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EFFECTS OF DIFFERENT DOSES OF NITROGEN AND CHICKEN MANURE ON TIR WHEAT (*Triticum aestivum* L. var. *leucospermum* (K ö r n.) F a r w.) YIELD AND YIELD COMPONENTS

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ABSTRACT

Chicken manure is a concentrated and quick acting fertiliser. Application of chicken manure at optimum doses together with nitrogen fertilising may provide balanced significant increase of crop productivity and production quality. In this study, the effects of nitrogen doses (0, 40, 80, 120 and 160 kg nitrogen ha^{-1} with sowing and 60 kg nitrogen ha^{-1} top fertiliser with tillering season except control plots in total 0, 100, 140, 180 and 220 kg nitrogen ha^{-1}) under the condition with chicken manure (10 t ha^{-1}) and without chicken manure on yield and yield components of Tir wheat were investigated. Experiment was laid out in Split Plots Design in Randomised Blocks with 3 replicates in Yuzuncu Yil University, in 2009–2010 and 2010–2011 growing seasons. While the highest seed yield was obtained at the chicken manure and 180 kg ha^{-1} nitrogen fertiliser as 2346 and 2073 kg ha^{-1}, repectively, the lowest seed yield was obtained without chicken manure and control as 1451 and 1270 kg ha^{-1} in years of 2011–2012 and 2012–2013, respectively. The results of the study indicated that nitrogen and chicken manure applications increased significantly the seed yield and yield components.

Keywords: wheat, chicken manure, nitrogen, yield, yield components.

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AIMS AND BACKGROUND

Nitrogen fertilisation is an important component of integrated chicken fertiliser systems in wheat. Artificial fertilisation has increased in the world for cereal production due to availability of inexpensive fertilisers[1,2].

The wheat is at the first rank in cereals in the world and Turkey[3]. The wheat which has 217 mil. ha sowing area and 653 mil. t of production in the world, has 8.1 mil. ha sowing area and 19 mil. t of production in Turkey. 2427 ha per kg average yield of Turkey is some lower than world average yield (3006 kg ha^{-1}). Use of organic wastes in agriculture is well known but the idea is not widely accepted due to some limitations. Phosphorus deficiency hinders plant growth and crop productivity[4]. The productivity of a crop is controlled by many factors of which the mineral nutrition especially of nitrogen is large. The most important factor is that the heavy and imbalanced use of chemical fertiliser has led to think about the use of organic manures in intensively growing areas for sustainable production system. Therefore, to sustain the land and to achieve production potential of crops, judicious use of organic manures and their scientific management is important. It must be stressed that the value of vermicompost, poultry manure and green leaf manure in soil improvement is due to their nutrient content, besides helping in the improvement of soil structure and water holding capacity of soil[5].

The purpose of this study was to explain the effects of nitrogen and chicken manure levels in winter wheat. Therefore, effect of these treatments on seed yield per area and yield elements of wheat was delved.

EXPERIMENTAL

Tir cultivar was well adapted wheat in Van ecological conditions[6,7]. The trial was established in 2009–2010 and 2010–2011 years in eastern Turkey (longitude 43°17′E′, latitude 38°33′N′, and altitude 1655 m). Layer manure used in this research includes organic matter, nitrogen, phosphorus potassium and salt in high level as 2.87, 2.90, and 2.35%, 6.5 ms/cm, respectively. The maximum humidity of this layer manure was reported as 20%. Licensed stabile layer manure was collected from Baytar Poultry in Turkey[8]. In 2009–2010 and 2010–2011, precipitation throughout the season was 455.3 and 361.6 mm, respectively (Table 1). Average temperature was 7.94°C in 2009–2010 and 8.28°C in 2010–2011. Average relative humidity was 66 and 58% in the first and 67% in the second vegetation periods[9]. Soils of experimental field were clay loam in texture, having low organic matter and high alkali reaction (Table 2).

Table 1. Meteorological data for the growing seasons of 2009–2010, 2010–2011 and long-term averages in Van, Turkey[9]

Month	Precipitation (mm)			Average temperature (°C)			Relative humidity (%)		
	2009–2010	2010–2011	LTA*	2009–2010	2010–2011	LTA*	2009–2010	2010–2011	LTA*
October	42.8	45.8	39.6	11.2	12.6	10.7	70	61	70
November	33.4	0.0	29.7	5.2	4.3	4.4	60	63	60
December	40.5	8.7	38.3	0.2	2.0	–0.9	60	54	60
January	32.1	14.2	29.4	–2.4	–1.6	–3.5	60	65	60
February	28.3	26.6	26.0	–0.4	–0.8	–3.1	60	67	60
March	37.4	30.7	33.2	3.8	2.4	1.0	60	61	60
April	65.9	133.7	57.0	9.2	8.6	7.5	60	60	70
May	77.5	62.8	70.8	13.5	13.0	13.0	70	59	70
June	62.3	28.1	65.8	18.1	19.2	18.1	80	45	80
July	35.0	11.0	37.1	20.8	23.1	22.2	80	39	80
Total	455.3	361.6	426.9						
Average				7.94	8.28	6.9	66	58	67

*LTA – long-term average (1979–2011).

Table 2. Some properties of the < 2 mm fraction of the top 20 cm of soil used for each site

Soil properties	2009–2010	2010–2011
Texture	sandy loam	sandy loam
pH[a]	8.3	8.4
Clay (%)[b]	18.6	28.2
$CaCO_3$ (%)[c]	17.4	17.9
Olsen soil test P (ppm)[d]	5.11	4.22
Total salt (%)[e]	0.020	0.021
Organic matter (%)[f]	1.79	1.85

[a] 1 : 2.5 soil : water; [b] Bouyoucos[10]; [c] lime by calcimetric methods; [d] Olsen et al.[11]; [e] Richard[12]; [f] Jackson[13].

In the trial, with the sowing chicken manure (2.87% nitrogen, 2.35% potassium and 2.90% phosphorus), without chicken manure and nitrogen doses (0, 40, 80, 120 and 160 kg nitrogen ha^{-1} with sowing and 60 kg nitrogen ha^{-1} top fertiliser with tillering season except control plots in total 0, 100, 140, 180 and 220 kg nitrogen ha^{-1}) were applied. This research was conducted in a Split Plots Design in randomised blocks with 3 replications. The row spacing was arranged as 20 cm. Plot size was 1.0 × 5 = 5 m^2 at harvest, 2 outer rows for each plot and 50 cm from each end of the plots were left as borders and the middle 3 m of the central rows were harvested. Seeds were sown on 14.10.2009 in the first year and on 16.10.2010 in the second year by hand. The plants were harvested on 07.07.2010 and 01.07.2011 by the sickle. All calculations and measures were conducted as based on the procedures and methods used by Kün[14]. Calculations and weighting pertained to yield components were made within the context of 10 plant samples randomly chosen after the margin effect was omitted from each plot. Crude protein ratio in the grain was determined by the Kjeldahl method[15]. The obtained values were subject to variance analysis according to Split Plots Design in Randomizsd Blocks and the differences between averages were tested at 1% significance level in accordance with the Duncan Multiple Range Test method. Statistical Analysis Software[16] and Duzgunes et al.[17] methods were used at the significance control of results and averages.

RESULTS AND DISCUSSION

Both of years effects were utilised in order to get statistically significant differences between 2009–2010 and 2010–2011, separately. Means related with yield, yield and quality components were evaluated with the Duncan groups statistics and the differences between averages values are given in Table 3.

The results showed that all fertiliser treatments increased significantly (5%) the plant height of wheat compared with the control treatment (Table 3). The plant heights ranged between 74.1–101.8 cm in 2009–2010 and 68.9–98.2 cm in 2010–2011 growing season. The highest plant heights of 101.8 and 98.2 cm were obtained in treatment receiving from 220 kg ha^{-1} nitrogen and chicken manure application, respectively. The lowest plant heights were in the control receiving no nitrogen and without chicken manure in both years. Zai et al.[18] stated that the highest plant height was obtained from chicken manure in wheat. The results of trials in this study show coherence with those obtained in the above mentioned study conducted by researchers.

The spike length of wheat was significantly ($p < 0.05$) greater in nitrogen fertiliser and chicken manure than in the control treatment (Table 3). Like plant heights, the highest spike lengths of 12.1 and 10.7 cm were obtained in treatment receiving from 220 kg ha^{-1} nitrogen and chicken manure in first and second years. The lowest spike lengths were in the control receiving no nitrogen and without chicken manure in both years. Spike length is the most important in yield component, the longer spike can produce more spikelets resulting in more numbers of grains per spike. Ozalp[19] reported that the highest spike lengths were obtained chicken and pigeon manure in wheat.

The number of spikelet ranged between 8.4–14.3 in first year and 7.4–12.5 in 2010–2011. The highest numbers of spikelet were obtained from 220 kg ha^{-1} nitrogen and chicken manure. The difference between this application and 180 kg ha^{-1} nitrogen and chicken manure was found to be statistically insignificant for the two years. The lowest number of spikelet was obtained from 100 kg ha^{-1} nitrogen and without chicken manure application in the first year. The difference between this application and control plot was found to be statistically insignificant. The lowest number of spikelet was obtained from control plots in the second year. Kiani et al.[20] stated that the number of spikelets per spike did not indicate any response to nitrogen fertilisation and farm yard manure. The differences may be from the manure and the ecological conditions.

Table 3. Effect of different doses nitrogen and chicken manure application on some yield and quality components of Tir wheat*

	Nitrogen levels (kg ha^{-1})	Plant height			Spike length			Number of spikelet		
		without chicken manure	chicken manure	mean	without chicken manure	chicken manure	mean	without chicken manure	chicken manure	mean
1	2	3	4	5	6	7	8	9	10	11
	0	74.1 f	86.6 d	80.4 E	7.1 g	8.4 f	7.8 D	8.6 f	12.3 d	10.4 C
	100	80.4 e	91.1 c	85.7 D	7.6 g	8.6 ef	8.1 D	8.4 f	13.5abc	10.9 C
2009–2010	140	85.9 d	94.6 bc	90.3 C	8.3 f	9.0 de	8.7 C	10.4 e	13.8ab	12.1 B
	180	92.6 c	96.9 b	94.7 B	9.5cd	10.0bc	9.8 B	12.5cd	14.3 a	13.4 A
	220	94.9bc	108.1a	101.5A	10.4 b	12.1a	11.2 A	13.0bcd	14.3 a	13.6 A
	mean	85.6 B	95.4 A		8.6 B	9.6 A		10.6 B	13.6 A	
	0	68.9 g	75.1 f	72.0 E	6.4 e	7.3 d	6.9 E	7.4 f	10.2 d	8.8 D
	100	71.4fg	80.5 e	75.9 D	6.8 e	8.1 c	7.5 D	8.4 e	11.2 c	9.8 C
2010–2011	140	80.9de	84.9cd	82.9 C	8.1 c	8.5 c	8.3 C	10.3 d	11.9 ab	11.1 B
	180	79.6e	93.5 b	86.5 B	8.5 c	9.4 b	8.9 B	11.2 c	12.3 a	11.8 A
	220	86.5c	98.2 a	92.4 A	9.2 b	10.7 a	9.9 A	11.5 bc	12.5 a	12.0 A
	mean	77.5 B	86.4 A		7.8 B	8.8 A		9.8 B	11.6 A	
		Seeds per spike			Biological yield			Seed yield		
	0	15.2	20.7	17.9 C	4460e	5101cd	4781B	1451	1905	1678 C
	100	16.5	24.2	20.4 B	4797de	5374bc	5086AB	1704	2137	1918 B
2009–2010	140	18.9	24.6	21.8 B	4592e	5724ab	5158A	1716	2246	1981AB
	180	21.1	25.5	23.3 A	4471e	5551bc	5011AB	1771	2346	2059 A
	220	22.1	26.3	24.2 A	4555e	6189a	5372A	1538	2247	1893 B
	mean	18.8 B	24.3 A		4575B	5588 A		1636B	2176A	
	0	12.1	17.2	14.6 D	4183 de	4206 d	4195 C	1270 g	1504 e	1387 D
	100	14.4	19.1	16.7 C	3912 de	4811	4362BC	1296 g	1802 d	1549 C
2010–2011	140	17.2	20.4	18.8 B	3821e	5155bc	4488 B	1379 f	1989 b	1684 B
	180	19.2	22.2	20.2 A	3887 de	5122ab	4505 B	1485 e	2073 a	1779 A
	220	19.6	22.2	20.9 A	4590 c	5423 a	5007 A	1388 f	1887 c	1637 B
	mean	16.5 B	20.2 A		4079B	4943A		1364B	1851A	

to be continued

Continuation of Table 3

1	2	3	4	5	6	7	8	9	10	11
		Harvest index			1000 seed weight			Protein ratio		
	0	32.6	37.3	34.9 C	40.7	41.9	41.3 C	10.8	11.3	11.1 D
	100	35.5	39.6	37.6 B	41.5	42.7	42.1 B	11.6	12.1	11.9 C
2009–2010	140	37.4	39.3	38.3 B	41.5	42.8	42.2 B	11.8	12.7	12.3 B
	180	39.7	42.3	40.9 A	42.6	45.1	43.9 A	12.5	12.6	12.6AB
	220	33.8	36.3	35.1 C	40.1	42.1	41.1 C	12.7	13.1	12.9 A
	mean	35.8 B	38.9 A		41.3 B	42.9 A		11.9 B	12.4 A	
	0	30.4 e	35.8 c	33.1 D	38.9 e	41.8bc	40.3 C	10.4	10.9	10.7 E
	100	33.1 d	37.5 b	35.3 C	40.9 cd	41.8 bc	41.4 B	11.2	11.5	11.3 D
2010–2011	140	36.1 c	38.6 b	37.4 B	41.2bcd	42.0 b	41.6 B	11.5	11.8	11.6 C
	180	38.2 b	40.5 a	39.4 A	41.4bcd	43.6 a	42.5 A	11.7	12.0	11.9 B
	220	30.2 e	34.8 c	32.5 D	41.5bc	40.5 d	41.0 B	12.0	12.2	12. A
	mean	33.6 B	37.4 A		40.8 B	41.9 A		11.4 B	11.7 A	

* For each row within each treatment means follows by the same letter do not differ significantly at 5% probability level.

Number of seeds per spike is the most important component of yield. The application of nitrogen had significant effect on the number of seeds per spike. The highest values of seeds per spike based on nitrogen doses in both years were obtained in 220 kg ha^{-1} nitrogen (Table 3). The difference between this application and 180 kg ha^{-1} nitrogen application was found to be insignificant in 2009–2011 and 2010–2011 years, whereas the lowest values pertained to the seeds per spike were obtained from those plots in which no nitrogen application was conducted (Table 3). Similarly, the highest values in terms of chicken manure applications in both years of the trial were obtained from chicken manure application, whereas the lowest values were obtained from those plots to which chicken manure was not applied. Kiani et al.[20] also indicated a significant increase in seeds per spike with nitrogen fertilisation and organic manure.

Results showed that all fertiliser treatments significantly increased the biological yield of wheat compared with the control treatment in first year. The maximum biological yield of 6189 kg ha^{-1} was obtained in treatment receiving from 220 nitrogen kg ha^{-1} and chicken manure application. The biological yield was minimum (4460 kg ha^{-1}) in the control receiving no nitrogen and without chicken manure. In the second year, while the maximum biological yield of 5423 kg ha^{-1} was obtained in treatment receiving from 220 nitrogen kg ha^{-1} and chicken manure application, the minimum biological yield of 3821 kg ha^{-1} was obtained in treatment receiving from 140 nitrogen kg ha^{-1} and without chicken manure application. These findings are in agreement with Negi and Mahajan[21], Mishra[22], Shah and Ahmad[23] who reported significant increase in wheat grain and straw yields with addition of farmyard manure to inorganic fertilisers as compared to no farmyard manure.

The application of nitrogen had significant effect on the seed yield. The highest seed yield based on nitrogen doses in both years were obtained in 180 kg ha^{-1} nitrogen (respectively 2059 and 1779 kg ha^{-1}). The lowest values pertained to the seed yield were obtained from those plots in which no nitrogen application was conducted (Table 3). Similarly, the highest values in terms of chicken manure applications in 2009–2010 and 2010–2011 years of the trial were obtained from chicken manure application (respectively 2176 and 1851 kg ha^{-1}), whereas the lowest values were obtained from those plots to which chicken manure was not applied. In the second year, while the maximum seed yield of 2073 kg ha^{-1} was obtained in treatment receiving from 180 nitrogen kg ha^{-1} and chicken manure application, the minimum seed yield of 1270 kg ha^{-1} was obtained in treatment receiving from control plot. Kumar and Sing[24] indicated that the maximum seed yield per area was obtained with the application of farm yard manure combined with 50% recommended nitrogen, phosphorus and potassium.

The application of nitrogen and chicken manure had significant effect on the harvest index. The highest harvest index based on nitrogen doses in both years were obtained in 180 kg ha^{-1} nitrogen (respectively 40.9 and 39.4%). The lowest values pertained to the harvest index were obtained from those plots in which no nitrogen application was conducted (respectively 34.9 and 33.1%). Similarly, the highest values in terms of chicken manure applications in both years of the trial were obtained from chicken manure application (respectively 36.3 and 37.4%), whereas the lowest values were obtained from those plots to which chicken manure was not applied. In the second year, while the maximum harvest index of 40.5% was obtained in treatment receiving from 180 nitrogen kg ha^{-1} and chicken manure application, the minimum harvest index of 30.4% was obtained in treatment receiving from control plot. Ozalp[19] reported that the highest harvest index was obtained with the application of certificated organomineral fertiliser but the difference between certificated organomineral fertiliser and pigeon and chicken manure application was statistically insignificant.

Use of chicken manure and inorganic nitrogen fertiliser significantly increased 1000 seed weight. The maximum 1000 seed weight based on nitrogen doses in both years were obtained in 180 kg ha^{-1} nitrogen (Table 3), whereas the minimum values pertained to the 1000 seed weight were obtained from those plots in which no nitrogen application was conducted. Similarly, the maximum values in terms of chicken manure applications in both years of the trial were obtained from chicken manure application, whereas the minimum values were obtained from those plots to which chicken manure was not applied. In the second year, while the maximum 1000 seed weight of 43.6 g was obtained in treatment receiving from 180 nitrogen kg ha^{-1} and chicken manure application, the minimum 1000 seed weight of 38.9 was obtained in treatment receiving from control plot. A similar response in 1000 seed weight to organic and mineral nitrogen was noticed in our previous studies[19,20].

The protein ratio in grain was affected by nitrogen rates and chicken manure application. Protein ratio in seed was obtained from 220 kg ha^{-1} nitrogen in both years. Keklikci et al.[25] reported that increased doses of nitrogen fertilisation improved the protein ratio in the seed and straw. Similarly, the highest protein ratio in terms of chicken manure applications in both years of the trial was obtained from chicken manure application. These findings are in agreement with Ozalp[19] who reported significant increase in wheat protein ratio in grain with addition of chicken manure. Ivanov et al.[26] reported that salicylic acid could act as a protector by activation of the antioxidant defense of wheat plants.

CONCLUSIONS

While the highest seed yield was obtained at the chicken manure and 180 kg ha^{-1} nitrogen fertiliser as 2346 and 2073 kg ha^{-1}, respectively, the lowest grain yield per area was obtained at without chicken manure and control as 1451 and 1270 kg ha^{-1} in years of 2011–2012 and 2012–2013, respectively. Application of chicken manure at optimum doses together with nitrogen fertilising may provide balanced significant increase of crop productivity and the important of production quality. In addition, remove lack of roughage will be contributed by used as roughage of cereals, because there is too lacking roughage in Turkey. In the final course of the study, it is concluded that, for soils of this region, which have poorer nitrogen content and which are highly alkaline, 180 kg ha^{-1} nitrogen and chicken manure application would bring good results and thus could be beneficial in order to have adequate wheat farming. Information gained from this trial will be utilised to develop more efficient chicken manure nitrogen fertilisation in winter wheat.

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