



## RESEARCH ARTICLE

### EFFECT OF NITROGEN AND PHOSPHOROUS APPLICATION ON YIELD AND YIELD COMPONENTS OF WHEAT (*TRITICUMAESTIVUM L.*), IN THREE SOILS SERIES AT NEW HALFA SCHEME

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#### ABSTRACT

A field experiment was conducted for two consecutive winter seasons (2017-2018) and (2018-2019) at New Halfa Scheme in three soil series (Asubri soil series at Hajir block, KashmAlgerba soil series at the Faculty Of Agric. Research Farm) and Sabaat soil series at Shabik block; to study effect of three levels of nitrogen (0, 43 and 86 kg N/ha), and three levels of phosphorus (0, 40, 80 Kg P<sub>2</sub>O<sub>5</sub>/ha) on yield of wheat (Debera cultivar). The experiment was arranged in Randomized Complete Block Design (RCBD) with three replications at each location in both seasons. Characters studied include (spike length, number of grains/Plant, 1000-grain weight, grains yield/ha, and harvest index). The results indicated that, increasing levels of nitrogen or phosphorus and their interaction increased the yield attributes. Across the three locations, the highest grain yield (3363.5kg/ha and 2609kg/ha) were obtained at shebaik and Faculty locations due to application of 2N2P treatment while 2N1P recorded the highest grain yield (32290.6kg/ha) at Hajer location. The positive effect of high N level and low level of P at Hajer site on grain yield may be a key factor for wheat production under semi-arid environment. In conclusion, application of high N level together with phosphorus could enhance wheat production in New Halfa Scheme.

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## INTRODUCTION

Wheat (*Triticumaestivum L.*) is a winter annual crop of the family Graminae, generally common to temperate zones and savannas (Wall et al., 2006). It is one of the most important crops in the world and ranked first among world food crops, measured both by cultivated area and by production and it is considered a good source of protein, minerals, B-group vitamins and dietary fiber (Hanchinalet al. 200; 5Shewry, 2007). Soils of New Halfa scheme falling in arid part of the country is known to be calcareous and alkaline in reaction (Ochtman, 1965). These soils are deficient in nitrogen and available phosphorus. In New Halfa, Gorashi (1988) found non-significant effect of P application. However, he stated that through work is needed to confirm or disconfirm the importance of P application to wheat at New Halfa. Application of N improve various growth parameters like fertile tillers (Behera, et al., 1991), grain yield (Singh, et al 1992), thousand grain weight (Warraich, et al 2002), more productive tillers (Wilhelm 1998). Different nitrogen and phosphorus levels significantly affect the agronomic parameters like, grain spike, thousand grain weight and root biomass (Ahmed et al., 2010). Also, many researchers.

(Naseri et al., 2010; Abdou et al., 2011 and Mattaset al 2011) reported that increasing nitrogen application rates, significantly increased spike length, number of grains per spike, 1000-grain weight, harvest index and grains yield per hectare. On the other hand Al-Rashidi (2004) indicated that application of phosphorus in high rates resulted in increasing length of spikes. On the other hand Malghaniet.al.(2010), observed significant effects of phosphorus on number of grains per spike in wheat. Also, Hussainet.al.(2006); observed an increase in 1000-grain weight with increase in P application and concluded that, Phosphorus being responsible for good root growth, directly affected the thousand grain weight. Furthermore, Karamanoset.al. 2003); reported that phosphorus fertilizers are equally efficient for grains yield kg/ha. While Kalilet al (2011), reported that application of P greatly increased harvest index. He claimed that highest harvest index was recorded at 90 kg P/ha. Phosphorus is also essential for many physiological processes, such as storage of energy and its transfer, respiration, photosynthesis, cell division and cell enlargement etc. Besides the environmental condition, the low yield of wheat in Sudan is mainly due to low crop stand, untimely sowing, inadequate fertilizer use, poor water management and delayed harvests (Ageeb, 1993). So keeping in mind these

studies does application of high N level together with phosphorus could enhanced wheat production in New Halfa Scheme. To understand the answer we conducted this study to assess effects of three level of N and P and their interaction on yield of wheat at three soil series.

## MATERIALS AND METHODS

A field experiments were carried out in three sites within New Halfa agricultural scheme for two successive seasons (2017/2018-2018/2019). Location one (L1) representing Asobryri soil series, located at (Hajer block of agriculture scheme). The second site (L2) is located at the faculty research farm (Medina Block) representing Kashmel Girba soil series. The third site (L3) is at Shebiak block representing Sabaat soil series. In each location a Randomized Complete Blocks Design (RCBD) experiment with three replications in both seasons was carried out to study the effect of three levels of nitrogen (designated as 0N, 1N and 2N, corresponding to nitrogen fertilizer rates of zero, 43, 86 kg N/ha respectively) and three levels of phosphorous fertilizers (designated as 0P, 1P and 2P, corresponding to rates of zero, 40, 80 Kg P<sub>2</sub>O<sub>5</sub>/ha.) on the growth and yield of wheat cultivar (Debera). Ten plants were randomly selected and tagged in each sub-plot to determine the following parameters:

**Spike length (cm):** the average length of spike was measured using a meter tap.

**Number of grains plant<sup>-1</sup>** per spike was determined.

**1000-grain weight (g):** From each subplot, 1000 grains were randomly selected and weighed using sensitive balance to determine the average 1000- grain weight.

**Grains yield (kg ha<sup>-1</sup>):** In each sub-plot, all plants grown in an area of 1.7 m<sup>2</sup>, in the two central ridges, were harvested, air-dried, and weighed to determine the average yield per unit area.

**Harvest index:** Harvest index (HI) was calculated as the ratio of grain yield to the total above ground shoot biomass as follows: HI = (Grain yield) / (Biological yield)

**Statistical analysis:** Data was statistically analyzed according to the analysis of variance (ANOVA) for RCBD using a computer software (STATISTICS 9). Mean comparisons was worked out by Duncan's Multiple Range Test (DMRT) at 5% level of probability.

## RESULTS

Generally, analysis of variance showed significant effects on spike length, number of grains per plant, 1000-grain weight, grain yield per hectare and harvest index due to application of nitrogen and phosphorous at all locations (Hajer (L1), the Faculty (L2) and Shabik (L3)) in both seasons. But the interaction (N x P) treatment showed significant effects on these traits except (spike length and harvest index) particularly at Hajer (L1). In this, increasing N levels increased spike length at all locations particularly in the first season (table 1). Application of phosphorus at the higher level (2N) increased number of grains per plant particularly in first season at the Faculty (L2). Application of phosphorus at the level (1P)

increased the spike length, grains per plant at L1 and L2 locations as compared with (2P) level (tables 1, 2). Also, application of combined (2N1P) treatment, increased the spike length, grains per plant at L1 and L2 locations compared with other treatments particularly in the first season (tables 1, 2). Application of either nitrogen or phosphorus at the 1N or 1P generally, increased the 1000- grain weight at all locations in both seasons (table 3). Moreover, application of combined (1N2P or 2N1P) treatments gave the higher 1000- grain weight at all locations in both seasons (table 3). Increasing N or P levels solely or in combine applications resulted in increasing grains yield per unit area at all locations in both seasons (table 4). In this respect, at Hajer (L1 representing Asobri soil series), analysis of variance showed significant effects on grain yield due to nitrogen and its interaction with phosphorus in both seasons, but phosphorous effected at the second season only. All treatment showed significant effects in both seasons at Faculty (L2 representing Kashm El Girba soil series. At Shebaik site (L3 representing Sabaat soil series) nitrogen affected only in the both season. But phosphorus and interaction effected in first seasons. In this regard, the highest grain yield obtained at Shabik (L3) compared with the two other locations. The higher dose of nitrogen (2N) gave the more yield particularly at Shebaik in the first season compared with lower doses (0N, 1N) at each location (table 4). Application of phosphorus at higher level (2P) increased the yield in the first season at Shebaik (L3). Also application of combine nitrogen with phosphorus (1N1P, 1N2P, 2N1P, 2N2P) increased yield at Shebaik (L3), (table 4). For the trait harvest index, increasing N or P levels increased this trait particularly in first season at L1 and L3. (table 5). Also, application of phosphorus at higher level (2P) with 1N showed marked on the harvest index particularly, at the Faculty (L2) (table 5).

## DISCUSSION

Wheat in Sudan grown entirely under irrigation during the short dry and comparatively cool winter season and in soil which inherently deficient in nitrogen. There for, fertilization is considered one of the most important factors for increasing wheat production. In this study many researchers (Sharma *et al.*, 1990; ALthabit, 2006; Singh, 2011; Sokoto and Singh, 2013), pointed out that nitrogen and phosphorus application were increased yield of wheat. This might explain the result obtained in the most of the growth and yield parameters measured in this study. In this experiment increase in yield attributes i.e. spike length, , number of grains plant<sup>-1</sup> and 1000-grains weight, which were due to application of nitrogen and phosphorus., might be due to instant availability of nitrogen effect on promotes tillers, this is reported by (Ashraf, 2009; increased of grain yield due to application of nitrogen fertilizer agreed with those results reported by (Zeidan *et al.*, 2009; Naseri *et al.*, 2010). Also they showed by many other workers (Waraich *et al.*, 2002; Zhou *et al.*, 2011). They concluded that increasing nitrogen rates increasing grain yield per hectare. Also the increased of harvest index due to application of nitrogen observed in this study was agreed with the results reported by (Naseri *et al.* 2010). They found that increasing of nitrogen increase harvest index. In this regard, the positive effects combination of P with high levels of N or P on grain yield and yield components measured in this study could be attributed to the positive effects of these fertilizers on improving growth characters and consequently enhanced crop to produce more number of spikes, grains per plant and

**Table(1): Mean of Spike length(cm) as affected by N and P fertilizers on performance and yield of wheat during 2016/2017 and 2017/2018 season**

Treatments	0N	1N	2N	Mean	0P	1P	2P	0N0P	0N1P	0N2P	1N0P	1N1P	1N2P	2N0P	2N1P	2N2P		
L1S1	9.88	10.02	10.02	9.77	9.90	9.93	10.02	9.83	9.95	9.87	9.93	9.88	10.23	9.93	9.97	10.17		
L1S2	5.47	6.60	5.58	5.88	5.24	7.38	5.02	5.87	6.47	4.07	4.47	8.60	6.73	5.40	7.07	4.27		
L2S1	8.33	8.70	9.17	8.73	9.24	7.97	8.99	9.70	6.30	9.00	8.43	8.57	9.10	9.60	9.03	8.87		
L2s2	9.33	8.89	9.49	9.24	9.38	9.02	9.31	8.40	9.67	9.93	9.93	8.73	8.00	9.80	8.67	10.00		
L3s1	8.96	8.34	8.60	8.63	9.04	8.72	8.13	9.40	9.40	8.07	8.90	8.33	7.80	8.83	8.43	8.53		
L3s2	6.83	8.34	7.14	6.94	6.98	6.89	6.43	6.43	7.33	6.73	6.93	6.30	6.30	7.57	7.23	6.63		
Mean	8.13	8.23	8.33	8.23	8.30	8.33	8.02	8.33	8.32	8.22	8.16	8.12	8.08	8.21	8.28	8.07		
S1	9.05	9.02	9.26	9.111	9.39	8.87	9.07											
S2	7.21	7.44	4.40	6.35	7.20	7.78	7.07											
L1	7.67	8.30	7.80	7.92	7.57	8.65	7.55											
L2	8.79	9.32	9.32	9.11	9.31	8.49	9.15											
L3	7.89	7.59	7.87	7.78	8.01	7.83	7.51											
LSD	S= 0.19 L=0.23			L*S=0.32		L*S*N=0.32		L*S*P=0.32			LxSxPxN=0.9		LxN=0.39		SxN=0.32		LxP=0.39 SxP=0.32	

**Table(2): Mean of number of grains t/plant(g) as affected by N and P fertilizers on performance and yield of wheat during 2016/2017 and 2017/2018 seasons**

Treatments	0N	1N	2N	Mean	0P	1P	2P	0N0P	0N1P	0N2P	1N0P	1N1P	1N2P	2N0P	2N1P	2N2P		
L1S1	180.4	176.6	232.1	226.49	178.74	329.11	171.62	177.23	215.00	149.20	178.33	136.67	215.00	180.67	635.67	150.67		
L1S2	47.04	64.73	57.02	56.27	48.58	57.84	62.38	48.33	56.47	36.33	55.80	61.33	76.87	41.60	55.53	73.93		
L2S1	153.00	214.79	166.02	177.94	189.32	149.17	195.32	161.17	133.33	164.50	246.43	149.93	258.00	164.23	160.37	173.47		
L2s2	99.00	94.56	58.18	83.91	86.74	47.00	93.96	83.33	81.67	132.00	135.33	64.33	84.0	41.67	67.00	65.87		
L3s1	235.56	240.89	214.79	230.46	249.72	265.00	185.67	250.67	283.33	166.67	126.00	166.00	179.33	232.50	201.33	211.00		
L3s2	25.89	30.42	28.42	28.24	27.71	28.87	28.16	28.27	23.67	25.73	28.30	31.60	31.47	26.67	31.33	27.27		
Mean	123.49	137.01	141.15		130.14	148.60	122.85	125.83	132.24	112.41	150.68	121.23	139.11	113.01	192.52	117.03		
S1	189.6	201.7	234.4	208.5	205.9	244.7	184.2											
S2	57.31	63.42	47.87	56.2	54.36	52.57	61.50											
L1	113.6	120.7	189.6	141.3	113.6	193.4	117.0											
L2	126.0	154.7	112.1	130.9	138.0	110.0	144.6											
L3	130.7	135.6	121.6	129.3	138.7	142.4	106.9											
LSD	S=35.92L=44.0			L*S=143.89		L*S*N=107.78		L*S*P=107.78			LxSxPxN=186.		LxN=175.2		SxN=143		LxP=175.2 SxP=143.8	

Table(3): Mean of 1000-grain weight(g) as affected by N and P fertilizers on performance and yield of wheat during 2016/2017 and 2017/2018 seasons

Treatments	0N	1N	2N	Mean	0P	1P	2P	0N0P	0N1P	0N2P	1N0P	1N1P	1N2P	2N0P	2N1P	2N2P
L1S1	28.97	30.64	30.10	30.20	27.84	32.10	30.67	25.06	31.23	30.53	29.22	32.07	30.64	29.22	32.91	30.84
L1S2	30.46	33.64	33.08	32.40	32.86	31.19	33.16	32.37	28.33	30.73	32.57	34.00	34.37	33.63	31.23	34.37
L2S1	33.91	33.47	30.80	32.69	32.68	33.24	32.16	34.03	34.34	33.36	32.85	35.30	31.96	31.15	30.09	31.16
L2s2	30.73	34.43	33.77	33.14	33.87	32.66	32.91	29.90	32.33	29.97	38.07	31.23	35.63	33.63	34.40	33.27
L3s1	30.30	32.02	30.22	30.85	29.82	30.97	32.16	31.36	29.82	29.72	29.93	31.53	34.60	28.17	31.59	30.93
L3s2	41.54	39.50	39.37	40.15	40.43	40.64	39.38	41.73	41.43	41.60	38.57	39.03	40.90	41	41.47	35.63
Mean	26.69	34.70	39.02	33.24	33.54	29.50	37.38	32.41	32.93	32.65	33.54	33.86	34.86	32.80	33.61	32.70
S1	31.05	32.05	30.67	32.82	30.11	32.10	31.52									
S2	34.26	36.02	35.40	35.22	35.71	34.83	35.14									
L1	29.72	32.14	32.03	31.29	30.34	30.64	31.91									
L2	32.32	34.15	32.24	32.90	33.27	32.94	32.54									
L3	35.94	35.76	34.79	35.29	35.12	35.80	35.56									
LSD	S=0.32L=0.40		L*S=0.56		L*S*N=0.79		L*S*P=0.79		LxSxPxN=		LxN=0.68		SxN=0.56		LxP=0.68SxP=0.56	

Treatment yeild	0N	1N	2N	Mean	0P	1P	2P	0N0P	0N1P	0N2P	1N0P	1N1P	1N2P	2N0P	2N1P	2N2P
L1S1	2110.1	1941.0	2200.4	2264.4	2062.1	1996.2	2193.7	2190.0	1915.0	2225.0	1472.0	1672.7	2150.0	2024.3	2290.6	217.60
L1S2	1038.2	1902.9	1698.2	562.7	1502.9	1522.9	1607.2	902.0	1131.4	1061.3	1931.3	1852.0	1922.7	1655.5	1601.5	183.77
L2S1	2336.4	2125.9	2200.4	1779.4	1838.2	1967.6	2542.9	2416.7	2191.3	2462.3	1538.7	2222.3	2616.7	1557.3	1489.0	2609.9
L2s2	990.0	945.6	581.8	839.1	867.8	710.0	939.6	672.5	705.3	1318.0	828.0	861.2	665.6	687.1	747.3	763.75
L3s1	2355.6	2408.9	2149.4	2304.6	2497.2	2560.0	1856.7	2537.9	2362.0	2441.0	1739.0	2466.0	2667.3	2424.3	2510.0	3363.5
L3s2	1650.2	1335.3	1368.0	284.2	1530.2	1280.3	2772.7	1673.0	1422.0	1445.7	1445.3	1179.7	1216.0	1858.0	1734.3	124.23
Mean	1411.5	1370.1	1234.9	1338.8	1301.4	1486.0	1228.5	1258.3	1322.4	1124.1	1506.8	12123	1391.1	1139.1	1925.2	117.03
S1	2298.0	2119.0	3386.0	2601.0	2044.0	2136.0	2522.0									
S2	1155.0	1322.0	1343.0	1273.0	1297.0	1247.0	1277.0									
L1	1574.0	1921.0	1940.0	1811.0	1782.0	1762.0	1900.0									
L2	1618.0	1455.0	1303.0	1458.0	1283.0	1368.0	1725.0									
L3	1988.0	1785.0	2192.0	1988.0	1946.0	1945.0	2074.0									
LSD	S=65.2	L=79.9	L*S=113.0		L*S*N=195.7		L*S*P=195.7		LxSxPxN=339.0		LxN=138.0		SxN=112.0		LxP=.13.83;SxP=112.9	

**Table (4).Mean of grains yield(kg/ha) as affected by N and P fertilizers on performance and yield of wheat during 2016/2017 and 2017/2018 seasons**

Treatment yeild	0N	1N	2N	Mean	0P	1P	2P	0N0P	0N1P	0N2P	1N0P	1N1P	1N2P	2N0P	2N1P	2N2P
L1S1	2110.1	1941.0	2200.4	2264.4	2062.1	1996.2	2193.7	2190.0	1915.0	2225.0	1472.0	1672.7	2150.0	2024.3	2290.6	217.60
L1S2	1038.2	1902.9	1698.2	562.7	1502.9	1522.9	1607.2	902.0	1131.4	1061.3	1931.3	1852.0	1922.7	1655.5	1601.5	183.77
L2S1	2336.4	2125.9	2200.4	1779.4	1838.2	1967.6	2542.9	2416.7	2191.3	2462.3	1538.7	2222.3	2616.7	1557.3	1489.0	2609.9
L2s2	990.0	945.6	581.8	839.1	867.8	710.0	939.6	672.5	705.3	1318.0	828.0	861.2	665.6	687.1	747.3	763.75
L3s1	2355.6	2408.9	2149.4	2304.6	2497.2	2560.0	1856.7	2537.9	2362.0	2441.0	1739.0	2466.0	2667.3	2424.3	2510.0	3363.5
L3s2	1650.2	1335.3	1368.0	284.2	1530.2	1280.3	2772.7	1673.0	1422.0	1445.7	1445.3	1179.7	1216.0	1858.0	1734.3	124.23
Mean	1411.5	1370.1	1234.9	1338.8	1301.4	1486.0	1228.5	1258.3	1322.4	1124.1	1506.8	12123	1391.1	1139.1	1925.2	117.03
S1	2298.0	2119.0	3386.0	2601.0	2044.0	2136.0	2522.0									
S2	1155.0	1322.0	1343.0	1273.0	1297.0	1247.0	1277.0									
L1	1574.0	1921.0	1940.0	1811.0	1782.0	1762.0	1900.0									
L2	1618.0	1455.0	1303.0	1458.0	1283.0	1368.0	1725.0									
L3	1988.0	1785.0	2192.0	1988.0	1946.0	1945.0	2074.0									
LSD	S=65.2 L=79.9		L*S=113.0		L*S*N=195.7		L*S*P=195.7		LxSxPxN=339.0		LxN=138.0		SxN=112.0		LxP=.13.83;SxP=112.9	

**Table(5). Mean of harvest index (HI) as affected by N and P fertilizers on performance and yield of wheat during 2016/2017 and 2017/2018 seasons**

Harvest index	0N	1N	2N	Mean	0P	1P	2P	0N0P	0N1P	0N2P	1N0P	1N1P	1N2P	2N0P	2N1P	2N2P
L1S1	0.72	0.79	0.79	0.78	0.73	0.74	0.87	0.77	0.67	0.83	0.73	0.75	0.88	0.68	0.80	0.90
L1S2	0.24	0.13	0.18	0.15	0.11	0.23	0.22	0.14	0.47	0.12	0.12	0.12	0.16	0.06	0.10	0.08
L2S1	0.30	0.31	0.34	0.32	0.34	0.23	0.39	0.53	0.23	0.43	0.68	0.63	1.45	0.35	0.25	0.39
L2s2	0.12	0.14	0.15	0.14	0.15	0.14	0.12	0.13	0.11	0.12	0.15	0.15	0.12	0.17	0.17	0.12
L3s1	0.76	0.76	0.85	0.77	0.75	0.74	0.82	0.77	0.68	0.67	0.73	0.70	0.84	0.75	0.83	0.97
L3s2	0.15	0.14	0.15	0.15	0.16	0.14	0.14	0.14	0.14	0.18	0.18	0.16	0.07	0.17	0.13	0.15
Mean	0.53	0.48	0.54	0.51	0.51	0.45	0.58	0.58	0.46	0.53	0.43	0.42	0.59	0.53	0.46	0.16
S1	0.47	0.62	0.44	0.67	0.48	0.42	0.33									
S2	0.17	0.13	0.12	0.14	0.41	0.17	0.12									
L1	0.50	0.46	0.43	0.46	0.41	0.48	0.49									
L2	0.64	0.53	0.66	0.61	0.67	0.41	0.54									
L3	0.42	0.41	0.49	0.44	0.45	0.44	0.47									
LSD	S=0.03L=0.04		L*S=0.06		L*S*N=0.10		L*S*P=0.10		LxSxPxN=0.1		LxN=00.06		SxN=0.7		LxP=0.06 SxP=0.75	

increasing individual grain weight which, in turn, positively increased grain yield. It was noticed that 1000-grain weight was higher in the second year. This might be due to better vegetative growth of the wheat plants that leads to more production of tillers, resultantly more seeds with higher weight were produced. It has been confirmed that the combined application of chemical fertilizer is a useful management manner for increasing soil fertility and maintaining high crop yield. Based on the findings of the current study, it could be concluded that, under application of 86kg N or P with solely or in combination, wheat cultivar Debera performed better in terms of growth, yield, and yield characters in both years. Therefore, wheat cultivar Debera may be grown under the agro-ecological conditions of Shebiak at northern region of New Halfa Scheme. The result indicated that application of high N and P levels solely or mixed enhanced growth and yield of wheat. The increased in grain yield was associated with significant in most of yield components. Grain yield was substantially affected by soil type due to diversity of their locations in soil composition. The positive effect of high N level and low level of P at Hajer site on grain yield may be a key factor for wheat production under semi-arid environment. In conclusion, application of high N level together with phosphorus could enhance wheat production in New Halfa Scheme.

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