and thus afforded more efficient utilization of available resources to onion plants to produce plants having more bulb diameter, length and weight than weedy check plants. The same conclusion was mentioned by Radwan and Hussein (2001); El-Sayed *et al. (*2002); Ghosheh (2004) and Ghalwash *et al.* (2008).

4 – Yield of bulbs/ fed:

The results in Table (5) indicate that Metosulam + Clodinafop – propargyl gave the highest onion yield and recorded 6.43 ton / fed increases over weedy check treatment, followed by Metosulam at 20 ml , hand hoeing twice, Metosulam + ammonium sulphate and Metosulam + urea. The superiority of herbicidal treatments and hand hoeing treatment might be attributed to that onion plants exposed to low weed competition as a result of eliminating weed and its negative impacts on onion plants. Weeds compete with onion plants for water, light and nutrients and the feasibility of maintaining high yield with good quality in absence of effective weed control is strongly doubtful. The above results are in agreement with those obtained by Sanjeev *et al.* (2003); Ghosheh (2004); Sharara *et al*. (2006) and Ghalwash, *et al.* (2008).

C- Some chemical constituents of onion bulbs:

Nitrogen, phosphorus and potassium contents:

The results in Table (6) indicate that there were significant increases in the contents of N, P and K in onion bulbs due to different herbicide treatments alone or in combination with urea or ammonium sulfate in comparison to the corresponding controls.

Maximum level of N content in bulbs was recorded with Metosulam + Clodinafop – propargyl followed by combined treatment of Clodinafop – propargyl with ammonium sulfate and its single treatment at 70g / fed. Phosphorus content in onion bulb was significantly less in all treatments relative to unweeded check, except in Metosulam + Clodinafop– propargyl treatments. Moreover, the content of K in onion bulbs (Table 6) exhibited the highest value with the combined treatment of Clodinafop – propargyl and ammonium sulfate followed by Metosulam at 40 ml/fed. Significant increment of nutrient contents in bulb onion (Table 6) may be attributed to the reduction of weed competition with onion plant due to the herbicide treatments alone, their combinations with urea or ammonium sulfate (Metwally and Hassan, 2001, El-Metwally, 2002 and Sharara, *et al.,* 2006), or hand hoeing (Radwan and Hussein, 2001 and El-Sayed *et al.,* 2002).

Total carbohydrate contents

Using the herbicides alone as well as their combinations with urea or ammonium sulfate caused significant increase in total carbohydrate contents in onion bulbs (Table 6). Hand hoeing was the most effective in increasing total carbohydrate as compared to control followed by Metosulam + urea (Table 6). On the other hand, the least carbohydrate content was recorded in onion bulbs of that unweeded plots. The results of increasing carbohydrate contents in bulbs of onion due to hand hoeing or herbicide treatments alone or their combination with urea or ammonium sulfate were previously mentioned by Rizk, *et al.* (1995); Metwally and Hassan, 2001 and El- Sayed *et al.* (2002).

Table (5): Effect of herbicide treatments alone or mixed with urea or ammonium sulphate on bulb criteria and onion yield at harvest (Combined analysis for 2008 / 2009 and 2009 /2010 seasons).

Treatments	Bulb length (cm)	% of increasing	Bulb diameter (cm)	% of increasing	Bulb weight (g)	% of increasing	Bulb yield (t / fed)	% of increasing
Metosulam at 40 ml / fed	7.5	27.1	6.4	15.04	179.8	40.43	7.19	40.4
Metosulam at 20 ml / fed	9.4	59.3	7.5	36.23	256.0	100.00	10.24	100.0
Metosulam at 20 ml / fed + urea at 2%	9.2	55.9	6.9	24.09	218.0	70.31	8.72	70.3
Metosulam at 20 ml / fed + AMS at 2%	8.6	45.8	7.0	26.09	226.5	76.95	9.06	76.95
Clodinafop – propargyl at 140 g / fed	8.9	50.9	6.7	22.10	214.8	67.77	8.59	67.77
Clodinafop – propargyl at 70 g / fed	8.2	39.0	6.5	18.30	198.8	55.27	7.95	55.27
Clodinafop – propargyl at 70 g / fed + urea at 2%	7.9	33.9	6.5	17.93	195.0	52.34	7.80	52.34
Clodinafop – propargyl at 70 g / fed + AMS at 2%	7.3	23.7	6.0	8.51	168.0	31.25	6.72	31.25
Metosulam at 20 ml / fed + Clodinafop – propargyl at 70 g / fed	9.7	64.4	7.9	43.30	288.8	125.59	11.55	125.59
Two hand hoeing	9.2	55.9	7.2	31.16	238.3	86.13	9.53	86.13
Unweeded (Control)	5.9	—	5.5	—	128.0	—	5.12	—
LSD at 0.05	0.97	—	0.9	—	6.3	—	1.04	—

Table (6): Effect of herbicide treatments alone or mixed with urea or ammonium sulphate on chemical composition of onion bulbs. (Combined analysis of 2008/2009 and 2009/2010 seasons).

Treatments	N %	P %	K %	Total carbohydrates (mg / 100 g dry weight)
Metosulam at 40 ml / fed	2.15	0.82	2.80	80.29
Metosulam at 20 ml / fed	2.05	0.69	2.05	72.64
Metosulam at 20 ml / fed + urea at 2%	1.80	0.76	1.62	90.52
Metosulam at 20 ml / fed + AMS at 2%	2.50	1.37	2.43	75.83
Clodinafop – propargyl at 140 g / fed	1.85	0.71	2.07	70.89
Clodinafop – propargyl at 70 g / fed	2.90	0.83	2.44	55.95
Clodinafop – propargyl at 70 g / fed + urea at 2%	1.75	1.11	2.01	78.71
Clodinafop – propargyl at 70 g / fed + AMS at 2%	3.95	0.96	4.15	62.26
Metosulam at 20 ml / fed + Clodinafop – propargyl at 70 g / fed	4.05	1.38	2.42	53.15
Two hand hoeing	2.05	0.69	2.71	91.47
Unweeded (Control)	1.90	1.21	2.00	52.56
LSD at 0.05	0.095	0.054	0.41	2.54

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