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EFFECT OF Ni ON NITROGEN UPTAKE AND YIELD OF WHEAT (*Triticum aestivum*)

R.P. SINGH[a1], S.K.S.CHANDEL[b], P.K. YADAV[c] AND S.N. SINGH[d]

Department of Agricultural Chemistry and Soil Science, Udai Pratap Autonomous College, Varanasi, U.P., India
[a]E-mail: drraghvendraupc@gmail.com
[b]E-mail: santoshchandel94@gmail.com
[c]E-mail: pankajyadavsoil@gmail.com
[d]E-mail: snsingh.agro@gmail.com

ABSTRACT

The effect of Ni as an essential micronutrient on dry matter yield, N content and uptake by wheat was investigated. Field experiment adopting randomized block design with 6 treatments (including controls) and 4 replications was conducted for this purpose. Treatments were T_1 (Control-1 = no input), T_2 (control-2 = Recommended dose of NPK at 120:60:60 kg ha^{-1}), T_3 (NPK + Ni at 1 kg ha^{-1}), T_4 (NPK + Ni at 2 kg ha^{-1}), T_5 (NPK + Ni at 4 kg ha^{-1}) and T_6 (NPK + Ni at 5 kg ha^{-1}). The obtained results showed that the dry matter yield (at 45 days after sowing, straw and grain) was significantly increased by the application of Ni at 1 and 2 kg ha^{-1} levels as compared to controls. At higher levels (4 and 5 kg Ni ha^{-1}) yield reduced as compared to lower levels but still was higher than that of controls. Similar trend was also observed with N content and uptake by the wheat.

KEY WORDS: Nickel, nitrogen, wheat

Ni is the most recent candidate to be added in the list of essential nutrients for higher plants although failure to complete the life cycle in the absence of Ni has only been demonstrated in a few plant species. Ni is considered an essential element primarily because of its function as an irreplaceable component of urease which is responsible for the hydrolysis of urea N. Urea N acquired by plants is not available for plant N metabolism unless hydrolyzed to CO_2 and NH_3. Consequently, urea grown plants are highly sensitive to inadequate Ni supply (Greendas and Sattelmacher, 1999).

Although Ni deficiency has not been reported under field conditions, the increasing use of urea as N fertilizer calls for more detailed studies on plant urea metabolism, particularly in cases where urea is applied as foliar fertilizer with high purity chemicals, where Ni supply may not be adequate**.** The apparent confirmation of the essentiality of Ni was provided by Brown et al. (1987a) who showed that Ni was essential for grain viability in barley. The related experiments with barley, wheat and oats grown with NH_4-N and NO_3-N deficiency symptoms, namely interveinal chlorosis and patchy necrosis of younger leaves, were observed (Brown et al., 1987b). Keeping these facts in mind the present study was undertaken.

MATERIALS AND METHODS

A field experiment was conducted in the year 2007-08 and 2008-09 with wheat. Randomized block design was applied with six treatments and four replications. Treatments were T_1 (Control-1 = no input), T_2 (control-2 = Recommended dose of NPK at 120:60:60 kg ha^{-1}). T_3 (NPK + Ni at 1 kg ha^{-1}), T_4 (NPK + Ni at 2 kg ha^{-1}), T_5 (NPK + Ni at 4 kg ha^{-1}) and T_6 (NPK + Ni at 5 kg ha^{-1}). Basel doses of N (50 % of total), P and K were applied through urea, di-ammonium phosphate and muriate of potash, respectively. The remaining N was applied as urea at tillering stage. Ni was applied in the form of $NiCl_2$ as basal application. The crop was irrigated as per recommended schedule and harvested at maturity. The straw and grain samples were dried at 105^0C. The samples were digested using H_2SO_4 : $HClO_4$ and determined the N content (Lindner,1944).

RESULTS AND DISCUSSION

Dry matter yield

Data presented in table-1 shows that the dry matter of wheat (at 45 days after sowing, straw and grain) significantly increased by thee application of Ni as compared to control 1 and 2. However, this increase was only up to 1 and 2 kg ha^{-1} levels. Positive response to Ni

[1]**Corresponding author**

application may be due to the effect of Ni as an essential micronutrient not only for nitrogen metabolism but also for protein synthesis in higher plants. Brown et al., (1987b) reported that Ni deprived barley had 30 % less fresh weight than those supplied with 1.0 μ M Ni. The increase in the yield may be because Ni is a component of enzyme urease (Dixon et al., 1975), which is present in wide range of plant species (Welch, 1981) and in this role Ni participates in metabolism during the reproductive phase of growth (Walker et al., 1985). At higher levels of applied Ni (4 and 5 kg ha^{-1}) the dry matter production decreased as compared to lower levels. Yield reduction may be attributed to factors like stiffening the expansion zone tissue, disruption of the integrity of roots meristems, reduced chlorophyll and increased levels of protochlorophyll, imbalance in nutrition of other essential nutrients, or a combination of such effects (Cataldo et al.,1978**).** It was interesting to note that though the dry matter yield decreased with higher levels of Ni application but was still higher than the controls. Highest dry matter yield was recorded when Ni was applied at 2 kg ha^{-1} level.

Nitrogen Content and Uptake

The application of NPK at recommended dose significantly increased the nitrogen content in plants (at 45 DAS), grain and straw (table-2). Nitrogen content was further significantly increased by the application of Ni at 1 and 2 kg ha^{-1} levels as compared to without Ni application. Applied Ni at higher levels (4 and 5 kg ha^{-1}) had antagonistic effect on nitrogen content. Maximum nitrogen content was recorded with Ni at 2 kg ha^{-1} level. Application of Ni at 1 and 2 kg ha^{-1} increased the N uptake in plants at 45 days after sowing, grain and straw as compared to controls. Higher levels (4 and 5 kg ha^{-1}) of Ni had antagonistic effect on N uptake. The maximum N uptake by wheat was registered with 2 kg Ni ha^{-1}. Similar results have also been reported by Singh et al. (1990).

CONCLUSION

Our results indicated that Ni has beneficial effect on wheat and production may be increased by the application of Ni up to 2 kg ha^{-1} level.

Table 1: Effect of Ni on dry matter yield of wheat

Treatments	Dry matter Yield at 45 DAS (q ha^{-1})		Grain Yield (q ha^{-1})		Straw Yield (q ha^{-1})	
	I	II	I	II	I	II
T_1	5.12	4.70	15.13	14.50	21.25	20.60
T_2	8.85	9.00	21.00	22.00	31.28	37.20
T_3	11.50	12.00	26.50	27.16	36.82	43.78
T_4	8.40	8.50	20.03	21.50	29.99	35.20
T_5	7.35	7.40	19.20	19.40	25.99	33.72
T_6	6.20	6.15	18.00	18.15	25.00	25.20
CD (P=0.05)	1.07	0.47	3.72	1.36	3.15	4.44

DAS= Days After Sowing I= 2007-08,II= 2008-09

Table 2: Effect of Ni on N content and uptake by wheat

Treatments	N content at 45 DAS (%)		N uptake at 45 DAS (kg ha^{-1})		N content in grain (%)		N uptake in grain (kg ha^{-1})		N content in straw (%)		N uptake in straw (kg ha^{-1})	
	I	II	I	II	I	II	I	II	I	II	I	II
T_1	0.98	1.01	5.02	4.75	0.78	0.76	11.80	11.02	0.245	0.254	5.21	5.23
T_2	1.95	2.02	17.26	18.18	1.61	1.65	33.81	36.30	0.465	0.465	14.54	17.30
T_3	2.00	2.08	23.00	24.96	1.63	1.66	43.19	45.09	0.490	0.487	18.04	21.32
T_4	2.10	2.15	17.64	18.28	1.64	1.68	32.85	36.12	0.495	0.505	14.85	17.78
T_5	1.90	1.93	13.97	14.28	1.60	1.63	30.72	31.62	0.435	0.437	11.31	14.74
T_6	1.14	1.12	7.06	6.89	1.50	1.51	27.00	27.41	0.321	0.312	8.03	7.86
CD (P=0.05)	0.054	0.032	2.34	1.08	0.16	0.11	8.04	4.13	0.04	0.04	1.90	1.82

DAS= Days After Sowing I= 2007-08, II= 2008-09

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