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Effect of Nutrient Management strategies and sources of Nutrient on yield and Nutrient uptake in Wheat under subtropical conditions

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ABSTRACT
The challenge that the world is facing has been to maximize food production to feed the increasing population. Further, agriculture at present encompasses many problems such as stagnating food-grain production, multi-nutrient deficiency, declining fertilizer response, reduction in land availability for cultivation, environmental pollution and land degradation. To manage long term soil fertility, productivity as well as environment quality, efficient nutrient management practices integration can be the most sustainable practices to adopt. Therefore a field experiment was conducted during 2015-16 and 2016-17 at Crop Research Centre of SardarVallabhbhai Patel University of Agriculture and Technology, Meerut (U.P.). The treatments comprised of all possible combinations of the two factors viz.,nutrient management strategies (6) as main plot factor and sources of nutrient (03) as sub plot factor, along with Farmer practice (control). Experimental results revealed that nutrient management strategies and sources of nutrient as whole adopted in treatment mean produced maximum dry matter accumulation yield attributes such as grains spike^{-1}, test weight (g) and productive tiller plant^{-1}, grain yield and nutrient uptake like nitrogen, phosphorous, potassium, sulphur and zinc in grain and straw in comparison to control mean during both the years. Similarly customized fertilizer had recorded significantly highest dry matter yield attributes nitrogen sulphur and zinc uptake as compared to all other treatments, whereas maximum PK uptake was recorded under target yield (5 t ha^{-1}) plots during both the years. Moreover, 75% inorg+25%FYM+Azot+PSB had showed a similar trends to noticed maximum values of all above parameters over 75 % inorg+25%FYM and 100 % inorganicduring both the years.

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INTRODUCTION

Wheat (*Triticum aestivum L.)* is the staple food of 40 percent human population across the globe and second most important cereal after rice. India is the second largest wheat producing country after China with an area of 29.64 million hectares, production of 92.46 million tones and average productivity of 3.12 t ha^{-1} [1]. Uttar Pradesh ranks first in area (36.6%) and production (39.3 %) of wheat in the country. Out of 100 leading wheat producing districts (each with more than lakh tones of production), 43 belong to Uttar Pradesh and of them 19 to the western part of the state in particularly wheat productivity is far lower than Panjab and Haryana. Since the mid-1980s, wheat yield in India has either declined or stagnated [2]. This is because of late sowing of wheat due to long duration rice varieties and late harvest of sugarcane, poor seed replacement rate, lack of quality seed at right time and place, lack of inputs (fertilizers, irrigation water) due to limited resources and small holding size and poor mechanization, etc. One of the main reasons is conventional blanket fertilizer recommendation, leading to imbalanced use of fertilizers and lower fertilizer use efficiency. Agricultural holdings in India are highly fragmented with variable nutrient supplying capacity both at the spatial and temporal scale. A recent onfarm study [3], using the omission plot studies in the Indo-Gangetic Plains, showed that wheat yield response ranged from 500-4750 kg ha^{-1}, 67 - 2806 kg ha^{-1}and 0–2222 kg ha^{-1} for N, P and K respectively, which is related to the soil nutrient supplying capacity. Though, universal deficiency of nitrogen and phosphorus is followed by Zn deficiency. Almost 50% of the world soils used for cereal production is Zn deficient. Moreover, water shortage, absence of high yield varieties of seeds and the lack of research and development are also one of the basic causes behind the low per hectare of wheat in India.

Agricultural production in western Uttar Pradesh is constrained by imbalance nutrients application, land degradation, soil salinity/sodicity and water logging problems. Farmers mostly follow traditional farming systems, with lack of financial resources, small land holdings and lack of awareness being the main hurdles to adopting modern technology. Nutrient management strategies offer the additional possibility of normal sown wheat, and of reducing fertilizer costs and associated greenhouse gas emissions. However, there have been very few studies to date of soil test based fertilizer application including customized fertilizer and *Special Products Analysis Division*(SPAD- 502 meter) techniques for obtaining targeted yield in NW India. There are no long-term studies to evaluate crop performance; effects on soil physical and chemical properties; microbiological balance; or effects of weeds, diseases and pests. Keeping all above facts in view the present investigation entitled "Effect of nutrient management strategies and sources of nutrient" has been planned to investigate yield and nutrient uptake in wheat under subtropical climatic conditions.

MATERIALS AND METHODS

Site description

A field experiment was conducted during 2015-16 and 2016-17 at Crop Research Centre of SardarVallabhbhai Patel University of Agriculture and Technology, Meerut (U.P.), located at a latitude of 29^0 40' North and longitude of 77^0 42' East with an elevation of 237 metres above mean sea level. The climate of this region is subtropical and semi-arid and climate characterized with summers and extremely cold winters. The mean maximum temperature of this region is about 43^0C to 45^0C is not uncommon during summer while very low temperature (4-10^0C) accompanied by frost may be experienced in December-January. About 80 to 90% of rainfall received during July to September and few showers are also a common feature during the month of December to January and in late spring season

The experimental field was well drained, sandy loam in texture (46.2 % sand, 18.4 % silt and 17.4 % clay) and slightly alkaline in reaction (pH 7.8), It was low in organic carbon (0.58 %), available nitrogen (222 kg/ha), medium in available phosphorus (16.5 kg/ha) and high in potassium (249 kg/ha) with an electrical conductivity 0.23 dSm^{-1} (1:2, soil: water suspension at $25C^o$) and bulk density of 1.50 Mg/m3, respectively. The treatments comprised of all possible combinations of the two factors viz., nutrient management strategies (6) as main plot factor and sources of nutrient (03) as sub plot factor, along with Farmer practice (control).

Wheat (PBW-550) with the spacing (rows) of 20 cm was grown with recommended agronomic package of practices in 19 m^{-2} plot size. The seeds were placed manually in the furrows with a seed rate of 100 kg ha^{-1} sown on 14 November 2015 while harvested on 20 April 2016 during first year and 18 November 2016 while harvested on 24 April 2017 during second year of experimentation. In experiment, 75:75:60 (kg ha^{-1}) nitrogen, phosphorus and potassium, respectively was applied under recommended NPK, recommended NPK followed by LCC and recommended NPK followed by SPAD plot as a basal. While, in targeted yield plot (4 & 5 t ha^{-1}) nitrogen, phosphorus and potassium was applied based on the organic and inorganic equation in NCR of Delhi. The NPK to 4 t ha^{-1} 99.2: 46.4: 30.2 kg ha^{-1} for inorganic, while 54.9: 36.5: 5.4 kg ha^{-1} for organic, respectively was recommended. Moreover, in case of 4 t ha^{-1} 152.3: 80.9: 57.2 kg ha^{-1} for inorganic, whereas 84.0: 65.7: 19.1 kg ha^{-1} for organic, respectively was recommended. Further, 120:60:40 (kg ha^{-1}) nitrogen, phosphorus and potassium, respectively was used under application of constituents of customized fertilizer (CF) on soil test value along with sulphur and zinc as per the CF formula. As per the soil test range, 150: 60: 60: 30: 0.5 kg ha^{-1} N:P:K:S:Zn was recommended. Half dose of N and full dose of P, K, S and Zn were applied as basal at the time of seeding through traditional seed drill. Remaining half N was top dressed in two equal split doses; first split before 1st post-sowing irrigation at crown root initiation stage and the second split before 3rd irrigation at pre-flowering stage, except LCC and SPAD plot where three times top dressing were carried out as per the threshold values of SPAD (15 kg ha^{-1}) and LCC (20 kg ha^{-1}). Basal application of fertilizer was made at 5 cm depth in furrows opened 2-3 cm by the side of seed furrow.

Targeted yield (4.0 and 5.0 t ha^{-1}) had relevant by making use of data on the yield of wheat, total uptake of N, P and K, initial soil test values for available N, P and K and doses of fertilizer N, P_2O_5 and K_2O applied, the basic parameters *viz*., nutrient requirement (NR), contribution of nutrients from soil (Cs), fertilizer (Cf) and farmyard manure (Cfym) were calculated as outlined by Ramamoorthy *et al*. [4].

Nutrient recommendation equation for wheat in NCR of Delhi

$FN = 5.31\ T - 0.51SN$

$FP_2O_5 = 3.45\ T - 5.55\ SP$

$FK_2O = 2.75\ T - 0.32\ SK$

Moreover, for integrated purpose the equation are given below
FN= 3.85T-0.41SN-1.64 FYM
Where,
T= Targeted yield
SN= Soil nitrogen
SP=Soil phosphorus
SK=Soil potassium
Source: http://stcr.gov.in/HTML/html/Bulletins/Delhi_bulletin.htm

Basic parameter

Observations on dry matter accumulation was recorded at harvest stage of crop. Yield attributes was recorded by selecting 10 plants from 19 m^2 and yields and harvest index was estimated by the produce obtained from net plot area, treatment wise during both the year.

Plant sampling and analysis

The plants measured for growth and yield were used for analyzing the N, P, K, S and Zn content in grains and straw. The grain and straw samples were dried at 70 °C in a hot air oven. The dried samples were ground in a stainless steel Thomas Model 4 Wiley ® Mill. The N content in grains and straw was determined by digesting the samples in sulfuric acid (H_2SO_4), followed by analysis of total N by the Kjeldahl method by Page [5]using a Kjeltec™ 8000 auto analyzer (FOSS Company, Denmark). The P content in grains and straw was determined by the vanadomolybdo-phosphoric yellow colour method and the K content both in grains and straw was analyzed in di-acid (HNO_3 and $HClO_4$) digests by the flame photometeric method. Further S content was determine by Turbidimetric method while Zn content by atomic absorption spectrophotometer [5]. The uptake of the nutrients was calculated by multiplying the nutrient content (%) by respective yield (kg/ha) and was divided by 100 to get the uptake values in kg/ha and then summing of grain and straw yield of computing total uptake of NPK.

For zinc

Grain uptake (g ha^{-1}) = Nutrient content (ppm) in grain/10^4x
Grain yield (q ha^{-1}) x 10^3
Straw uptake (g ha^{-1}) = Nutrient content (ppm) in straw/10^4 x
Straw yield (q ha^{-1}) x 10^3

Statistical analysis

The data obtained were subjected to statistical analysis as outlined by Gomez and Gomez [6]. The treatment differences were tested by using "F" test and critical differences (at 5 per cent probability).

RESULTS AND DISCUSSION

Dry matter accumulation

Nutrient management strategies and nutrient sources as a whole when attempted in control mean did let to reduction in dry matter accumulation (meter^{-1} row length) in comparison to treatment mean. Though, the effect was non-significant during both the years. The plot which treated with customized fertilizer accumulated significantly higher dry matter accumulation in comparison to those grown with other nutrient management strategies during both the years. Target yield (5 t ha^{-1}) resulted in higher dry matter accumulation compared to target yield (4 t ha^{-1}), NPK 100%, PK+50 % N->LCC and PK+50 % N->SPAD-502. However, these treatment, except target yield (4 t ha^{-1}) was statistically on par with each other at all the growth stages. Target yield (4 t ha^{-1}) resulted in dry matter accumulation lesser than remaining treatments. Though, the differences was significant. Dry matter accumulation of wheat was higher under 75 % inorg+25%FYM+Azot+PSB compare to 75 % inorg+25%FYM and 100 % inorganic, during both the years. However, the variation was not significant during both the year.It might be due to balanced and fair supply of the essential elements might have facilitated utilization of assimilates towards synthesis of high molecular weight compounds like amino acids, proteins and nucleic acids etc. thereby maintaining a continuous demand for carbon assimilation. Favorable effect of Nitrogen, Phosphorus and Potassium application on dry matter accumulation in wheat has also been reported by Behera and Singh [7], Zn by Nadim *et al.* [8] and that of bio-fertilizers i.e. *Azotobacter* and PSB by Singh and Pal [9].

Yield attributes

A reduction in grains spike^{-1}, test weight (g) productive tiller plant^{-1} were recorded under control mean in comparison to treatment mean during both the years. Though the differences were non- significant (Table 1). Crop produce more grains spike^{-1}, test weight (g) productive tiller plant^{-1} of significant effect under customized fertilizer over other nutrient management condition during both the years. However, it was remained on par with target yield (5 t ha^{-1}). Target yield (5 t ha^{-1}) had also produces more grains spike^{-1}, test weight (g) productive tiller plant^{-1} over PK+50 % N->SPAD-502, PK+50 % N->LCC and NPK 100%. However, the differences among them was not significant during both the years. This might be due to higher leaf area index, higher photosynthesis and intense formation and filling of the grains. Favorable effect of nitrogen, phosphorus and potassium application on yield attributes of wheat has also been reported by Singh *et al*. [10] and Zahedifar *et al.* [11]. Likewise, grains spike^{-1}, test weight (g) productive tiller plant^{-1} were significantly higher under 75 % inorg+25%FYM+Azot+PSB in comparison to 75 % inorg+25%FYM and 100 % inorganic. Though, 100 % inorganic were recorded lowest grains spike^{-1}, test weight (g) productive tiller plant^{-1}during both the year.

Grain yield and harvest index

The yield of a crop is function of crop stand and performance of individual plant that are largely governed by successful completion of the vegetative phase. In wheat, crop stand and test weight are the key yield components (Table 2). Control mean irrespective of nutrient management strategies and sources of nutrient resulted in considerable reduction in grain yield as compared to treatment mean. However a reverse trends were noticed in harvest index where treatments mean recorded lowest harvest index. The plot which treated with customized fertilizer gave significantly higher yield over rest of the treatment during both the year, though no other nutrient management strategies was as good as customized fertilizer. It was mainly due to the fact that under favorable soil conditions, the plant accumulates and translocation photosynthetic from source to the sink more efficiently which inturn increased all the growth and yield attributes too. Similar report was also made by Singh and Ram [12]. Differences among PK+50 % N->SPAD-502, PK+50 % N -> LCC and NPK 100% were however non-significant. Moreover, Target yield (4 t ha^{-1}) gave significantly higher harvest index over rest of the treatment, next in order target yield (5 t ha^{-1}), 100% NPK, customized fertilizer, PK+50 % N -> LCC and PK+50 % N->SPAD-502 during both the years. All the treatments of nutrient management was significantly differ with each other.The data on yield presented in Table 2 indicated that 75% inorg+25%FYM+Azot+PSB had more advantageous to obtained higher grain yield as well as harvest index in comparison to 75 % inorg+25%FYM and 100 % inorganic. However, the difference among them was not significant during both the years of experimentation.

Protein content (%)

Data presented in Table 2 revealed higher values of protein content had noticed in treatment mean than in control mean, the differences were however non-significant between them.Protein content in grain was significantly highest in customized fertilizer as compared to all other treatments, except Target yield (5 t ha^{-1}) during both the years. The mean percent of protein content in customized fertilizer was 10.20 % during both the year. Target yield (4 t ha^{-1}) was recorded lowest protein content over all other treatments, however it was on par with PK+50 % N->SPAD-502, PK+50 % N -> LCC and NPK 100% during both the year. The mean percent of protein content in target yield (4 t ha^{-1}) was 9.79 % during both the year. Higher protein content in grains was mainly due to the more nitrogen content in grains and higher grain yield which inturn improved the protein yield.The data on protein content given in Table 2 disclosed that 75% inorg+25%FYM+Azot+PSB slightly raised protein content as compared to 75 % inorg+25%FYM and 100 % inorganic during both the years. However the differences among them were non-significant during both the years.Simultaneous use of *Azotobacter&* PSB proved more effective. Higher grain protein content with application of nitrogen and micronutrients by Kajla *et al*. [13] have been observed in wheat. Further, the balanced availability of the essential nutrients in harmony with crop demand across the growth stages might have favored various metabolic processes related to protein synthesis.

Nutrient uptake

Data on nutrient content presented in Table 3 & 4 revealed that higher values of nitrogen, phosphorous, potassium, sulphur and zinc uptake in grain and straw had noticed in treatment mean than in control mean, the differences were however significant to phosphorous uptake in grain during 2015-16. Phosphorous in grain and straw and potassium uptake in straw were significant highest in target yield (5 t ha^{-1}) plots during both the years over target yield (4 t ha^{-1}). Whereas, nitrogen sulphur and zinc uptake in grain and straw, potassium uptake in grain was remained significantly higher with the used of customized fertilizer as compared to all other treatments during both the years. Differences among PK+50 % N->SPAD-502, PK+50 % N -> LCC and NPK 100% were however non-significant to nitrogen phosphorous, potassium, sulphur and zinc uptake in grain and straw during both the year. Target yield (4 t ha^{-1}) was inferior over all other treatments during both the year. The higher uptake of nitrogen, phosphorus and potassium in this treatment was mainly due to more grain and straw yields along with higher nutrient contents present in grains and straw Nutrient uptake is mainly governed by nutrient content and yield. Combined action of both led to more uptakes in grain, straw as well as total. The results confirm the findings of Shivay*et al.* [14] and Gupta and Sharma [15].The data on nutrient uptake in grain and straw given in Table 2 & 3 disclosed that 75% inorg+25%FYM+Azot+PSB had slightly raised nitrogen, phosphorous, potassium, sulphur and zinc uptake in grain and straw as comparison to 75 %

inorg+25%FYM and 100 % inorganic during both the years. However the differences were significant to sulphur uptake in grain and straw during both the years.The beneficial effect of Zn when applied in conjunction with organic/inorganic/bio-fertilizers might have helped in increasing and balancing the availability of essential plant nutrients and organic fertilizers sustained it over a long time. Microbial decomposition of organic manure (FYM) with simultaneous release of organic acid which act as chelating agent might have facilitated the availability and absorption of micro-nutrients as indicated by plant nutrient content and residual soil fertility. The results confirm the findings of Kumar and Thenua [16].

Table 1: Effect of nutrient management strategies and sources of nutrient on growth and yield attributes of wheat

Treatments	Dry matter accumulation meter^{-1} row length		Grains spike^{-1}		Test weight (g)		Productive tiller plant^{-1}	
	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17
Control V/S Rest								
Control Mean	274.20	285.62	44.40	45.20	35.07	35.6	1032.5	1084.0
Treatment Mean	291.99	304.80	48.84	49.94	36.2	36.86	1066.3	1110.2
S.Em.±	9.50	10.32	1.97	2.08	0.77	1.07	26	27.5
CD *(P=0.05)*	NS	NS	NS	NS	NS	NS	NS	NS
Nutrient management strategies								
NPK 100%	277.79	286.37	45.67	46.53	35.5	36.27	1052.5	1081.1
PK+50 % N->SPAD-502	293.06	305.67	49.40	50.40	36.47	37.03	1077.0	1106.8
PK+50 % N -> LCC	284.93	297.12	47.27	48.37	36.03	36.43	1068.0	1110.8
Target yield (4 t/ha)	270.22	282.19	43.17	43.93	34.5	34.97	1008.1	1060.6
Target yield (5 t/ha)	304.57	321.49	53.03	54.17	37.13	37.97	1088.1	1140.8
Custom Fertiliser	321.36	335.94	54.52	56.22	37.56	38.5	1104.1	1161
S.Em.±	3.57	3.75	0.61	0.62	0.49	0.55	12.9	13.6
C.D. (P=0.05)	11.24	11.81	1.92	1.96	1.54	1.73	40.8	42.8
Sources of nutrient								
100 % inorg	288.27	299.63	48.02	49.00	35.95	36.58	1060.9	1103.2
75 % inorg+25%FYM	292.25	306.00	48.98	50.14	36.24	36.88	1066.2	1112.5
75 % inorg+25%FYM+Azot+PSB	295.44	308.76	49.53	50.67	36.4	37.12	1071.8	1114.8
S.Em.±	4.71	4.92	0.78	0.80	0.48	0.73	17.2	17.9
C.D. (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS

Table 2: Effect of nutrient management strategies and sources of nutrient on growth and yield attributes of wheat

Treatments	Grain yield (t ha^{-1})		Harvest index		Protein content (%)	
	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17
Control V/S Rest						
Control Mean	4.43	4.52	44.08	44.05	9.86	9.86
Treatment Mean	4.79	4.86	43.43	43.37	9.98	10.01
S.Em.±	0.17	0.26	0.35	0.34	0.22	0.22
CD *(P=0.05)*	NS	NS	NS	NS	NS	NS
Nutrient management strategies						
NPK 100%	4.58	4.67	43.22	43.15	9.95	9.95
PK+50 % N->SPAD-502	4.79	4.87	42.67	42.74	9.95	10.01
PK+50 % N -> LCC	4.70	4.75	42.86	42.79	9.95	9.95
Target yield (4 t/ha)	4.29	4.39	45.12	45.10	9.78	9.80
Target yield (5 t/ha)	5.17	5.23	43.54	43.51	10.08	10.14
Custom Fertiliser	5.19	5.24	43.11	42.90	10.18	10.22
S.Em.±	0.06	0.06	0.01	0.01	0.12	0.12
C.D. (P=0.05)	0.19	0.19	0.02	0.03	0.38	0.38
Sources of nutrient						
100 % inorg	4.68	4.78	43.26	43.33	9.94	9.97
75 % inorg+25%FYM	4.82	4.88	43.55	43.47	9.99	10.02
75 % inorg+25%FYM+Azot+PSB	4.86	4.92	43.46	43.30	10.00	10.05
S.Em.±	0.07	0.08	0.004	0.01	0.16	0.16
C.D. (P=0.05)	NS	NS	NS	NS	NS	NS

Table 3: Effect of nutrient management strategies and sources of nutrient on nitrogen, phosphorus and potassium uptake in grain and straw

Treatments	Nitrogen uptake (Kg ha^{-1})				Phosphorus uptake (Kg ha^{-1})				Potassium uptake (Kg ha^{-1})			
	Grain		Straw		Grain		Straw		Grain		Straw	
	2014-15	2015-16	2014-15	2015-16	2014-15	2015-16	2014-15	2015-16	2014-15	2015-16	2014-15	2015-16
Control V/S Rest												
Control Mean	76.38	77.92	26.48	27.62	13.77	14.50	8.45	8.63	18.66	19.49	92.96	95.51
Treatment Mean	83.68	85.16	33.52	33.32	16.08	16.61	9.60	9.94	21.17	22.27	105.08	107.68
S.Em.±	4.54	4.54	2.87	2.39	0.97	0.99	0.68	0.68	1.20	1.25	6.03	6.06
CD *(P=0.05)*	NS	NS	NS	NS	2.78	NS	NS	NS	NS	NS	NS	NS
Nutrient management strategies												
NPK 100%	79.70	81.18	35.71	30.99	15.45	16.05	9.25	9.65	20.50	21.35	101.48	104.06
PK+50 % N->SPAD-502	83.35	85.17	33.09	33.98	16.64	17.23	10.10	10.23	21.44	22.76	108.72	111.28
PK+50 % N -> LCC	81.76	82.69	33.33	33.32	16.32	16.68	9.84	10.19	21.03	22.22	105.85	108.22
Target yield (4 t/ha)	73.40	75.38	24.42	25.04	13.04	13.67	7.15	7.70	17.92	18.96	85.78	88.86
Target yield (5 t/ha)	91.35	92.93	36.34	37.49	18.51	18.90	11.21	11.58	23.70	25.02	114.22	116.53
Custom Fertiliser	92.50	93.62	38.22	39.13	16.49	17.15	10.08	10.26	22.40	23.29	114.45	117.15
S.Em.±	2.10	2.14	0.90	0.85	0.43	0.43	0.26	0.26	0.54	0.55	2.62	2.67
C.D. (P=0.05)	6.62	6.74	2.84	2.69	1.36	1.34	0.81	0.82	1.69	1.74	8.25	8.40
Sources of nutrient												
100 % inorg	81.60	83.46	31.28	32.17	15.46	15.92	9.09	9.24	20.39	21.51	103.13	105.54
75 % inorg+25%FYM	84.24	85.53	33.02	33.47	16.27	16.73	9.74	10.10	21.40	22.52	105.25	107.77
75 % inorg+25%FYM+Azot+PSB	85.20	86.50	36.25	34.33	16.51	17.19	9.98	10.47	21.71	22.78	106.86	109.73
S.Em.±	2.70	2.75	1.07	1.06	0.50	0.53	0.31	0.32	0.69	0.72	3.34	3.42
C.D. (P=0.05)	NS	NS	3.20	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table 4: Effect of nutrient management strategies and sources of nutrient on sulphur and zinc uptake in grain and straw

Treatments	Sulphur content (kg ha^{-1})				Zinc content (g ha^{-1})			
	Grain		Straw		Grain		Straw	
	15-16	16-17	15-16	16-17	15-16	16-17	15-16	16-17
Control V/S Rest								
Control Mean	4.45	4.54	15.78	16.12	284.66	295.41	63.72	69.62
Treatment Mean	5.38	5.45	23.52	23.91	353.32	364.77	85.29	89.62
S.Em.±	0.58	0.58	3.33	3.38	30.20	30.70	11.02	11.55
CD *(P=0.05)*	NS	NS	NS	NS	NS	NS	NS	NS
Nutrient management strategies								
NPK 100%	5.10	5.20	18.50	18.88	307.80	318.14	69.43	72.68
PK+50 % N->SPAD-502	4.96	5.04	23.21	23.52	356.24	367.28	83.42	88.09
PK+50 % N -> LCC	4.76	4.82	21.98	22.30	335.57	344.41	74.52	78.21
Target yield (4 t/ha)	3.73	3.83	12.74	13.07	261.92	274.71	56.29	59.89
Target yield (5 t/ha)	6.06	6.13	27.82	28.18	409.01	419.04	93.86	97.47
Custom Fertiliser	7.64	7.70	36.86	37.51	449.41	465.06	134.23	141.40
S.Em.±	0.16	0.17	0.62	0.63	9.07	9.53	2.08	2.15
C.D. (P=0.05)	0.51	0.52	1.95	1.97	28.57	29.47	6.56	6.78
Sources of nutrient								
100 % inorg	5.03	5.13	22.08	22.40	339.46	351.28	81.53	85.91
75 % inorg+25%FYM	5.45	5.51	23.82	24.21	355.13	367.04	85.56	89.68
75 % inorg+25%FYM+Azot+PSB	5.66	5.72	24.66	25.12	365.38	376.00	88.79	93.28
S.Em.±	0.19	0.19	0.79	0.80	11.38	11.76	2.82	2.97
C.D. (P=0.05)	0.57	0.58	2.36	2.40	NS	NS	NS	NS

CONCLUSION

Based upon above findings, it can be concluded that adoption of customized fertilizer have been provided better outcome in western Uttar Pradesh condition and retained sustainability in the production system. Our results provide a substantial basis to promote this technology with farmers in the sandy loam soils of North West India and other similar regions. Moreover, a continued effort to understand the processes that influence nutrient management strategies and sources of nutrient under these systems is needed in order to make full use of the potential to convert this knowledge into practical guidelines for farmers.

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