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Study of wheat grain protein increasing through foliar application of nitrogen after anthesis

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Abstract

An experiment was conducted to study wheat grain protein increasing through foliar application of Nitrogen after flowering. The RCBD design was analysed with three replications and four N-treatments as foliar application as (N0=0, N1=4kg.ha^{-1} Urea, N2=8kg.ha^{-1} Urea, N3=4kg.ha^{-1} Ammonium Sulfate). Results showed that seed protein content increased significantly by foliar application of Nitrogen. Data showed that there was significant difference among protein content of treatment. According to results, use of 8kg.ha^{-1} Urea was the best treatment for grain protein increase. In this treatment, seed protein content increased from 11.3 to 12.8 percent. Grain yield didn't affect by treatments.

Keywords: Wheat; Protein; Nitrogen; Seed protein; Foliar

1. Introduction

Like all organisms, plants need Nitrogen for growth and development. Nitrogen absorbed by plants mainly in the form of nitrate and Amonium. The Ammonium is combined with Carbon to make Glutamic acids. Protein is built up by different combinations of Amino Acids. (Malakouti, 1995). The sun pest is known as national problem with high priority of control. High costs are settled for airplane spraying against sun pest. Airplane spraying has begun since 1921 and rapidly improved in recent years. Recently other chemicals sprayed with plane, like fertilizers such as Urea. Applying Urea and ammonium sulphate accompanying phenitrition for wheat crop can be accomplished without any side effects in wheat cropping. This method can be replaced by other traditional method especially topdressing of fertilizers. (Malakouti et al, 2002). The up took Nitrogen which is consumed for vegetative growth at first. Then the Nitrogen is used to produce the seed protein (salardini, 1993). Gabala et al (2003) reported that applying 10 Kg.ha-1 of Urea by spraying in earring stage increased seed protein from 10.2 to 11.8 percent. According to Johnson and Perfine (2002), spraying of 10kg.ha^{-1} Urea in milky stage of wheat growth, led to seed protein increasing from 9.9 to 10.8 percent, but the yield was not affected by spraying. Dekov (2004) indicated that the Nitrogen spraying on the leaves during 2-3 weeks after flowering was led to a significant seed protein increasing without any significant effecton yield. Increasing of seed protein content from 11 to 12.2 percent by spraying of 12 kg.ha^{-1} in doughy stage was reported by Svenson et al (2002), but they emphasized that yield was not affected by spraying. Sowers et al (1994) showed a significant increasing in wheat seed protein after Urea spraying in pollination stage. There are many researches concerning the relation between fertilization interval and wheat qualitative and quantitative performance. Results showed that late application of Nitrogen caused seed protein increasing. Hunter and Stanford (1973), Hamid and Sarvar (1976), Cooper and Blakeny (1990), Lotfollahi et al. (1997). Strong (1982) was detected that

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spraying on leaves is one of the effective fertilizing methods. He applies three treatments of Nitrogen spraying (2.5, 5 and 10 kg.ha^{-1}N) in 3 different growth stages (earring, flowering and 16 days after flowering) correspondingly. He observed seed protein increasing by applying 10 kg.ha^{-1} of Nitrogen 10 days after flowering. Gooding and Daivis (1992) emphasized that Nitrogen application as spraying after flowering stage, increase the seed protein and baking quality of flours. Base on the Clare and Spink (1993) and Michalik (1992) researches, seed protein content increased by Nitrogen spraying. Applying 20kg.ha^{-1} Nitrogen which was sprayed as Urea in flowering stage or 7 to 14 days after flowering stage, was led seed protein increasing but had no significant effect on grain yield. (Sarandon and Gianbelli, 1991). Butarina et al (1991) also showed that applying 30 kg.ha-1 of Nitrogen as Urea in milky stage, accompanying with Molybdenum application, caused to seed protein increasing without affecting grain yield. Indoor investigation results reported by Saad and Thalooth (1990) showed significant seed protein increasing by solution spraying included 1% of Urea and 0.35% of phosphoric Acid.Gianbelli and Sarandon (1991) was reported seed protein increasing, caused by applying 20 kg.ha^{-1} Nitrogen spraying as Urea in flowering stage and 14 days after flowering.

According to research results, it seems that use of Nitrogen sources as spraying in doughy stage, was led to seed protein increasing, therefore this experiment was conducted to find out the effect of spraying different sources of Nitrogen on seed protein increasing. This experiment was laid out in Varamin Agricultural Research Center, have experimental station (51°, 41´E and 35°, 12´N) in a dry climate with 124 mm of rainfall during 2002-2004 cropping season (for 3 years).The rainfall was 163, 154 and 144 mm in 2002, 2003 and 2004 cropping season correspondingly. The mean temperature was 16.6^{0}c during three years experiment. The climate of experiment location was known as Accentuated sub desertic.The soil was classified as Fine Loamy, mixed, Thermic, Xerofluventic Camborthids. The soil temperature regime was Thermic and the soil humidity regime was detected as Aridic (Safar and fallahi.1989).

2. Materials and Methods

The experiment design was randomized complete block (RCBD) with three replications and four N-treatments as fallow:

1- without N spraying (0% concentration of N)

2- Spraying of 4 kg.ha^{-1} Nitrogen as Urea (8% concentration of N)

3- Spraying of 8 kg.ha^{-1} Nitrogen as Urea (16% concentration of N)

4- Spraying of 4 kg.ha^{-1} Nitrogen as Ammonium Sulfate (4% concentration of N)

25 L/ha solution (contain 24 liter water and 1 liter phenitrition and Nitrogen fertilizer) were used. Spraying was done by Antonov airoplane.Each experimental plots had 200 meter length and 60 meter wide. Before planting, soil and irrigation water were sampled and samples were analyzed in soil and water research institute by common method (Ali-ehyayi) that results showed in table 1 and 2.

Mahdavi cultivar was planted with 400 seeds per square meter at mid of November. Base on the soil test, Nitrogen as Urea, K2O as Potassium Sulfate and P_2O_5 as Triple Super Phosphate were used 300,150 and 100 kg.ha-1 respectivly. Nitrogen spraying was done at mid of the April in milky stage (Zadoks75). Leaves were sampled after one week and were analyzed. In mid of May at physiologic maturity stage, plants were harvested. In each experimental units, three 10 square meter plots were selected randomly and harvested, then grain yield were pick up and seed protein content measured in lab. Data analysis performed with MSTATC software.

Table1. Soil Chemical and Physical analysis

Texture	B	Cu	Mn	Zn	Fe	K	P	TNV	N	O.C	SP	PH	EC	Depth
	mg.kg^{-1}							(%)	(%)	(%)	(%)		dS.m^{-1}	
CL	0.4	1.6	16	0.8	8	240	6	19	0.03	0.41	38	7.2	1.5	0-30

Table 2. Chemical analysis of irrigation water

Class	SAR	Sum of Cations	Na^{+}	$Ca^{2+}+Mg^{2+}$	Sum of Anions	SO_4^{2-}	Cl^{-1}	HCO_3^{-}	pH	dS.m^{-1}
		meq.l^{-1}								
C_1S_1	1.2	8.2	2.2	6.1	8.5	2.2	1.5	4.7	7.6	0.69

3. Results

Results of Chemical and Physical soil properties illustrated in table No 1.Chemical characteristics of irrigation water showed in table 2. Analysis of variance table for seed protein and yield at different years also summarized in tables 3, 4 and 5.

Effects of treatments on seed protein content were significant (table 3, 4 and 5) and there was a significant difference among seed protein contents. Results of Duncan's Multiple Range Test were showed in Table No 6.

Nitrogen mean (nitrate) of leaves at different treatments, after seven days foliar application was showed in table 7.

Table 7 showed that use of 8kg.ha^{-1} Urea increased Nitrogen as nitrate in leaves to maximum level (325mg.kg^{-1}). Data showed significant difference among seed protein content in treatments. Duncan's Multiple Range Test was showed in Table No 9.

Table 3. Analysis of variance of seed protein and yield variables 2002

SOV	*DF*	M.S	
		%protein	Yield
Replication	2	0.366ns	77500ns
A-factor	3	1.83**	7500ns
Error	6	0.37	64166

ns non significant
** (p<0.01)

Table 4. Analysis of variance of seed protein and yield variables 2003

SOV	*DF*	M.S	
		%protein	Yield
Replication	2	0.002ns	47500ns
A-factor	3	0.423**	1111ns
Error	6	0.062	71944

**(p<0.01)

Table 5. Analysis of variance of seed protein and yield variables 2004

SOV	*DF*	M.S	
		%protein	Yield
Replication	2	0.589ns	5833ns
A-factor	3	3.46**	15555ns
Error	6	0.10	24722

** (p<0.01)

Table6. Effects of treatments on seed protein contents at different years

Treatments	2002	2003	2004
Control	10.80B	15.50B	6.69D
Urea(4Kg.ha-1)	12.37A	15.69B	8.70B
Urea(8Kg.ha-1)	12.56A	16.33A	9.47A
Ammonium Sulfate(4Kg.ha-1)	11.79AB	15.50B	7.92C
LSD	1.22	0.497	0.641

Means with the same letter are not significantly different.

Table7. Mean of Nitrogen as nitrate in leaf at different years

Treatments	1379	1380	1381	Mean
Control	180	190	200	190
Urea(4Kg.ha-1)	290	332	325	315
Urea(8Kg.ha-1)	310	340	325	325
Ammonium Sulfate(4Kg.ha-1)	250	240	200	230

Table 8. Complex Analysis of variance of yield and seed protein contents variables

SOV	*DF*	M.S	
		%protein	Yield
year	2	169.8ns	101944ns
Error	6	0.309	-
A-factor	3	4.54**	9907ns
Year*A-factor	6	0.58ns	7129ns
Error	18	0.179	53611

ns non significant
*(p<0.05)
** (p<0.01)

Table 9. Mean of seed protein content in treatments among years

Treatments	%protein
Control	11.13C
Urea(4Kg.ha-1)	12.25AB
Urea(8Kg.ha-1)	12.79A
Ammonium Sulfate(4Kg.ha-1)	11.74BC
LSD	0.994(p=0.01)

Means with the same letter are not significantly different.

4. Conclusion

Effects of treatments on seed protein contents at different years illustrated in table 6.These data indicated that the best treatment for foliar application is 8 kg.ha^{-1} Urea as foliar application. In these years, this treatment had significant difference in comparison to others. Mean of seed protein content among years were showed in table 9. According to data, foliar application of 8 kg.ha^{-1} Urea increased seed protein to maximum level (12.79%) in comparison to other treatments. On the whole, results of experiment indicated that increasing of seed protein content through foliar application is possible. Results of this research are similar to other researcher results. For example, Gab-Alla et al (2003) showed that use of 10kg.ha^{-1} Urea as foliar application increased seed protein content from 10.2 to 11.8 percent. Base on the Cooper and Blakeny (1990), Lotfollahi and Malakouti (1997) results, seed protein content was increased (2.9 % and 3.7% respectively) by Urea spraying at flowering stage. Results of many researcher show that Nitrogen spraying after flowering stage have significant effects on seed protein content, because through flowering stage, root system cannot absorb enough Nitrogen, so Nitrogen supplying, specially as spraying have positive effects on seed protein content (Akcozen et al, 1993).

Many of qualitative parameters of wheat crop control genetically, but they affected by environmental factors such mineral nutrients. Results of many researchers emphasized that seed protein content increased by Nitrogen supply. Our result showed, Nitrogen spraying after anthesis increase seed protein content. Based on the results, use of 8kg.ha^{-1} Urea as spraying at doughy stage was highly recommended for seed protein increasing.

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