Available online at www.ijpab.com

DOI: http://dx.doi.org/10.18782/2320-7051.7659

ISSN: 2582 – 2845

Ind. J. Pure App. Biosci. (2019) *7*(5), 17-24

Research Article

Indian Journal of Pure & Applied Biosciences

Performance of Wheat Varieties as Influenced by Organic and Chemical Sources of Nitrogen under Semi-Arid Environment

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Received: 18.07.2019 | Revised: 26.08.2019 | Accepted: 3.09.2019

ABSTRACT

The field experiment was conducted at Research Farm, Department of Agronomy, at CCS Haryana Agricultural University, Hisar during Rabi seasons 2017-18 with the objective to study performance of wheat varieties as influenced by nutrient sources of nitrogen under semi-arid environment in split plot design with three replications. In the main plots there were five wheat varieties (WH-1105, WH-1142, HD-3086, HD-2967 and DBW-88) and in sub plots there were different nitrogen source namely 100 RDN through inorganic source (urea) , 100 per cent RDN through organic source (vermicompost) and 50 per cent RDN through inorganic + 50 per cent RDN through organic source. The variety WH-1105 produced significantly taller plant with higher dry matter accumulation per meter row length and grain yield over other varieties but did not differ significantly with variety HD-3086. Combined application of 50 per cent RDN through inorganic source + 50 per cent RDN through organic source had significantly improved the growth component viz. plant height and dry matter accumulation over 100 per cent RDN organic source but did not differ significantly with 100 per cent RDN through inorganic. Significantly higher grain yield was obtained with 100 per cent RDN through inorganic source over 100 per cent RDN through organic source but it was statistically at par with 50 per cent RDN through inorganic + 50 per cent RDN through organic source. The grain yield increased under the 100 per cent RDN through inorganic source by 29.1, 8.2 % over 100 RDN through organic source and 50 per cent RDN through inorganic + 50 per cent RDN through organic source, respectively.

Keywords: *Wheat, Nitrogen source, Yield and Environment*

INTRODUCTION

Wheat (*Triticum aestivum* L.) is the most important and dominant cereal crop of the world due to rich source of carbohydrates and being staple food both for human as well as livestock. India is the second largest producer of wheat in the world next to China. The area, production and productivity of wheat in India was 30.7 m ha, 97.4 m t and 3172 kg ha^{-1}, respectively. In Haryana, area, production and productivity of wheat was 2.5 m ha, 11.4 m t and 4407 kg ha^{-1}, respectively (Singh, 2017).

Cite this article: Wazir, M., Kumar, P., Kumar, S., Sewhag, M., & Kumar, J. (2019). Performance of Wheat Varieties as Influenced by Organic and Chemical Sources of Nitrogen under Semi-Arid Environment, *Ind. J. Pure App. Biosci.* *7*(5), 17-24. doi: http://dx.doi.org/10.18782/2320-7051.7659

Productivity of wheat is governed by improved varieties coupled with good production technology. Suitability of varieties to a particular agro-climate is the most important factor in realizing their potential yield, which is further influenced by their response to application of nutrients, particularly nitrogen (Maqsood et al., 2014). Nitrogen is one of the primary nutrients, an integral part of the plant tissues and has both direct and indirect effects on the crop performance by enhancing leaf production and expansion rate that influences interception of photo synthetically active radiation and subsequently dry matter production. (Ali et al., 2012). It was observed that both an optimized nitrogen management for a less responsive cultivar and a restrictive management for a more demanding cultivar may result in lower yield and damage the environment either through lodging or nutrients leaching (Riley et al., 2001; & Ma et al., 2010).

Application of synthetic fertilizer increased crop yield, but their use has both positive and negative effects, as after their application they act immediately on soil fertility unlike organic fertilizers which needed decomposition before absorption. Moreover, use of chemical fertilizer as a source of nitrogen seems to provide adequate and on-time nutrients for the wheat crop, but its high price, non-availability, low efficiency and adverse effects to human and livestock health and environment cause limitations to their application. Whereas, manures are natural sources of plant nutrients derived from plants and animal sources and play a very significant role in increasing soil fertility.

Importance of organic manures for crop production as substitute of chemical fertilizers cannot be overlooked. The world nitrogen demand is growing at the rate of 1.5 percent, but its production is expected to grow around at annual growth rate 1.4 percent. In Asian countries, the bulk increase world demand for nitrogen is expected from China (18 percent), next from India (17 percent), followed by Indonesia (6 percent), Pakistan (4 percent), Bangladesh (2 percent), Vietnam (2 percent) and Malaysia and Thailand, 01 percent each (F.A.O, 2015). Therefore, application of nitrogen in adequate quantity through organic and inorganic sources is essential to meet the growing demand of nitrogen. This has necessitated the practice of using organic and inorganic sources of nitrogen in crop production. Thus devising a sound strategy for judicious nitrogen management with both commercial and organic sources is the need of the hour for sustaining crop productivity (Zhang et al., 2016).

MATERIALS AND METHODS

Site characterization

The experiment was conducted at Agronomy Research Area, Department of Agronomy, CCS Haryana Agricultural University, Hisar during *Rabi* seasons 2017-18; which is situated at 29º 10´ N latitude and 75º 46´ E longitude with an elevation of 215.2 meter above mean sea level in Haryana State of India. The physico-chemical properties of soil along with method used for interpretation presented in Table 1.

Treatments and experimental design

Field experiment comprising of five varieties WH 1105, WH 1142, HD 2967, HD 3086 and DBW 88 and three nitrogen sources *viz.* 100 per cent RDN through inorganic source (urea), 100 per cent RDN through organic source (vermicompost) and 50 per cent through inorganic (urea) + 50 per cent through organic source (vermicompost) was conducted in split-plot design replicated thrice.

Cultural practices

The details of cultural operations carried out during the pre and post sowing of wheat in the experiment field are presented in Table 2.

Observations recorded

Plant height of three randomly selected plants was measured from ground surface to terminal growing point of main shoot at periodical intervals. Plants were selected in one meter row length representing the entire plot from the second row on either side in each plot and cut from the ground surface, sun dried and then dried in oven at 65°C temperature so as to attain constant weight. These dried samples were weighed for calculating dry weight in grams per meter row length. Yield attribute are measured by adopting standard procedure. Grain, straw and biological yield data were recorded on whole plot basis and then converted to kg ha^{-1}.

Statistical analysis

The experimental data for various growth, yield attributing characters, yield, quality parameters and nutrients uptake was statistically analyzed by standard method of analysis of variance (ANOVA) as described by Panse & Sukhatme (1985) and linear regression by using statistical software SPSS. The significance of treatment effects were computed with the help of 'F' (variance ratio) test and to judge the significance of differences between means of two treatment, critical differences (CD) was worked out as described by Gomez & Gomez (1983) as follows:

$$CD = \sqrt{\frac{2 \text{ x EMS}}{n}} \text{ x t value at 5\%}$$

Where,

CD = Critical difference

n = Number of observations of that factor for which CD is to be calculated

t value at 5% = Value of Fisher's table (Fisher, 1950) for error degree of freedom at five per cent level of significance

RESULTS AND DISCUSSION

Growth parameters

The response of varieties and nitrogen source to growth components in terms of plant height and dry matter accumulation per meter row length are depicted in Figure 1 and Figure 2. Almost all the growth components were significantly influenced by the varieties. The variety *WH-1105* produced significantly taller plant with higher dry matter accumulation per meter row length over other varieties but did not differ significantly with variety *HD-3086*. The differences in growth and development may be due to the genetic constitution or environmental factors. The genetic factors refer to genes, the genomes and the chromosomes which determine the phenotype of plant. In other words, a plant displays unique traits which make such trait inherent in plant. Similar results reported by Mondal et al. (2015) and Singh et al. (2018).Combined application of 50 per cent RDN through inorganic source + 50 per cent RDN through organic source had significantly improved the growth component *viz*. plant height and dry matter accumulation over 100 per cent RDN organic source but remained at par with 100 per cent RDN through inorganic. Generally the plant growth rate was slow in beginning because the major parts of the plant absorbed nutrients are utilized for the extension of root system and for the formation of new leaves with the limited availability of photosynthates. As a result, the development of growth parameters like plant height and dry matter accumulation lower in early stage of crop growth. Similar, findings was reported by Zahir et al. (2007) and Devi et al. (2011).

Yield and its attributes

The yield attribute and yield in the terms of effective tillers per meter square, grain per spike, spike length, test weight, grain, straw and biological yield are summarized in Table 3. All these characters were significantly differed among the various varieties. Almost all these yield attributes significantly higher under the *WH-1105* over *WH-1142*, *HD-2967* and *DBW-88* except effective tillers which was at par with variety *HD-2967* and which was remained statistically at par with *HD-3086* and in respect to effective tillers per meter square, grains per spike, spike length, test weight, grain yield except straw and biological yield. Significantly higher straw yield obtained under the variety *WH-1105* over *HD-2967*, *HD-3086* and DBW-88 but statistically at par with *WH-1142* variety. Significantly higher biological yield was recorded under the variety *WH-1105* over others varieties. The similar result finding was reported by Choudhary et al.

(2017) and Sandhu et al. (2017). Integration of 50 per cent RDN through inorganic + 50 per cent RDN through organic source had significantly improved the yield attributes and yield in the terms of effective tillers per meter square, grains per spike, grain yield except straw and biological yield over 100 per cent RDN through organic source which statistically at par with 100 per cent RDN through inorganic source except test weight which did not differ significantly among the various nutrient source. Straw and biological yield significantly higher under 100 per cent RDN through inorganic source over others nitrogen source. Significantly higher spike length produce under the 100 per cent RDN through organic source over 100 per cent RDN through inorganic source which statistically at par with 50 per cent RDN through inorganic + 50 per cent RDN through organic source under adequate N supply there would have been greater translocation of photosynthates from leaves via stem to sink site. This resulted in production of longer and heavier spikes with more grains spike^{-1}. Similar result reported by Azam et al. (2012) and Yousefi & Sadeghi (2014). Descriptive statistics and ANOVA of the model are given in the Table 4 and 7, respectively.

Correlation studies

Correlation between grain per spike and grain yield is significant as p (0.022< 0.05), where as correlation between spike length and grain yield is highly significant p (0.000<0.05, Table 5). The variation in grain yield (dependent variable) i.e. 99 percent is explained by independent variable viz. test weight, effective tillers, spike length and grain per spike as adjusted R^2 of the model is 0.99 (Table 6).In the regression model, the coefficients of independent variables i.e. grain per spike, spike length and test weight are statistically significant (Table 8). The normal plots (p-p) of standardized residuals and scatter plot between grain yield and spike length are shown in Fig. 3(a & b), respectively.

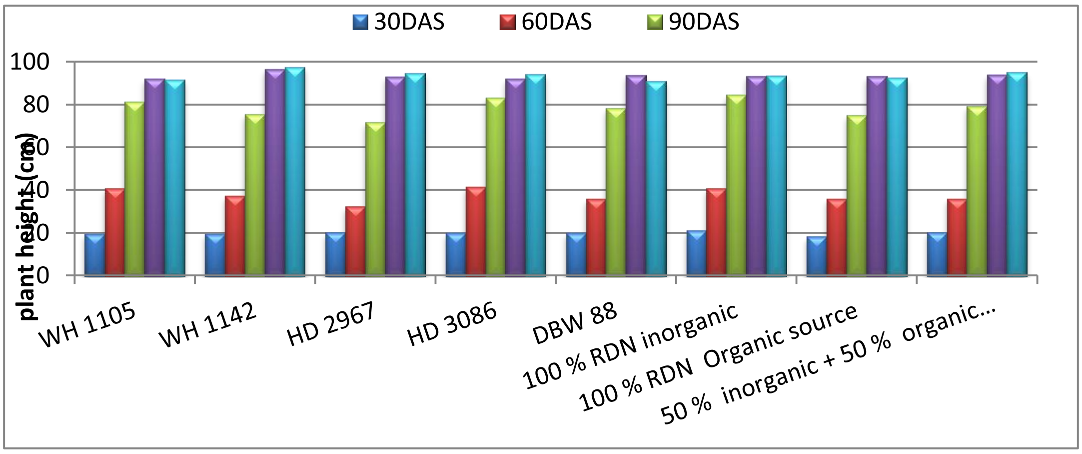

Fig. 1: Effect of varieties and nitrogen sources on plant height of wheat

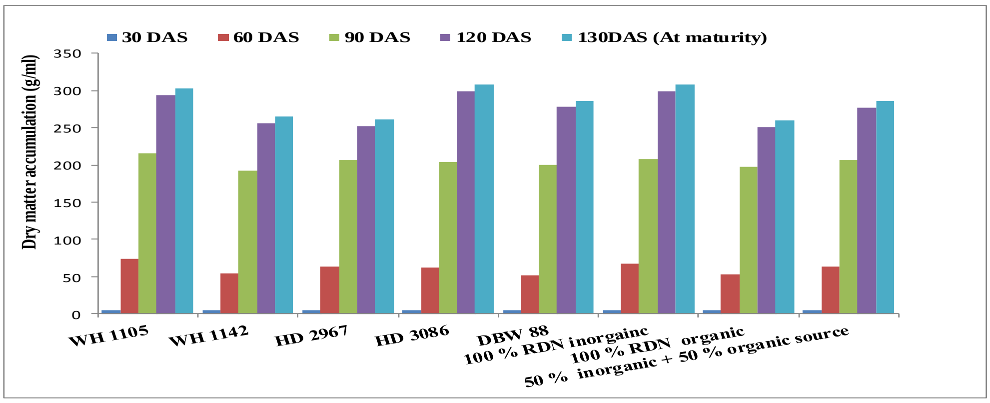

Fig. 2: Effect of varieties and nitrogen sources on dry matter accumulation per meter row length of wheat

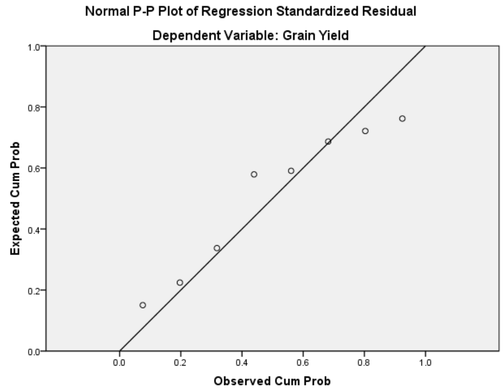

Fig. 3(a)

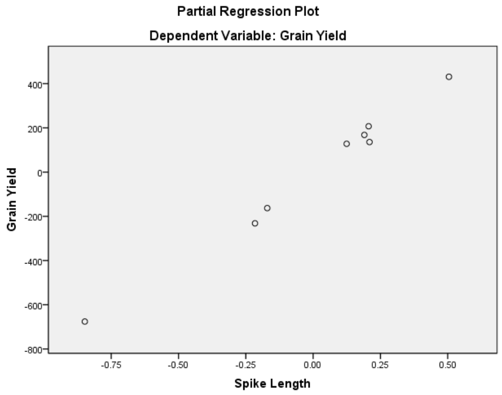

Fig. 3(b)

Fig. 3: Regression

Table 1: Physico-chemical properties of experimental field

Soil properties		Values	Method used
A.	Mechanical composition of soil (%)		
	Sand	74.0	International Pipette Method (Piper, 1996)
	Silt	17.0	
	Clay	9.0	
B.	Chemical composition of soil		
	PH (1:2)	7.73	Glass electrode pH meter (Jackson, 1973)
	EC (dSm^{-1}) at 25 ºC	0.23	Conductivity bridge meter (Richards, 1954)
	Organic carbon (%)	0.25	Walkley and Black wet oxidation method (Jackson, 1973)
C.	Nutrients available		
	Available N ($kg\ ha^{-1}$)	133	Alkaline permagnate method (Subbiah and Asija, 1956)
	Available P ($kg\ ha^{-1}$)	18	Olsen's method (Olsen *et al*., 1954)
	Available K ($kg\ ha^{-1}$)	245	Flame photometric method (Richards, 1954)

Table 2: Details of cultural operations carried out in the experiment field.

	Nature of operation	Details of operation
A	Pre-sowing operation	
1	Pre sowing irrigation	Pre-sowing irrigation was applied
2	Seed bed preparation	Two cross harrowing followed by ploughing with cultivator and planking
3	Layout and basal dose of fertilizer application	150 kg N. Half dose of N was applied as basal dose at the time of sowing and remaining dose of N was applied at 25 DAS after first irrigation as top dress.
B	Post sowing operation	
1	Sowing	Seeds were sown by seed drill machine.
2	Final layout	Irrigation channel and boundaries were made
3	Weeding	Two times hand weeding was done at vegetative stages
4	Fertilizer	Remaining nitrogen fertilizer applied as top dress after first irrigation.
5	Irrigation	Four irrigations were applied at 21, 45, 85 and 122 DAS. In each plots 5 cm irrigation was applied through Check basin irrigation method.
6	Harvesting	Harvesting was done with the help of sickle and bundles were kept in the field for sun drying.
7.	Threshing	Threshing by plot thresher and grain yield was recorded

Table 3: Effect of varieties and nitrogen sources on yield attributes and yield of wheat

Treatment	Effective tillers (No. m^{-2})	Grains per spike	Spike length (cm)	Test weight (g)	Grain yield ($kgha^{-1}$)	Straw yield (kg ha^{-1})	Biological yield (kg ha^{-1})
Varieties							
WH-1105	295.5	70.18	10.24	42.4	4833	6700	11533
WH-1142	228.8	54.48	9.26	35.6	4016	6166	10182
HD-2967	263.3	63.40	9.33	36.9	4166	5111	9277
HD-3086	285.5	69.40	9.77	39.9	4555	5250	9666
DBW-88	156.6	53.77	9.36	38.7	3944	5944	9888
CD (P=0.05)	59.0	5.5	0.60	3.6	542	729	857
Nitrogen source							
100 % RDN through inorganic source (urea)	239.0	66.48	10.27	38.3	5083	6616	11700
100 % RDN through organic source (vermicompost)	211.6	61.24	8.67	38.8	3600	5186	8786
50 % RDN through inorganic + 50 % RDN through organic source	227.3	65.02	9.84	39.0	4664	5700	10166
CD (P=0.05)	19.49	3.5	0.83	NS	436	808	1057

Table 4: Descriptive Statistics

	Mean	Std. Deviation
Grain Yield	4357.63	504.760
Effective Tillers	238.4500	44.27837
Grain per Spike	62.9963	6.20764
Spike Length	9.5925	.54189
Test Weight	38.7000	2.00855

Table 5: Correlations

		Grain Yield	Grain per Spike	Spike Length	Test Weight
Pearson Correlation	Grain Yield	1.000	0.721	0.976	0.440
	Grain per Spike	0.721	1.000	0.643	0.676
	Spike Length	0.976	0.643	1.000	0.502
	Test Weight	0.440	0.676	0.502	1.000
Sig. (1-tailed)	Grain Yield		0.022	0.000	0.137
	Grain per Spike	0.022		0.043	0.033
	Spike Length	0.000	0.043		0.103
	Test Weight	0.137	0.033	0.103	

Table 6: Model Summary[b]

Model	R	R Square	**Adjusted R Square**	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	**Sig. F Change**	
dimension0 1	0.998[a]	0.996	**0.990**	50.335	0.996	175.235	4	3	**0.001**	1.639

a. Predictors: (Constant), Test Weight, Effective Tillers, Spike Length, Grain per Spike

b. Dependent Variable: Grain Yield

Table 7: ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	**Sig.**
	Regression	1775881.168	4	443970.292	175.235	**0.001[a]**
	Residual	7600.707	3	2533.569		
	Total	1783481.875	7			

a. Predictors: (Constant), Test Weight, Effective Tillers, Spike Length, Grain per Spike

b. Dependent Variable: Grain Yield

Table 8: Coefficients[a]

Model		Unstandardized Coefficients		T	**Sig.**
		B	Std. Error		
	Constant	-3085.596	446.599	-6.909	**0.006**
	Effective Tillers	-1.874	.822	-2.281	**0.107**
	Grain per Spike	36.357	7.698	4.723	**0.018**
	Spike Length	831.909	46.194	18.009	**0.000**
	Test Weight	-61.509	13.987	-4.398	**0.022**

REFERENCES

Ali, A., Khaliq, T., Ahmad, A., Ahmad, S., Malik, A.U., & Rasul, F. (2012). How wheat responses to nitrogen in the field? A review. *Crop Environ. 3*, 71-76.

Azam, S., Shah, M., Shah, S., Mohammad, W., Shafi, M., & Nawaz, H. (2012). N uptake and yield of wheat as influenced by integrated use of organic and mineral nitrogen. *International Journal of Plant Production*. *3***(**3), 45-56.

Choudhary, R.R., Prajapat, A.L., Choudhary, S.L., & Meena, O.P. (2017). Response of Wheat [Triticum aestivum L) emend. Fiori & Paol] cultivars to integrated nutrient management *International Journal of Current microbiology and Applied Science*.*6*(8), 1607-1612.

Devi, K. N., Singh, M. S., Singh, N. G., & Athokpam, H. S. (2011). Effect of integrated nutrient management on growth and yield of wheat (Triticum aestivum L.). *Journal of Crop and Weed*, *7*(2), 23-27.

FAO, (2015) .World fertilizer trends and outlook to 2018, *Food and Agriculture organization of the United Nations (FAO),* Rome, ISBN 978-92-5-108692-6, Annual Report 14.

Fisher, R.A. (1950). Statistical Methods for Agriculture Research Workers. II[nd] Ed. *Oliver and Boyand*, London.

Gomez, K.A., & Gomez, A.A. (1983). Statistical procedures for agricultural research, IRRI. A Wiley Pub., New York, pp: 199-201.

Jackson, M. L. (1973). Soil chemical analysis. Prentice Hall of India Pvt. Ltd. New Delhi. pp. 183-192.

Ma, B. L., Wu, T. Y., Tremblay, N., Deen, W., McLaughlin, N. B., Morrison, M. J., & Stewart, G. (2010). On-farm assessment of the amount and timing of nitrogen fertilizer on ammonia volatilization. *Agronomy Journal*. *102*(1), 134-144.

Maqsood, M., Shehzad, M.A., Yaser, R., & Sattar, A. (2014). Effect of nitrogen on growth, yield and radiation use efficiency of different wheat (*Triticum aestivum L.*) Cultivars. *Pakistan Journal of Agricultural Sci*ence.*51*(2), 441-448.

Mondal, H., Mazumder, S., Roy, S. K., Mujahidi, T. A., & Paul, S. K. (2015). Growth, yield and quality of wheat varieties as affected by different levels of nitrogen. *Bangladesh Agronomy Journal*. *18*(1), 89-98.

Olsen, S. R., Cole, C. V., Watanable, F. S., & Dean, C. A. (1954). Estimation of available phosphorus in soil extraction with sodium bicarbonate. *Circ. V. S. Deptt. Agric*., 939, Washington, D. C.

Panse, V.G., & Sukhatme, R.V. (1985). Statistical methods for agricultural workers 4th Ed. ICAR, New Delhi.

Piper, C. S. (1966). Soil and water analysis. *Published by Univ. Adelaide, Australia*

Richards, L. A. (1954). Diagnosis and improvement of saline and alkali soils. USDA Hand Book No. 60, *Washington, D. C.*

Riley, W. J., Ortiz-Monasterio, I., & Matson, P. A. (2001). Nitrogen leaching and soil nitrate, nitrite, and ammonium levels under irrigated wheat in Northern Mexico. *Nutrient Cycling in Agroecosystems*. *61*(3), 223-236.

Sandhu, S., Balkaran, & Dhaliwal, S., & Nirmaljit. (2017). Comparative performance of wheat cultivars in Muktsar district of Punjab. *Adv. Res. Journal of Crop Improve. 8*(2), 186-190.

Singh, A., Darvhankar, M.S., Singh, G., & Sonam. (2018). Impact of organic and inorganic amendments on yield and growth of wheat (*Triticum aestivum* L.). *International Journal of Current Microbiology and Applied Science*. 7(8), 789-794.

Singh, G.P. (2017). Director's Report of AICRP on wheat and Barley 2016/17 *ICAR-Indian institute of wheat and Barley Research, Karnal, Haryana, India.P*.87.

Yousefi, A.b., & Sadeghi, M. (2014). Effect of vermicompost and urea chemical fertilizers on yield and yield components of wheat (*Triticum aestivum*) in the field condition. *International Journal of Agriculture and Crop Science. 7*(12), 1227-1230.

Zahir, Z. A., Afzal, A., Ajmal, M., Naveed, M., Asghar, H. N., & Arshad, M. (2007). Nitrogen enrichment of composted organic wastes for improving growth, yield and nitrogen uptake of wheat. *Soil and Environment*. *26*(1), 15-21.

Zhang, H., Yu, X. Y., Zhai, B. N., Jin, Z. Y., & Wang, Z. H. (2016). Effect of manure under different nitrogen application rates on winter wheat production and soil fertility in dryland. *Earth and Environmental Science. 39*(1), 12-48.