



Research Article

EFFECT OF DIFFERENT LEVELS OF NITROGEN, PHOSPHORUS AND BIO-FERTILIZER ON CHEMICAL PARAMETERS AND YIELD OF IRRIGATED WHEAT (*Triticum aestivum* L.) UNDER BHAL REGION

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Abstract: Considering the importance of nitrogen, phosphorus and bio-fertilizers on growth and yield of irrigated wheat, the present experiment was conducted to analyze the effect of different levels of nitrogen, phosphorus and bio-fertilizer on yield of irrigated wheat under Bhal region during rabi season of the year 2016-17 and 2017-18 on medium black highly saline soil at Agricultural Research Station, Anand Agricultural University, Arnej, Bhal and Coastal Zone-VIII at Gujarat, India. Eight treatment combinations comprising of four levels of Nitrogen (N_1 : 60 kg N/ha, N_2 : 60 kg N/ha + Bio NPK, N_3 : 90 kg N/ha and N_4 : 120 kg N/ha) and two levels of Phosphorus (P_1 : 30 kg P_2O_5 /ha and P_2 : 60 kg P_2O_5 /ha) were laid out in a Randomized Block Design (Factorial) with four replications. The application of 120 kg N/ha recorded the significantly highest grain yield compared to other treatments. The grain yield recorded were 2349, 2430 and 2389 kg/ha during the year 2016-17, 2017-18 and in pooled data, respectively. For phosphorus levels treatment application of 60 kg P_2O_5 /ha recorded the significantly highest grain yield 2340, 2465 and 2402 kg/ha during both the year 2016-17, 2017-18 and in pooled data, respectively. It could be concluded that for securing maximum grain yield of wheat, application of 120 kg N/ha and 60 kg P_2O_5 /ha from which 50 % at basal and 25% at 30 DAS and remaining 25% after 45 DAS from the source of Urea and DAP were effective.

Keywords: Wheat (*Triticum aestivum* L.), Nitrogen, Phosphorus, Bio-fertilizers

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Introduction

Wheat (*Triticum aestivum* L.) is the first important and strategic cereal crop for the majority of world's populations. It is the most important staple food of about two billion people (36% of the world population). India is one of the main wheat producing and consuming countries of the world [1]. Moreover, wheat is one of the most durable and dependable cereal crops after rice, grown under diverse agro-climatic conditions, occupying nearly 31.3 million ha with a record production of 95.8 million tons during 2013- 2014, and provides 20% of the total food calories of human requirement [2,3]. The more nitrogen application results in toxicity and harms the plant growth by making it more susceptible to lodging, causing environmental pollution through nitrate leaching and volatilization in form of ammonia [4], which become a cause of high cost production resulting in less net benefit to the farmers because only 1/3 part of applied nitrogenous fertilizer is taken-up by the cereal crops and assimilate it to their grains.

Considering the importance of nitrogen, phosphorus and bio-fertilizers on growth and yield of irrigated wheat, the present experiment was conducted to analyze the effect of different levels of nitrogen, phosphorus and bio-fertilizer on yield of irrigated wheat under moisture conserve condition.

Materials and Methods

A field experiment was conducted during rabi season of the year 2016-17 and 2017-18 at Agricultural Research Station, Anand Agricultural University, Arnej, Gujarat. The texture of the soil is loamy clay. The soil is very deep and fairly moisture retentive. The soil was low in organic carbon and nitrogen, medium in available phosphorus and high in potassium with pH 8.1. The soil was medium black highly saline soil. Eight treatment combinations comprising of four levels of Nitrogen (N_1 : 60 kg N/ha, N_2 : 60 kg N/ha + Bio NPK, N_3 : 90 kg N/ha and N_4 : 120 kg N/ha) and two levels of Phosphorus (P_1 : 30 kg P_2O_5 /ha and P_2 : 60 kg P_2O_5 /ha)

were tried out in a RBD (Factorial) with four replications. The fertilizers were applied 50 % at basal and 25% at 30 DAS and remaining 25% after 45 DAS from the source of Urea and DAP. The biometric observations for studying of individual plant characters were recorded from 5 randomly selected and previously tagged plants from each treatment and each replication. The details of various yield attributes and yield as well as chemical parameters studied during the course of investigation. The statistical analysis of the various growth, yield and quality characters studied during the course of investigation was carried out by using statistical method appropriate to Randomized Block Design by computer system at the Computer Centre, Department of the Agricultural Statistics, BACA, AAU, Anand, Gujarat. The variances of different sources of variation in ANOVA were tested by "F-test" and compared with the value of Table-Fat 5% level of significance. To elucidate the treatment effect, summary tables along with S.E.m. $\pm$ and CD at 5% are given in chapter "experimental results" and their analysis of variance are given in the Appendices at the end.

Results and Discussion

No. of tillers per plant

A perusal of data revealed that the effect of different levels of nitrogen, phosphorus and bio-fertilizer on number of tillers per plant of wheat was found significant during both the year of experiments. The result revealed that the application of nitrogen at 120 kg/ha produced significantly higher number of tillers per plant for both the year but in case of pooled analysis was found non-significant. However, in case of different levels of phosphorus 60 kg/ha produced maximum number of tillers per plant for the year 2016-17 and in pooled data but in case of the year 2017-18 was found non-significant. These findings are supported by Khan et al. (2010) [5], who reported that wheat plant tillers were increased with increasing the application of N and P_2O_5 .

Table-1 Yield attributes at harvest as influenced by different levels of nitrogen, phosphorus and bio-fertilizers

Treatments	No. of tillers/plant			Days to 50 % flowering			Days to maturity			Test weight (g)		
	At 30 DAS			At 45 DAS			At 30 DAS			At harvest		
	2016-17	2017-18	Pooled	2016-17	2017-18	Pooled	2016-17	2017-18	Pooled	2016-17	2017-18	Pooled
Nitrogen levels (N)												
N ₁ - 60 kg N/ha	5.21	5.61	5.41	71.64	70.11	70.88	120.79	118.5	119.64	37.76	39.00	38.38
N ₂ - 60 kg N/ha +Bio NPK	5.78	5.21	5.49	71.41	71.41	71.41	118.61	121.86	120.24	38.06	39.09	38.58
N ₃ - 90 kg N/ha	5.61	5.74	5.68	73.24	72.65	72.94	118.74	124.03	121.38	39.68	39.00	39.34
N ₄ - 120 kg N/ha	6.19	5.9	6.04	75.44	75.64	75.54	121.73	114.08	117.9	39.2	38.53	38.86
S.Em ±	0.19	0.17	0.21	1.59	1.63	1.14	3.04	2.58	1.99	0.81	0.73	0.55
C.D (P=0.05)	0.56	0.49	NS	NS	NS	3.26	NS	NS	NS	NS	NS	NS
Phosphorus levels (P)												
P ₁ - 30kg P/ha	5.36	5.53	5.45	74.13	71.83	72.98	120	117.88	118.94	38.26	38.48	38.37
P ₂ - 60 kg P/ha	6.03	5.7	5.87	71.73	73.08	72.41	119.93	121.35	120.64	39.09	39.32	39.21
S.Em ±	0.13	0.12	0.09	1.12	1.16	0.81	2.15	1.82	1.41	0.58	0.51	0.39
C.D (P=0.05)	0.39	NS	0.25	NS	NS	NS	NS	NS	NS	NS	NS	NS
N × P	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
C.V %	9.39	8.36	8.9	6.17	6.38	6.28	7.16	6.1	6.65	5.95	5.29	5.63

Table-2 Effect of grain yield and straw yield (kg/ha) of wheat at harvest as influenced by different levels of nitrogen and phosphorus

Treatments	Grain yield			Straw yield		
	(kg/ha)			(kg/ha)		
	2016	2017	Pooled	2016	2017	Pooled
Nitrogen levels (N)						
N ₁ -60 kg N/ha	1778	1981	1880	3017	3038	3027
N ₂ -60 kg N/ha + Bio NPK	1828	2038	1933	3399	3479	3439
N ₃ - 90 kg N/ha	2073	2183	2128	3407	3483	3445
N ₄ - 120 kg N/ha	2349	2430	2389	3723	3670	3697
S.Em ±	83.6	77.61	56.69	152.87	152.17	107.6
C.D @ 0.05	246	225	162	446.78	447.55	308.25
Phosphorus levels (P)						
P ₁ - 30 kg P ₂ O ₅ /ha	1675	1851	1763	3174.31	3210	3192
P ₂ - 60 kg P ₂ O ₅ /ha	2340	2465	2402	3598.26	3625	3612
S.Em ±	59.11	54.17	40.09	108.09	107.6	76.26
C.D (P=0.05)	174	159	115	317.97	316.46	217.96
N × P	NS	NS	NS	NS	NS	Sig.
C.V %	11.78	10.04	10.89	12.65	12.59	12.62
Y × N	---	---	NS	---	---	NS
Y × P	---	---	NS	---	---	NS
Y × NP	---	---	NS	---	---	NS

Table-3 Interaction effect of nitrogen and phosphorus on straw yield

Treatments	Straw yield (kg/ha)			
	N ₁	N ₂	N ₃	N ₄
P ₁	3106	3076	3080	3508
P ₂	2949	3802	3810	3885
S.Em ±	152.52			
C.D (P=0.05)	436			
C.V %	12.62			

Table-4 Economics as influenced by different levels of nitrogen, phosphorus and bio-fertilizers on yield of irrigated wheat

Treatment	Grain yield (kg/ha)	Income from Grain yield	Straw yield (kg/ha)	Income from Straw Yield	Gross realization (Rs./ha)	Cost of cultivation (Rs./ha)	Treatment cost (Rs./ha)	Total cost of cultivation (Rs./ha)	Net realization (Rs./ha)	BCR
Nitrogen levels (N)										
N ₁ -60 kg N/ha	1880	37600	3027	1514	39114	13261	3613	16874	22240	2.32
N ₂ -60 kg N/ha+Bio NPK	1933	38660	3439	1720	40380	13261	3750	17011	23369	2.37
N ₃ - 90 kg N/ha	2128	42560	3445	1723	44283	13261	4072	17333	26949	2.55
N ₄ - 120 kg N/ha	2389	47780	3697	1849	49629	13261	4511	17772	31857	2.79
Phosphorus levels (P)										
P ₁ - 30 kg P ₂ O ₅ /ha	1763	35260	3192	1596	36856	13261	2742	16002	20854	2.3
P ₂ - 60 kg P ₂ O ₅ /ha	2402	48040	3612	1806	49846	13261	3276	16537	33309	3.01

Days to 50 % flowering

A perusal of data revealed that the effect of different levels of nitrogen, phosphorus and bio-fertilizer on days to 50 % flowering of wheat was found non-significant for both the year 2016-17, 2017-18 and in pooled data.

The interaction effect between different levels of nitrogen and phosphorus on days to 50 % flowering of wheat was found non-significant for both the year 2016-17, 2017-18 and in pooled data.

Days to maturity

A perusal of data revealed that the effect of different levels of nitrogen, phosphorus and bio-fertilizer on days to maturity and test weight (g) of wheat at harvest was found non-significant for both the year 2016-17, 2017-18 and in pooled data. The interaction effect between different levels of nitrogen and phosphorus on days to maturity and test weight (g) of wheat at harvest was found non-significant for both the year 2016-17, 2017-18 and in pooled data.

Grain yield (kg/ha)

The result revealed that the grain yield of wheat was found significant due to the effect of different levels of nitrogen, phosphorus and bio fertilizer for both the year 2016-17, 2017-18 and in pooled data also. The application of 120 kg N/ha gave significantly the highest grain yield was recorded as compared to the rest of treatments. Significantly the highest grain yield 2349, 2430 and 2389 kg/ha were recorded during both the year 2016-17, 2017-18 and in pooled data, respectively. While in case of phosphorus levels, application of 60 kg P₂O₅/ha was recorded significantly the highest grain yield 2340, 2465 and 2402 kg/ha during both the year 2016-17, 2017-18 and in pooled data, respectively. Increase in grain yield with increasing NP application might be an outcome of more NP availability for plant growth which resulted in more grains per spike and thousand grain weight that resulted in an increase in grain yield. This finding is supported by the findings of Batten, *et al.*, (1984) [6]. The interaction effect between different levels of nitrogen and phosphorus on grain yield (kg/ha) of wheat at harvest was found non-significant for both the year 2016-17, 2017-18 and in pooled data.

Straw yield (kg/ha)

The result revealed that the straw yield of wheat was found significant due to the effect of different levels of nitrogen, phosphorus and bio fertilizer for both the year 2016-17, 2017-18 and in pooled data also. The application of 120 kg N/ha gave significantly higher straw yield was recorded as compared to the rest of treatments. The application of 120 kg N/ha gave significantly the higher straw yield 3723, 3670 and 3697 kg/ha were recorded which was remained at par with 90 kg N/ha and 60 kg N/ha + Bio NPK during both the year 2016-17, 2017-18 and in pooled data, respectively. While in case of phosphorus levels, application of 60 kg P₂O₅/ha was recorded significantly the highest straw yield 3598, 3625 and 3612 kg/ha during both the year 2016-17, 2017-18 and in pooled data, respectively. The interaction effect between different levels of nitrogen and phosphorus on grain yield (kg/ha) of wheat at harvest was found non-significant for both the year 2016-17 and 2017-18 but interaction effect was significant in pooled basis.

The combination of N₄P₂ (120 kg N/ha and 60 kg P₂O₅/ha) was recorded significantly higher straw yield (3885 kg/ha) as compared to others, which was remained at par with N₃P₂ (90 kg N/ha and 60 kg P₂O₅/ha), N₂P₂ (60 kg N/ha + Bio NPK and 60 kg P₂O₅/ha) and N₄P₁ (120 kg N/ha and 30 kg P₂O₅/ha) [Table-3].

Soil analysis

Macro nutrient contents (kg/ha)

A perusal of data revealed that the effect of different levels of nitrogen, phosphorus and bio-fertilizer macro nutrient contents N (kg/ha), P (kg/ha), K (kg/ha), EC (ds/m), and pH of wheat after harvest was found non-significant for both the year 2016-17, 2017-18 and in pooled data also. While in case of OC (%), it was found non-significant for both the year 2016-17 and 2017-18 but it was found significant in pooled analysis. The interaction effect between different levels of nitrogen and phosphorus macro nutrient contents N (kg/ha), P (kg/ha), K (kg/ha), EC (ds/m), pH and OC (%) of wheat after harvest was found non-significant for both the year 2016-17, 2017-18 and in pooled data.

Economics

The relative economics of each treatment combination were estimated in terms of net profit in order to determine the most effective and remunerative treatment. The economics of different treatments are calculated on the basis of average production and the data are presented in [Table-4]. Among nitrogen levels, N₄: 120 kg N/ha was secured maximum net realization (Rs. 31,857) with net BCR of 2.79 followed by N₃: 90 kg N/ha. In case of phosphorus levels, P₂: 60 kg P₂O₅/ha accrued higher net realization (Rs. 33,309) with net BCR of 3.01.

Summary and Conclusion

In view of results obtained from the present investigation, it could be concluded that for securing maximum grain yield, straw yield and economic returns are advised to grow wheat (GW 496) with 60 kg N/ha and 60 kg P₂O₅/ha as a basal and remaining 60 kg N/ha in two equal split application at 30 DAS and 45 DAS.

Application of research: The study was conducted to analyze the effect of different levels of nitrogen, phosphorus and bio-fertilizer on yield of irrigated wheat under moisture conserve condition.

Research Category: Bio-fertilizers

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Study area / Sample Collection: Agricultural Research Station, Arnej, 382230

Cultivar / Variety / Breed name: Wheat (*Triticum aestivum* L.)

Conflict of Interest: None declared

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.

Ethical Committee Approval Number: Nil

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