International Journal of Bioorganic Chemistry
2017; 2(4): 185-191
http://www.sciencepublishinggroup.com/j/ijbc
doi: 10.11648/j.ijbc.20170204.15

Effect of Foliar Applied Urea on Growth and Yield of Wheat (Triticum Aestivium L.)

Zohaib Ahmed Wagan[1], Mahmooda Buriro[1], Tufail Ahmed Wagan[2], Zahoor Ahmed Wagan[3], Sikandar Ali Jamro[4], Qurat Ul Ain Memon[5], Shoaib Ahmed Wagan[5, *]

[1]Department of Agronomy, Faculty of Crop Production, Sindh Agriculture University, Tando Jam, Sindh, Pakistan

[2]Hubei Insect Resources Utilization and Sustainable Pest Management Key Laboratory, College of Plant, Science and Technology, Huazhong Agricultural University, Wuhan, China

[3]Department of Horticulture, Faculty of Crop Production, Sindh Agriculture University Tando Jam, Sindh, Pakistan

[4]School of Agronomy, Anhui Agricultural University, Hefei, China

[5]College of Economics and Management, Anhui Agricultural University, Hefei, China

Email address:

waganshoaib@yahoo.com (S. A. Wagan)

[*]Corresponding author

To cite this article:

Zohaib Ahmed Wagan, Mahmooda Buriro, Tufail Ahmed Wagan, Zahoor Ahmed Wagan, Sikandar Ali Jamro, Qurat Ul Ain Memon, Shoaib Ahmed Wagan. Effect of Foliar Applied Urea on Growth and Yield of Wheat (Triticum Aestivium L.). *International Journal of Bioorganic Chemistry*. Vol. 2, No. 4, 2017, pp. 185-191. doi: 10.11648/j.ijbc.20170204.15

Received: October 17, 2017; **Accepted**: November 2, 2017; **Published**: December 1, 2017

Abstract: The aim of this study is to assess effect of foliar application of urea on growth and yield of wheat crop. The field experiment was conducted to observe the effect of foliar applied urea on growth and yield of wheat. The experiment was laid out in a three replicated randomized complete block design (RCBD) having net plot size 5×4m= (20 m2). The wheat verity TJ-83 (Tando Jam-83) was tested against six treatments of foliar applied urea such as (T1= control (sole water), T2=1%, T3= 2%, T4=3%, T5=4%, and T6=5%). Basal dose of phosphorus @ 84 kg ha^{-1} and nitrogen @ 120 kg ha^{-1} was applied at the time of sowing. The results indicated that the maximum plant height (97.1 cm), number of tillers plant-1 (10.0), spike length (12.4 cm), spikeletes $spike^{-1}$ (22.5) number of grains $spike^{-1}$ (65.4), grain weight $spike^{-1}$ (26.4) seed index (73.2 g), straw yield (6275.3 kg ha^{-1}) andgrain yield (5774.6 kg ha^{-1}) was observed in foliar applied urea @ 5%. The results were statistically significant. However, foliar applied urea @ 4% was ranked 2nd and it was recorded the plant height (96.2 cm), number of tillers plant-1 (20.4), spike length (12.0 cm), spikeletes $spike^{-1}$ (21.8) number of grains $spike^{-1}$ (63.9), grain weight $spike^{-1}$ (25.3) seed index (71.7 g), straw yield (6035.3 kg ha^{-1}) and grain yield (5534. 6 kg ha^{-1}). However the foliar applied urea @ 3%, 2% and 1% were also significantly affected on all the growth and yield traits of wheat, whereas, the lowest values were also recorded in control treatment in all the yield traits of wheat.

Keywords: Effect of Foliar, Urea, Wheat, Yield

1. Introduction

Wheat is the leading food grain of Pakistan occupying the largest area under single crop. Wheat contributes 10.0 percent to the value added in agriculture and 2.1 percent to GDP. Area under wheat crop was 9180 thousand hectares and production of wheat stood at 25.478 million tonnes [12]. The commodity at present is being traded at $ 250-258 per ton or Rs 928 per 40 kg. Further, wheat export for Pakistan would only be possible if price in the global market touches $ 300-350 per ton or Rs 1260 per 40 kg. In 2010-11, the country produced over 25 million tons wheat, 24 million tons in 2009-10 and about nearly 23 million tons in 2008-09, while it is expecting 25 million tons in 2011-12. Out of expected 25 million tons wheat, Punjab will produce 19 million ton, KP 1.5 million tons, Balochistan 0.8 m tons and Sindh will come up with 3.8 million. Wheat price at Rs 1150 per 40 kg, production can be increased by 2 to 2.5 million tons as it would enable farmers to bear increased inputs cost, which, during last three years have increased by manifold. Due to floods in Sindh, wheat production would be affected this year and production from

lower Sindh would decline by 20-30 percent against last year's in Pakistan, Punjab is the leading wheat producing province, followed by Sindh province. Wheat was cultivated in Pakistan on an area of 8805 thousand hectares with a production of 24.2 million tons [12].

Root nitrogen (N) absorption reduces intensively in wheat upon shifts from vegetative to reproductive growth. At this stage and during the course of ripening, roots may either senesce or function less effectively. Subsequently, assimilates including N-bearing molecules move and deplete from vegetative parts to fill the grain [9]. Nitrogen partitioning within grain plays a major role in both yield and seed quality (Wilhelm et al., 2002). Earlier reports have suggested a lower efficiency of N partitioning prior to anthesis [10]. It is generally accepted that foliar application and uptake of N during anthesis is more appropriate than soil applications of urea, allowing a rapid (50% absorption within 6 h) and efficient transportation of N to the grain. Thus the effects of variable amounts of urea sprayed at phenological stages on quality, grain yield, and supply of N requirements of winter wheat were evaluated. The role of macro and micro nutrients is crucial in crop nutrition for achieving higher yields [26]. The soils of Pakistan are deficient in nitrogen and are supplemented with chemical fertilizer for enhancing the crop productivity. Nitrogenous fertilizers play a vital role in modern farm technology, however only 20- 50% of the soil applied nitrogen is recovered by the annual crops [6]. The left over nitrogen is lost from the soil system through dentrification, volatilization and leaching. The partial and in-efficient use of nitrogen results in lower crop harvests. Moreover, fertilizers are energy intensive to produce and are very expensive. The present price hike of fertilizers is one of the main constraints to increase the economic yield of crops. Thus efforts are needed to minimize its losses and to enhance its economic use. Foliar fertilization, that is nutrient supplementation through leaves, is an efficient technique of fertilization which enhances the availability of nutrients. It has been observed that utilization of fertilizers especially urea applied through soil is not as effective as when it is supplied to the plant through foliage along with soil application [22]. It also ensures the sample availability of nutrients to crops for obtaining higher yield [5]. Several researchers justified the idea that nutrients (like N) may be taken up through roots and leaves and may spread within the plant [13]; [3]. The efficiency of N assimilation through foliage, however, depends upon several factors including varieties or genotypes. The study under report was initiated to investigate the efficiency of foliar application of urea for yield and yield components of wheat when applied at different growth stages. Looking the importance and economic importance of wheat crop in our country the following objectives were studied:

2. Materials and Methods

The field experiment was conducted at Agriculture chemistry (soil) section ARI Tando jam during the year 2013-2014 to observe the effect of foliar applied urea on growth and yield of wheat. The basal dose of phosphorus @ 84 kg ha^{-1} and nitrogen @ 120 kg ha^{-1} was applied at the time of sowing. Foliar spray of urea at concentrations 0, 1, 2, 3, 4, 5% was prepared by the addition of urea fertilizer in water (w/v) and a surfactant tween-80 was mixed @ 0.1% v/v (1 ml per 1 liter) with the solution to increase adhesion of solution with plant foliage. The required quantity of foliar spray of urea in formulated concentrations was applied to crop at tillering, stem elongation and boot stage according to the respective protocol of the treatment. The control treatment was sprayed with sole water. The description of experimental design and treatments are under.

Experimental design: Randomized Complete Block Design (RCBD)

Replications=03

Plot size=5m × 4m (20 m2)

Variety=TJ-83

Treatments=(Foliar applied urea) 06

T1=Control (Sole water)

T2=1%

T3=2%

T4=3%

T5=4%

T6=5%

Observations were recorded:

1. Plant height (cm)
2. Tillers per plant
3. Spike length (cm)
4. Spikelet's per spike
5. Grains per spike
6. Grain weight per spike(g)
7. Seed index (1000 grain weight, g)
8. Straw yield (kg ha^{-1})
9. Grain yield (kg ha^{-1})

2.1. Statistical Analysis

The data was collected and subjected to statistical analysis to analyze the variance in treatment means. Least Significant Difference test was applied to observe the statistical differences within treatments following the method developed by [8].

2.2. Layout Plan

Title: Effect of foliar applied urea on growth and yield of wheat (Triticamaestivium L.)

Experimental design: =Randomized Complete Block Design (RCBD)

Replications= 03

Net Plot Size = 5m × 4m= (20 m2)

Variety= TJ-83

Treatments= (Foliar applied urea) 06

T1=Control (Sole water)

T2=1%

T3=2%

T4=3%

T5=4%

T6=5%

4m RIRIIRIIIS

	T2		T4		T3
	T5		T1		T4
	T3	Feeding	T6	Feeding	T1
5 m	T4	channel	T2	channel	T5
	T1		T5		T6
	T6		T3		T2

MAIN CHANNEL

3. Results

The field experiment was conducted at Agriculture chemistry (soil) section Agriculture Research Institute (ARI) Tando jam during the year 2013-2014 to observe the effect of foliar applied urea on growth and yield of wheat. The results are presented in this chapter.

3.1. Plant Height (cm)

The mean plant height (cm) of wheat as affected by different levels of foliar applied urea is presented in Table-1 and their analysis of variance as Appendix-I. The analysis of variance suggested that the plant height was significantly (P<0.01) affected by the different levels of foliar applied urea.

The results showed that maximum plant height (97.1cm) was observed in foliar applied urea @ 5% followed by (96.2cm) plant height in foliar applied urea @ 4% whereas, the foliar applied urea @ 3%, 2%, 1% was observed 92.2, 91.8 and 90.4 cm plant height respectively, while the minimum (88.1cm) plant height was observed under the control treatment (Sole water) where no foliar urea was applied.

Table 1. *Plant height (cm) of wheat as affected by foliar applied urea.*

Foliar applied urea	RI	RII	RIII	Mean
T1 = Control (Sole water)	90.5	84.4	89.5	88.1 C
T2 = 1%	89.4	89.4	92.4	90.4 C
T3 = 2%	91.9	91.9	91.9	91.8 BC
T4 = 3%	94.9	93.9	93.9	94.2 AB
T5 = 4%	96.9	95.9	95.9	96.2 A
T6 = 5%	97.8	96.8	96.8	97.1 A

SE = 1.1858
LSD @ 5% = 2.6420
LSD @ 1% = 3.7580

3.2. Tillers Per Plant

The mean tillers per plant of wheat as affected by different levels of foliar applied urea are present in Table-2 and their analysis of variance as Appendix-II. The analysis of variance suggested that the tillers/ plant were significantly (P<0.01) affected by the different levels of foliar applied urea.

Table 2. *Tillers per plant of wheat as affected by foliar applied urea.*

Foliar applied urea	RI	RII	RIII	Mean
T1 = Control (Sole water)	7	6	5	6.0 C
T2 = 1%	6	7	6	6.3 C
T3 = 2%	7	7	8	7.3 BC
T4 = 3%	8	9	8	8.3 B
T5 = 4%	9	8	9	8.6 AB
T6 = 5%	10	9	11	10.0 A

SE = 0.6611
LSD @ 5% = 1.4730
LSD @ 1%= 2.0952

The results further revealed that maximum (10.0) tillers plant-1 was observed under the foliar applied urea @ 5% as compared foliar applied urea @ 4% which was recorded (8.66) tillers plant-1, whereas, the foliar applied @ 3%, 2%, 1% was observed 8.33, 7.33 and 6.33 tillers plant-1 respectively, while the minimum (6.00) tillers plant-1 was observed under the control treatment (Sole water) where no foliar urea was applied.

3.3. Spike Length (cm)

The data on spike length (cm) of wheat as affected by different levels of foliar applied urea are presented in Table-3 and their analysis of variance as Appendix-I. The analysis of variance suggested that the spike length (cm) was significantly (P<0.01) affected by the different levels of foliar applied urea.

The results showed that maximum plant height (12.4 cm) was observed in spike length was observed in foliar applied urea @ 5% followed by (12.0 cm) plant spike length in foliar applied urea @ 4% whereas, the foliar applied urea @ 3%, 2%, 1% was observed (11.7, 11.2 and 10.8 cm) spike length respectively, while the minimum (10.1cm) spike length was observed under the control treatment (Sole water) where no foliar urea was applied.

Table 3. *Spike length (cm) of wheat as affected by foliar applied urea.*

Foliar applied urea	RI	RII	RIII	Mean
T1 = Control (Sole water)	10.0	10.2	10.1	10.1 F
T2 = 1%	10.7	10.9	10.8	10.8 E
T3 = 2%	11.2	11.1	11.4	11.2 D
T4 = 3%	11.6	11.7	11.9	11.7 C
T5 = 4%	12.0	12.1	11.9	12.0 A
T6 = 5%	12.3	12.6	12.4	12.4 A

SE = 0.0829
LSD @ 5% = 0.1846
LSD @ 1% = 0.2626

3.4. Spikeletes Per Spike

The data on spikeletes spike^{-1} of wheat as affected by different levels of foliar applied urea are presented in Table-4 and their analysis of variance as Appendix-IV. The analysis of variance suggested that the spike length (cm) was significantly (P<0.01) affected by the different levels of foliar applied urea.

The results further revealed that maximum (22.5) spikelet's spike^{-1} was observed under the foliar applied urea

@ 5% followed by foliar applied urea @ 4% which was recorded (21.8) spikelet's spike^{-1}, whereas, the foliar applied urea @ 3%, 2%, 1% was observed 21.8, 19.7 spikeletes spike^{-1} respectively, while the minimum (18.6) spikeletes spike^{-1} was observed under the control treatment (Sole water) where no foliar urea was applied.

Table 4. *Spike Spikeletes per spike of wheat as affected by foliar applied urea.*

Foliar applied urea	RI	RII	RIII	Mean
T1 = Control (Sole water)	18.1	19.0	18.7	18.6 D
T2 = 1%	19.8	19.9	19.5	19.7 C
T3 = 2%	19.8	19.9	19.6	19.7 C
T4 = 3%	21.4	21.6	20.9	21.3 B
T5 = 4%	21.4	22.0	21.9	21.8 AB
T6 = 5%	22.2	22.6	22.9	22.5 A

SE = 0.2451
LSD @ 5% = 0.5460
LSD @ 1% = 0.7767

3.5. Grains Spike^{-1}

The data regarding for the number of grains spike^{-1} of wheat as affected by different levels of foliar applied urea are presented in Table-5 and its analysis of variance as Appendix-V. The analysis of variance suggested that the grains spike^{-1} was significantly (P<0.01) affected by the different levels of foliar applied urea.

The results showed that maximum grain spike^{-1} (65.4) was observed in foliar applied urea @ 5% followed by (63.9) grain spike^{-1} in foliar applied urea @ 4%(63.9) grains spike^{-1}, whereas the foliar applied urea @ 3%, 2%, 1% was observed 62.5, 59.7 and 57.2 grains spike^{-1} respectively, while the minimum (55.3) grains spike^{-1} was observed under the control treatment (Sole water) where no foliar urea was applied.

Table 5. *Grain per spike of wheat as affected by foliar applied urea.*

Foliar applied urea	RI	RII	RIII	Mean
T1 = Control (Sole water)	55.3	54.7	56.0	55.3 F
T2 = 1%	57.0	57.1	57.6	57.2 E
T3 = 2%	59.1	60.0	60.1	59.7 D
T4 = 3%	62.7	62.0	62.9	62.5 C
T5 = 4%	64.1	63.8	64.1	63.9 B
T6 = 5%	66.0	65.0	65.5	65.4 A

SE= 0.3274
LSD @ 5%= 0.7295
LSD @ 1%= 1.0377

3.6. Grain Weight Per Spike (g)

The mean data pertaining to grain weight spike^{-1} (g) of wheat as affected by different levels of foliar applied urea fertilizer are presented in Table-6 and its analysis of variance as Appendix-VI. The analysis of variance suggested that the grain weight spike^{-1} (g) was significantly (P<0.01) affected by the different levels of foliar applied urea.

The results further revealed that maximum (26.4 g) grain weight spike^{-1} was observed under the foliar applied urea @ 5% as compared foliar applied urea @ 4% which was recorded (25.3g) grain weight spike^{-1}, whereas the foliar applied urea @ 3%, 2%, 1% was observed 25.0, 24.4 and 22.0 g grain weight spike^{-1} respectively, while the minimum (21.1 g) grain weight spike^{-1} was observed under the control treatment (Sole water) where no foliar urea was applied.

Table 6. *Grain weight per spike (g) of wheat as affected by foliar applied urea.*

Foliar applied urea	RI	RII	RIII	Mean
T1 = Control (Sole water)	19.9	19.3	24.1	21.1 C
T2 = 1%	21.0	23.0	22.0	22.0 BC
T3 = 2%	23.8	24.6	24.9	24.4 AB
T4 = 3%	24.6	24.9	25.5	25.0 AB
T5 = 4%	25.2	25.4	25.4	25.3 A
T6 = 5%	27.5	26.0	25.8	26.4 A

SE = 1.0130
LSD @ 5% = 2.2570
LSD @ 1% = 3.2104

3.7. Seed Index (g)

The mean data pertaining to seed index (g) of wheat as affected by different levels of foliar applied urea fertilizer are presented in Table-7 and its analysis of variance as Appendix-VII. The analysis of variance suggested that the seed index (g) was significantly (P<0.01) affected by the different levels of foliar applied urea.

The results further revealed that maximum (73.2 g) seed index was observed under the foliar applied urea @ 5% as compared foliar applied urea @ 4% which was recorded (71.7 g) seed index, whereas the foliar applied urea @ 3%, 2%, 1% were observed 67.4, 57.4 and 50.4 g seed index respectively, while the minimum (45.8 g) seed index were observed under the control treatment (Sole water) where no foliar urea was applied.

Table 7. *Seed index (g) of wheat as affected by foliar applied urea.*

Foliar applied urea	RI	RII	RIII	Mean
T1 = Control (Sole water)	48.1	44.2	45.1	45.8 D
T2 = 1%	48.3	50.4	52.7	50.4 D
T3 = 2%	58.3	58	56.1	57.4 C
T4 = 3%	66.3	69	67.1	67.4 B
T5 = 4%	72.7	73.0	69.4	71.7 AB
T6 = 5%	73.1	71.5	75.1	73.2 A

SE = 1.6145
LSD @ 5% = 3.5973
LSD @ 1% = 5.1167

3.8. Straw Yield kg ha^{-1}

The data recorded for straw yield kg ha^{-1} of wheat as affected by different levels foliar applied urea are presented in Table-8 and its analysis of variance as Appendix VIII. The analysis of variance suggested that the straw yield (kg ha^{-1}) was significantly (P<0.01) affected by the different levels of foliar applied urea.

The results showed that maximum straw yield (6275.3 kg ha^{-1}) was observed in foliar applied urea @ 5% followed by (6035.3 kg ha^{-1}) straw yield in foliar applied urea @ 4%, whereas the foliar applied urea @ 3%, 2%, 1% was observed

5973.9, 5824.1 and 5747.2 kg ha^{-1} straw yield respectively, while the minimum (5420.9 kg ha^{-1}) straw yield was observed under the control treatment (Sole water) where no foliar urea was applied.

Table 8. *Straw yield (kg ha^{-1}) of wheat as affected by foliar applied urea.*

Foliar applied urea	RI	RII	RIII	Mean
T1 = Control (Sole water)	5425.8	5436	5400.8	5420.9 D
T2 = 1%	5800.7	5731	5709.9	5747.2 C
T3 = 2%	5849.9	5820.9	5801.4	5824.1 C
T4 = 3%	5974.7	6006.7	5940.2	5973.9 B
T5 = 4%	6057.0	6088.9	5960.1	6035.3 B
T6 = 5%	6268.5	6280.9	6276.67	6275.3 A

SE= 24.293
LSD @ 5%= 54.128
LSD @ 1% = 76.991

3.9. Grain Yield (kg ha^{-1})

The data recorded for grain yield kg ha^{-1} of wheat as affected by different levels foliar applied urea are presented in Table-9 and its analysis of variance as Appendix-IX. The analysis of variance suggested that the grain yield (kg ha^{-1}) was significantly (P<0.01) affected by the different levels of foliar applied urea.

The results further revealed that maximum (5774.6 kg ha^{-1}) grain yield was observed under the foliar applied urea @ 5% as compared foliar applied urea @ 4% which was recorded (5534.6 kg ha^{-1}) grain yield, whereas, the foliar applied urea @ 3%, 2%, 1% was observed 5473.1, 5323.3 and 5246.5 kg ha^{-1} grain yield respectively, while the minimum (4920.1 kg ha^{-1}) grain yield was observed under the control treatment (Sole water) where no foliar urea was applied.

Table 9. *Grain yield (kg ha^{-1}) of wheat as affected of foliar applied urea.*

Foliar applied urea	RI	RII	RIII	Mean
T1 = Control (Sole water)	4925.0	4935.2	4900.1	4920.1 D
T2 = 1%	5300.0	5230.2	5209.1	5246.5 C
T3 = 2%	5349.2	5320.1	5300.7	5323.3 C
T4 = 3%	5474.0	5506.0	5439.4	5473.1 B
T5 = 4%	5556.2	5588.1	5459.3	5534.6 B
T6 = 5%	5767.7	5780.1	5775.9	5774.6 A

SE = 24.293
LSD @ 5% = 54.128
LSD @ 1% = 76.991

4. Discussion

Fertilizers constitute an integral part of improved crop production technology (Saifullah et al., 2002). The proper amount of fertilizer application is considered a key to the bumper crop production (Tariq et al., 2007). Foliar fertilization of crops can complement and guarantee the availability of nutrients to crops for obtaining higher yields (Arif et al., 2006).

The present results indicated that maximum plant height were observed under the foliar applied urea @ 5% as compared to foliar applied urea @ 4% which was recorded plant height, whereas the foliar urea @ 3%, 2%, 1% were observed 92.2, 91.8 and 90.4 plant height respectively, while the minimum (88.1cm) plant height was observed under the control treatment (Sole water) where no foliar urea was applied. Our results are similar with the findings of Alston (1979) who reported better vegetative growth of wheat with foliar application of N. Similarly, Soylu et al. (2005); Kenbaev and Sade (2002) and Arif et al. (2006) reported significant increase in plant height of wheat crop with foliar application of different nutrients individually or in combination. They further indicated that maximum (10.0) tillers plant-1 was observed under the foliar applied urea @ 5% as compared foliar applied urea @ 4% which was recorded (8.6) tillers plant-1, whereas, the foliar applied @ 3%, 2%, 1% was observed 8.3, 7.3 and 6.3 tillers plant-1 respectively, while the minimum (6.0) tillers plant-1 was observed under the control treatment (Sole water) where no foliar urea was applied. Similarly Dwivedi and Tiwari (1991) also reported that highest number of pods was obtained by 2% urea than 2%.

It is obvious from the results that maximum (12.4 cm) spike length was observed under the foliar applied urea @ 5% as compared foliar applied urea @ 4% which was recorded (12.0) spike length, whereas, the foliar applied @ 3%, 2%, 1% was observed 11.7, 11.2 and 10.8 spike length respectively, while the minimum (10.1cm) spike length was observed under the control treatment (Sole water) where no foliar urea was applied the (Patel and Patel, 1994) who stated that the application of urea could increase the pod length of green gram. (Kalarani and Moosa Sheriff, (1994) showed positive response when application of foliar nitrogen concentration applied at different growth stages. The results further revealed that maximum (22.5) spikeletes spike^{-1} was observed under the foliar applied urea @ 5% as compared foliar applied urea @ 4% which was recorded (21.8) spikeletes spike^{-1}, whereas the foliar applied @ 3%, 2%, 1% was observed 21.8, 19.7 spikeletes spike^{-1} respectively, while the minimum (18.6) spikeletes spike^{-1} was observed under the control treatment (Sole water) where no foliar urea was applied. Gooding & Devies (1992) reported better performance of wheat crop for foliar application of N. Similarly, Seth & Mosluh (1981) reported marked increase in number of spikelets per spike of wheat when urea was applied as foliar spray.

It is seen from the results that maximum (73.2 g) seed index was observed under the foliar applied urea @ 5% as compared foliar applied urea @ 4% which was recorded (71.7 g) seed index, whereas, the foliar applied @ 3%, 2%, 1% was observed 67.4, 57.4 and 50.4 seed index respectively, while the minimum (45.8 g) seed index was observed under the control treatment (Sole water) where no foliar urea was applied. These results are in line with Soylu et al. (2005) and Guenis et al. (2003) who reported significant increase in thousand grains weight with foliar application of nutrients. Application of foliar fertilizers on different growth stages showed positive response. The results further revealed that

maximum (62.75.3 kg ha^{-1}) straw yield was observed under the foliar applied urea @ 5% as compared foliar applied urea @ 4% which was recorded (6035.3 kg ha^{-1}) straw yield, whereas, the foliar applied @ 3%, 2%, 1% was observed 5973.9, 5824.1 and 5747.2 kg ha^{-1} straw yield respectively, while the minimum (5420.9 kg ha^{-1}) straw yield were observed under the control treatment (Sole water) where no foliar urea were applied. The maximum (5774.6 kg ha^{-1}) grain yield were observed under the foliar applied urea @ 5% as compared foliar applied urea @ 4% which were recorded (5534.6 kg ha^{-1}) grain yield, whereas, the foliar applied @ 3%, 2%, 1% was observed 5473.1, 5323.3 and 5246.5 kg ha^{-1} grain yield respectively, while the minimum (4920.1 kg ha^{-1}) grain yield were observed under the control treatment (Sole water) where no foliar urea were applied. Previous researcher also confirmed that the foliar application of urea resulted significant increase in seed yield of pigeonpea. Pujari et al. (1998). The growth stages also significantly influenced by different foliar application concentration. Zameer et al. (2006)

5. Conclusion

Foliar applied @ 3%, 2%, 1% was observed 5973.9, 5824.1 and 5747.2 kg ha^{-1} straw yield respectively, while the minimum (5420.9 kg ha^{-1}) straw yield were observed under the control treatment (Sole water) where no foliar urea were applied. The maximum (5774.6 kg ha^{-1}) grain yield were observed under the foliar applied urea. It is concluded from this study that the foliar applied urea @ 5% performed better and enhanced the wheat productivity as compared to other treatments.

References

[1] Abad, A. A. Michlena and J. lloveras. 2005. Effects of nitrogen supply on wheat soil nitrate. Agron. Sustain. Dev., 25:439–446.

[2] Abbasi, F. F., M. A. Baloch, Z. hassan, K. H. Wagan, A. N. Shah and I. Rajpar. 2010. growth and yield of okra under foliar application of some new multinutrient fertilizer products. Pak. J. Agri., Agril. Engg., Vet. Sci., 26 (2):11-18.

[3] Ahmed, M. A and M. K. A. Ahmed. 2005. Growth and productivity of wheat plants as affected by complete foliar fertilizer compound under water stress conditions in newly cultivated sandy land. Arab Univ. J. Agric. Sci., Ain Shams Univ., Cairo, 13:269-284.

[4] Ali, I. A. Mahmood, F. Hussain and M. Salim. 2007. Response of rice to soil and foliar Application of K_2SO_4 fertilizer, Sarhad J. Agric., 23(4): 847-850.

[5] Arif, M., M. A. Chohan, S. Ali, R. Gul and S. Khan. 2006. Response of wheat to foliar application of nutrients. J. Agric. and Bio. Sci., 1(4):30-34.

[6] Bajwa, M. I. 1992. Soil fertility management for sustainable agriculture. Proc. 3rd National Congress of Soil Science, held at Lahore from 20th to 22nd March 1990: 7-25.

[7] Gholami, A. S. Akhlaghi, S. Shahsavani and N. Farrokhi. 2011. Effects of urea foliar application on grain yield and quality of winter wheat, Communi. in Soil Sci. Pl. Anal., 42:719–727.

[8] Gomez, K. A. and A. A. Gomez, (1984). Statistical procedures for agricultural research (2 ed.). John wiley and sons, New York, 680p.

[9] Gooding, M. J and W. P. Davies. 1992. Foliar urea fertilization of cereals. Fertilization Res., 32:202–222.

[10] Gooding, M. J., P. J. Gregory, K. E. Ford and S. Pepler. 2005. Fungicide and cultivar affect postanthesis patterns of nitrogen uptake, remobilization, and utilization efficiency in wheat. J. Agri. Sci., 143:503–518.

[11] Gooding, M. J., P. S. Kettlewell, Barbottin, A., C. Bouchard and M. Jeuffroy. 2005. Nitrogen remobilization during grain filling in wheat: Genotypic and environmental effect. Crop Sci., 45:1141–1150.

[12] Government of Pakistan., 2013-14. Economic survey of Pakistan, Ministry of finance, Government of Pakistan, Islamabad.

[13] Hassanein, M. S. 2001. Effect of variety and nitrogen levels on growth, yield and yield.

[14] Components of wheat (*Triticum aestivum* L.) in newly cultivated land. Egypt. J. Agron., 23, 111-131.

[15] Islam, M. N., R. K. Paul and T. M. K. Anwar. 1993. Effect of foliar application of nitrogen on grain yield of wheat, Pak. J. Agri. Sci., 30 (4):403-406.

[16] Javad, A. N. Maryam and S. A Reza. 2013. Effects of foliar nitrogen and foliar feeding on Vegetative growth, yield and quality of cucumber Cultivars in autumnal sowing superdaminu. Int. J. Agri. Crop Sci., 5(6):646-650.

[17] Khan, P, Memon, M. Y. Imtiaz, M And Aslam. M. 2009. Response of wheat to foliar and soil application of urea at different growth stages Pak. J. Bot., 41(3):1197-1204.

[18] Mahmoodi. P. M. Yarnia, R. Amirnia and M. B. K Benam. 2011. Effect of nitrogen foliar application on grain filling rate and period in 3 cultivars of corn (*Zea mays* L.) African J. Agri. Res., 6(29):6226-6231.

[19] Maryam, H and B. Farhad. 2013. Effects of stages and amount of nitrogen foliar application on yield and yield components in hybrid alestar sunflower ARPN J. Agric. Biol. Sci., 8(3):224-226.

[20] Mazher, A. A. D. Sheikh, M. Shahbaz and A. Afzaal. 2007. Food security through wheat productivity in Pakistan. Source: Sarhad J. Agric., 23 (4):1239-1247.

[21] Mondal, A B and A. A mamun. 2011 Effect of foliar application of urea on the growth and yield of Tomato. Front. Agric. China, 5(3): 372–374.

[22] Mosluh, K. I., J. Seth and A. K. K. Rashid. 1978. Efficacy of urea spray for wheat crop underirrigated conditions on Iraq. Plant and Soil, 49:175-178.

[23] Njuguna, M. N., M. Macharia, T. E. Akuja, J. K. Waweru and J. N Kamwaga. 2011. Effect of foliar fertilization on wheat Triticum aestivum (l) in marginal areas of Eastern Province, Kenya. J. Animal and Plant Sci., 9(2):1161- 1182.

[24] Nicoulaud. B. A. L and A. J Bloom.1996. Absorption and Assimilation of Foliarly Applied Urea in Tomato. J. Amer. Soc. Hort. Sci., 121(6):1117–1121.

[25] Qurat Ul Ain Memon, Shoaib Ahmed Wagan, Tufail Ahmed Wagan, Irfan Hussain Memon, Zohaib Ahmed Wagan, Hina Memon, Zahoor Ahmed Wagan, Asadullah Jamro, Shakeel Ahmed Wagan, Imran Hussain Memon, Adnan Hussain Memon. Economic Analysis of Hybrid Rice in Taluka Golarchi District Baddin Sindh, Pakistan. International Journal of Business and Economics Research. Vol. 4, No. 6, 2015, pp. 250-255. doi: 10.11648/j.ijber.20150406.11

[26] Raun, W. R and G. V. Johnson. 1999. Improving nitrogen use efficiency for cereal production. Agron. J., 91: 357-363.

[27] Shoaib Ahmed Wagan, Luan Jingdong, Xiao Shuangxi, Sanaullah Noonari, Irfana Noor Memon, Qurat Ul Ain Memon, Ghulam Hussain Wagan. Economic Assessment of Rice Production in Sindh, Pakistan. American Journal of Environmental and Resource Economics. Vol. 1, No. 1, 2016, pp. 37-42. doi: 10.11648/j.ajere.20160101.1

[28] Triboi, E and A. M. Triboi-Blondel. 2002. Productivity and grain or seed composition: A new approach to an old problem. European J. Agro., 16:163–186.

[29] Walsh, O. S., R. J. Christiaens and A. P. Montana. 2013. Foliar-applied nitrogen fertilizers in spring wheat production State University, Western Triangle Agricultural Research Center (WTARC), Conrad, MT A publication of the WERA-103 Committee, 5(3): 3-5.

[30] Wilhelm, W. W., G. S. McMaster and D. M. Harrell. 2002. Nitrogen and dry matter distribution by culm and leaf position at two stages of vegetative growth in winter wheat. Agron. J., 94:1078–1086.

[31] Yari, Z. M. Barary, A Hatami, Z. Tahmasebi. 2013. Effect of urea foliar application and irrigation on some morphological characteristics, yield and yield components of fennel (foenicuum vulgare mill L) Int. J. Agron. Pl. Pro., 4 (12):3267-3270.

[32] Yildrim, E. I. Guvenc, M. Turan and A. Karatas.2007. Effect of foliar urea application on quality, growth, mineral uptake and yield of broccoli (*brassica oleracea* L., var. *Italica***)** plant. Sci. Environ., 53 (3):120–128.