E-ISSN: 2618-0618
P-ISSN: 2618-060X

www.agronomyjournals.com
2025; SP-8(3): 08-14
Received: 17-12-2024
Accepted: 19-01-2025

Sandeep Kumar
Research Scholar, Department of Agronomy, C. S. Azad University of Agriculture and Technology, Kanpur, Uttar Pradesh, India

AK Tripathi
Associate Professor, Department of Agronomy, Banda University of Agriculture and Technology, Banda, Uttar Pradesh, India

Corresponding Author:
Sandeep Kumar
Research Scholar, Department of Agronomy, C. S. Azad University of Agriculture and Technology, Kanpur, Uttar Pradesh, India

Residual effect of organic and inorganic sources of nitrogen on growth and yield of wheat (*Triticum aestivum* L.) in plain zone of Uttar Pradesh

Sandeep Kumar and AK Tripathi

DOI: https://www.doi.org/10.33545/2618060X.2025.v8.i3Sa.2596

Abstract
A field experiment was conducted during two consequentive years (2015-16 and 2016-17) at Chandra Shekhar Azad University of Agriculture and Technology, Kanpur-2 to assess the residual effect of organic and inorganic fertilizer sources of N on growth and productivity of succeeding wheat (*Triticum aestivum* L.) crop. The experiment was conducted in split plot design involving 5 and 4 treatments of N through organic inorganic secondly respectively. The results expressed maximum plant height, dry matter accumulation, yield attributes, wheat and Straw yield with the application of organics, followed by vermicompost and FYM each @50% RDN and which were found superior to lower does. The maximum uptake of NPK by wheat was recorded with organic application. The system productivity of wheat, net returns and cost: benefit ratio were favourably influenced by different sources of organics and fertilizer N when applied at different levels to wheat. Under organic sources of nutrient, maximum mean gross and net return values of wheat was significantly recorded under FYM @ 50% RDN (₹ 116315 and 72115/ha), followed by FYM @ 25% RDN (₹ 112905 and 68705/ha) and vermicompost @ 50% RDN (₹ 110434 and 66234/ha), respectively.

Keywords: Wheat, organic fertilizers, inorganic fertilizers, uptake, cost: benefit ratio, split plot design

Introduction
Wheat (*Triticum aestivum* L.), another major important staple cereal, supplies the bulk of calories and nutrients in the diets of a large segment of the world population. Globally, India is the second largest wheat producing country and contributes about 11.9% to the world wheat production from about 12% of world area (Singh *et al*., 2010) [12].

No doubt, the application of chemical fertilizers may augment the productivity of baby corn, but keeping in mind that continuous use of chemical fertilizers for adopting intensive cropping system is leading to imbalance of nutrients into soil, which has an adverse effect on soil health and also on crop yields. Chemical fertilizers may lead to hazardous effect on environmental health, besides increasing production cost due to sky high cost of fertilizers.

Organic manure (Farm yard manure, vermicompost, green manure and farm residue) is also considered as an important source of macro- and micronutrients to increase crop yield. Due to higher prices of inorganic fertilizers, farmers in India can easily afford to manage the need of nutrients through this FYM and vermicompost, besides their production at farm level is very easy. Manure contains all the plant nutrients including trace elements needed for crop growth. However, the availability or efficiency of manure utilization by a crop is determined by the method and time of incorporation and the status of decomposition by micro-organisms in the soil. On the other hand, the use of organics alone will not result in spectacular increase in crop yields, due to slow release of nutrients from organic sources, hence judicious use of fertilizers from different sources on crop or baby corn will maintain the environmental sustainability in years to come without affecting the environmental health (Ranjan *et al*., 2013) [8].

Nutrient management strategies should be aimed at achieving the twin goals of fertilizer economy and sustainability. The negligence to the conservation and use of organic sources for nutrients has not only exhausted soil nutrient reserves, but also resulted in an imbalance among

the available nutrients, leading to soil problems. Integration of inorganic and organic sources such as vermicompost, poultry manure, farm yard manure and their efficient management has shown promise in sustaining the productivity and soil health, besides meeting part of crop nutrient requirement (Chaudhary *et al.,* 2014) [2].

Integrated nutrient management (INM) practices are important to get maximum benefit of crop grown under wheat rotation. To cope up with the situation, the use of organic and inorganic sources of nutrients was taken to evaluate the varying levels of nutrients with and without organic sources on productivity, profitability and physico-chemical properties of soil in baby corn-wheat cropping system under irrigated condition of Central Uttar Pradesh.

Materials and Methods

A field experiment was conducted for two consequeetive years at Students' Instructional Farm, Department of Agronomy of Chandra Shekhar Azad University of Agriculture & Technology, Kanpur. Determination of N, P, K, organic carbon, EC, pH was done both before planting and harvesting of the experiment Determination of N content and protein in wheat grain with made during both the year. The experiments were laid out in split plot design. Five N organic sources, *viz*., control, FYM@25%, @50% of RDN, Vermicompost @25% and @50% of RDN were applied in main plot with 4 levels of N through inorganic fertilizers (50%, 75% 100% and 125% RDF) in sub plots.

Wheat verity K-402 was used for investigation. It was developed and released at Chandra Shekhar Azad University of Agriculture and Technology, Kanpur. It is resistant to important pests and diseases of wheat. Nutrient uptake was estimated by multiplying the dry-matter accumulation at maturity in grain and straw of wheat by their respective percentages. Total uptake was calculated by adding uptake of grain and straw. Soil-moisture content was determined by gravimetric method. The yield parameters and yields were recorded and economics was worked out. The statistical analysis the data recorded on different characters was same as per produce of split plot design.

Results and Discussion

1. Effect of previously applied organic sources of N

Residual effect on growth parameters of wheat

Growth of wheat was markedly influenced by organic matter substitution in the preceding baby corn crop. The plots which received 25 and 50% N substitution through FYM to preceding crop had the best expression. These treatments, however, also differed significantly with corresponding treatments involving inorganic fertilizers (75%) substituted 25 and 50% N by vermicompost. Further, FYM @ 50% RDN, closely followed by FYM @ 25% RDN, vermicompost @ 50% RDN varied significantly and had higher values of growth parameters *viz*., shoots at maximum tillering, ear heads at harvest, plant height and dry matter accumulation/plant compared to plots receiving no organic manures (Tables-1&2). Stimulated vegetative growth of wheat on account of adequate and prolonged supply of essential nutrients in treatments of organic resulted into higher dry matter production and translocation, and the conversion of photosynthates into reproductive parts (Sharma *et al*. 2007) [9].

Table 1: Residual effect of organic and inorganic fertilizer sources of N on plant population of wheat during 2015 and 2016

Treatment	Plant population per meter square								
	No. of plants at germination			No. of shoots at maximum tillering			No. of ear-heads at harvest		
	2015-16	2016-17	Pooled	2015-16	2016-17	Pooled	2015-16	2016-17	Pooled
Nitrogen through organic manures									
Control (No organic)	169.99	178.39	174.19	390.04	413.51	401.78	344.48	361.28	352.88
FYM @ 25% RDN	168.71	178.75	173.73	423.21	456.56	439.89	378.70	404.83	391.77
FYM @ 50% RDN	169.77	178.89	174.33	426.79	463.48	445.14	384.04	415.23	399.64
VC @ 25% RDN	170.13	178.64	174.39	410.71	438.30	424.51	365.92	387.36	376.64
VC @ 50% RDN	170.23	179.57	174.90	415.14	450.06	432.60	371.51	396.51	384.01
S.Em±	1.23	1.51	0.970	2.94	4.12	2.531	4.21	5.78	3.577
CD (P=0.05)	NS	NS	NS	9.58	13.41	7.586	13.71	18.84	10.722
Nitrogen through inorganic fertilizer									
50% RDN	169.72	179.00	174.36	399.13	430.51	414.82	354.61	377.70	366.16
75% RDN	168.60	178.40	173.50	410.05	442.94	426.50	367.73	392.13	379.93
100% RDN	170.35	179.03	174.69	420.33	451.70	436.02	376.52	401.87	389.20
125% RDN	170.38	178.95	174.67	421.24	452.37	436.81	376.86	400.45	388.66
S.Em±	1.06	1.35	0.857	2.81	3.179	2.121	3.02	4.39	2.664
CD (P=0.05)	NS	NS	NS	8.11	9.18	5.998	8.71	12.69	7.534

Residual effect on yield attributes of wheat

Organic manures applied to the preceding baby corn crop had carry-over effect on wheat which resulted in better expression of yield attributes in plants, spikelets/spike, grains/spike, grain weight/spike, ear length, ear weight and 1000-grain weight raised in plots which had experienced substitution of nutrients through organic sources in the preceding crop. The highest values for all the yield attributing characters of subsequent wheat crop were recorded from the treatment receiving 50% N through FYM in the preceding season. The treatment which got 75% recommended dose of N through inorganic and the balance 25% N substituted through FYM and 50%v N substituted through vermicompost in the preceding crop also had higher values for all the yield attributes than the treatments receiving no organics in preceding crop (Tables-3&4).

Table 2: Plant height at harvest and dry matter accumulation (g/plant) of wheat as influenced by residual effect of organic and inorganic N fertilizers during 2015 and 2016

Treatment	Plant height at harvest (cm)			Dry matter accumulation (g/plant)		
	2015-16	2016-17	Pooled	2015-16	2016-17	Pooled
Nitrogen through organic manures						
Control (No organic)	79.43	85.49	79.43	7.837	8.143	7.990
FYM @ 25% RDN	86.79	90.44	86.79	8.685	8.921	8.803
FYM @ 50% RDN	88.89	92.38	88.45	8.824	9.416	9.120
VC @ 25% RDN	82.87	87.19	74.77	8.101	8.263	8.182
VC @ 50% RDN	84.77	88.90	87.52	8.459	8.690	8.574
S.Em±	0.79	0.85	0.580	0.154	0.162	0.108
CD (P=0.05)	2.56	2.78	1.739	0.471	0.528	0.325
Nitrogen through inorganic fertilizer						
50% RDN	80.60	84.00	82.30	7.592	7.756	7.674
75% RDN	84.28	87.52	85.90	8.251	8.465	8.358
100% RDN	86.25	90.25	88.25	8.801	9.197	8.999
125% RDN	87.05	91.61	89.33	8.880	9.327	9.104
S.Em±	0.67	0.77	0.512	0.122	0.132	0.090
CD (P=0.05)	1.95	2.22	1.448	0.352	0.382	0.254

Table 3: Residual effect of organic and inorganic N fertilizers on no. of spikelets/spike, grains/spike and grain weight/spike during 2015 and 2016

Treatment	Spikelets/spike			Grains/spike			Grain weight/spike		
	2015-16	2016-17	Pooled	2015-16	2016-17	Pooled	2015-16	2016-17	Pooled
Nitrogen through organic manures									
Control (No organic)	17.18	17.79	17.48	47.08	47.21	47.14	1.56	1.62	1.59
FYM @ 25% RDN	18.57	18.82	18.69	50.72	51.85	51.28	1.79	1.87	1.83
FYM @ 50% RDN	18.78	18.93	18.86	52.19	53.45	52.82	1.88	1.99	1.94
VC @ 25% RDN	17.70	18.53	18.11	48.01	49.20	48.61	1.66	1.70	1.68
VC @ 50% RDN	18.10	19.18	18.64	49.28	50.47	49.87	1.73	1.76	1.74
S.Em±	0.20	0.25	0.16	0.66	0.69	0.48	0.03	0.04	0.02
CD (P=0.05)	0.66	0.80	0.48	2.16	2.26	1.44	0.09	0.11	0.07
Nitrogen through inorganic fertilizer									
50% RDN	17.20	17.78	17.49	42.26	45.85	44.05	1.43	1.54	1.49
75% RDN	17.88	18.45	18.16	49.60	47.63	48.62	1.69	1.76	1.73
100% RDN	18.58	19.15	18.86	52.35	49.54	50.94	1.88	1.93	1.90
125% RDN	18.60	19.22	18.91	53.61	51.45	52.53	1.89	1.95	1.92
S.Em±	0.17	0.21	0.13	0.53	0.57	0.39	0.03	0.03	0.02
CD (P=0.05)	0.49	0.60	0.38	1.53	1.66	1.11	0.08	0.09	0.03

Table 4: Residual effect of organic and inorganic N fertilizers on ear length, ear weight and 1000-grain weight (g) during 2015 and 2016

Treatment	Ear length (cm)			Ear weight (g)			1000-grain weight (g)		
	2015-16	2016-17	Pooled	2015-16	2016-17	Pooled	2015-16	2016-17	Pooled
Nitrogen through organic manures									
Control (No organic)	7.43	7.74	7.58	2.08	2.20	2.14	40.02	42.42	41.22
FYM @ 25% RDN	7.91	8.88	8.39	2.40	2.54	2.47	43.01	45.04	44.02
FYM @ 50% RDN	8.04	9.07	8.55	2.50	2.62	2.56	44.11	45.51	44.81
VC @ 25% RDN	7.80	8.53	8.16	2.25	2.32	2.28	41.23	43.77	42.50
VC @ 50% RDN	7.85	8.71	8.28	2.33	2.43	2.38	42.36	44.37	43.36
S.Em±	0.05	0.08	0.05	0.02	0.04	0.02	0.43	0.32	0.27
CD (P=0.05)	0.12	0.25	0.13	0.08	0.12	0.06	1.41	1.03	0.80
Nitrogen through inorganic fertilizer									
50% RDN	7.58	7.86	7.72	2.01	2.08	2.04	39.59	40.04	39.82
75% RDN	7.77	8.51	8.14	2.27	2.39	2.33	41.56	43.27	42.42
100% RDN	7.86	8.98	8.42	2.47	2.59	2.53	43.62	46.19	44.90
125% RDN	8.01	8.98	8.50	2.50	2.62	2.56	43.81	47.22	45.52
S.Em±	0.04	0.06	0.04	0.02	0.03	0.02	0.38	0.28	0.23
CD (P=0.05)	0.11	0.17	0.10	0.06	0.09	0.05	1.09	0.80	0.66

Residual effect on yield of wheat

The organic manures applied in different proportions to baby corn crop significantly enhanced mean biological, grain and straw yield of wheat to the extent of overall 9.56, 7.38 and 11.21%, respectively over no organic treatment (Table-5&6). Higher yields of wheat was owing to better yield attributing characters *viz*., spikelets/spike, grains/spike, grain weight/spike, ear length, ear weight and 1000-grain weight as a result of improvement in soil physical, chemical and biological properties with organics. Secondly, after baby corn, the treatments having organic manures (FYM and vermicompost) might have left more nutrients in the soil than inorganic fertilizer plots, which was available for wheat crop. Kumar (2008) [4] also obtained similar carry over effect of FYM on wheat in maize-wheat cropping system. Naresh *et al.* (2013) [7] also reported that the practice of IPNM (15 t/ha FYM + 150:50:30 kg NPK/ha) applied to maize

exhibited positive effects on the performance of wheat, a subsequent crop in the cropping systems. Chaudhary *et al.* (2014) [3] also obtained similar carry over effect of FYM and vermicompost on wheat in rice-wheat cropping system. Similar results are also reported by Manjhi *et al*. (2014) [6] and Singh *et al*. (2015) [11].

Residual effect on NPK uptake and protein content in wheat

The uptake of NPK in grain and straw of wheat was significantly maximum with FYM @ 50% RDN followed by vermicompost @ 50% RDN and minimum uptake in no-organic (control) treatment (Table-6&7). The beneficial effect of FYM and vermicompost may be due to release of other nutrients from the decomposition of organic matter of these organic manures. The results may be supported by the findings of Verma and Prasad (2002) [13] who also reported higher N, P, and K uptake in wheat with organic manures over no-organic manures.

Table 5: Residual effect of organic and inorganic N fertilizer sources on biological, grain, straw yield (t/ha) and harvest index (%) of wheat during 2015 and 2016

Treatment	Biological yield			Grain yield			Straw yield			Harvest index		
	2015	2016	Pooled	2015	2016	Pooled	2015	2016	Pooled	2015	2016	Pooled
Nitrogen through organic manures												
Control (No organic)	10.141	12.475	11.308	4.531	5.165	4.848	5.609	7.310	6.460	44.68	41.39	43.04
FYM @ 25% RDN	11.746	13.200	12.473	4.899	5.622	5.261	6.847	7.578	7.213	41.70	43.09	42.40
FYM @ 50% RDN	12.123	13.415	12.769	4.990	5.883	5.437	7.133	7.533	7.333	41.16	43.86	42.51
VC @ 25% RDN	11.386	12.690	12.038	4.776	5.235	5.006	6.609	7.455	7.032	41.94	41.25	41.60
VC @ 50% RDN	11.624	12.933	12.279	4.827	5.413	5.120	6.796	7.520	7.158	41.52	41.85	41.69
S.Em±	0.154	0.181	0.119	0.067	0.070	0.049	0.063	0.054	0.042	0.38	0.24	0.22
CD (P=0.05)	0.502	0.588	0.356	0.219	0.228	0.146	0.207	0.176	0.125	1.24	0.78	0.67
Nitrogen through inorganic fertilizer												
50% RDN	11.088	12.191	11.640	4590	5.127	4.859	6.498	7.064	6.781	41.47	42.43	41.95
75% RDN	11.331	12.744	12.038	4778	5.382	5.080	6.553	7.362	6.958	42.24	42.21	42.23
100% RDN	11.522	13.249	12.385	4903	5.593	5.248	6.619	7.656	7.137	42.63	42.20	42.41
125% RDN	11.673	13.586	12.630	4.948	5.752	5.350	6.726	7.834	7.280	42.45	42.31	42.38
S.Em±	0.089	0.168	0.095	0.046	0.046	0.033	0.043	0.034	0.027	0.25	0.17	0.15
CD (P=0.05)	0.257	0.486	0.269	0.133	0.132	0.099	0.125	0.097	0.077	0.72	NS	NS

Table 6: Residual effect of organic and inorganic N fertilizers on N, P and K uptake by wheat grain (kg/ha) during 2015 and 2016

Treatment	Nutrient uptake by wheat grain								
	N uptake			P uptake			K uptake		
	2015-16	2016-17	Mean	2015-16	2016-17	Mean	2015-16	2016-17	Mean
Nitrogen through organics									
Control (No organic)	79.06	90.70	84.88	9.80	11.72	10.76	10.14	12.14	11.14
FYM @ 25% RDN	96.40	111.26	103.83	14.68	17.84	16.26	16.97	20.07	18.52
FYM @ 50% RDN	113.05	132.78	122.92	19.12	23.24	21.18	23.79	28.71	26.25
VC @ 25% RDN	88.65	97.73	93.19	12.38	14.14	13.26	13.57	15.44	14.50
VC @ 50% RDN	102.14	115.03	108.58	16.47	19.11	17.79	19.86	22.30	21.08
S.Em±	1.97	2.25	1.50	0.23	0.38	0.22	0.28	0.35	0.22
CD (P=0.05)	6.41	7.34	4.48	0.73	1.24	0.66	0.91	1.13	0.66
Nitrogen through inorganics									
50% RDN	89.31	100.08	94.70	13.05	15.07	14.06	15.22	17.23	16.23
75% RDN	94.46	106.73	100.60	14.13	16.47	15.30	16.28	18.78	17.53
100% RDN	98.65	112.92	105.79	15.05	17.67	16.36	17.63	20.58	19.11
125% RDN	101.01	117.28	109.15	15.73	18.87	17.30	18.54	22.09	20.32
S.Em±	1.63	1.8	1.17	0.19	0.31	0.18	0.23	0.31	0.19
CD (P=0.05)	4.71	4.87	3.31	0.55	0.91	0.52	0.67	0.90	0.55

Residual effect of organic manures have affected protein content significantly where FYM and vermicompost attained significantly maximum protein content in wheat grain and minimum in the control plot (Table-7).

Economics of wheat cultivation

Under organic sources of nutrient, maximum mean gross and net return values of wheat was significantly recorded under FYM @ 50% RDN (₹ 116315 and 72115/ha), followed by FYM @ 25% RDN (₹ 112905 and 68705/ha) and vermicompost @ 50% RDN (₹ 110434 and 66234/ha), respectively. However, benefit: cost ratio was also maximized under same treatments (Table-8). The minimum gross and net return as well as benefit: cost ratio was recorded under the no-organic plots. The grain and straw yields were the major factors which caused differences in gross and net returns. Higher gross and net returns from wheat cultivation with FYM application have also been reported by Verma and Prasad (2002) [13]. Chaudhary *et al.* (2014) [2] also obtained similar carry over effect of FYM and vermicompost on economics of wheat in rice-wheat cropping system.

Effect on soil properties assessed after harvest

Soil pH and EC both reduced after wheat harvest under residual fertility of organic manures and reduction was maximum under organic manures and minimum in no-organics (Table-9). It may be due to application of organic manures through FYM/vermicompost in preceding baby corn crop.

Table 7: Residual effect of organic and inorganic N fertilizer sources on N, P and K uptake by wheat straw (kg/ha) and protein content (%) during 2015 and 2016

Treatment	Nutrient uptake by wheat straw									Protein content in wheat grain		
	N uptake			P uptake			K uptake					
	2015	2016	Mean	2015	2016	Mean	2015	2016	Mean	2015	2016	Mean
Nitrogen through organic manures												
Control (No organic)	12.53	17.18	14.85	1.953	3.363	2.658	92.91	100.51	96.71	10.90	10.98	10.94
FYM @ 25% RDN	23.04	26.30	24.67	4.780	6.138	5.459	103.29	111.02	107.15	12.29	12.37	12.33
FYM @ 50% RDN	34.21	36.61	35.41	7.264	7.834	7.549	112.61	119.62	116.12	14.16	14.11	14.14
VC @ 25% RDN	18.56	21.84	20.20	3.406	4.697	4.052	98.33	106.08	102.21	11.59	11.67	11.63
VC @ 50% RDN	27.52	31.28	29.40	5.625	7.219	6.422	106.48	114.30	110.39	13.68	13.28	13.48
S.Em±	0.51	0.58	0.38	0.11	0.19	0.11	1.39	1.59	1.06	0.11	0.13	0.51
CD (P=0.05)	1.64	1.88	1.15	0.35	0.61	0.32	4.52	5.18	3.16	0.35	0.44	0.09
Nitrogen through inorganic fertilizer												
50% RDN	21.20	23.45	22.33	4.049	4.662	4.356	81.24	88.51	84.88	12.13	12.2	12.13
75% RDN	22.47	25.62	24.05	4.458	5.742	5.100	93.13	100.71	96.92	12.32	12.39	12.32
100% RDN	23.83	27.94	25.89	4.744	6.201	5.473	105.42	113.23	109.33	12.54	12.62	12.54
125% RDN	25.18	29.77	27.48	5.170	6.816	5.993	109.91	118.37	114.14	12.73	12.74	12.73
S.Em±	0.43	0.52	0.34	0.08	0.15	0.08	1.15	1.35	0.89	0.09	0.07	0.21
CD (P=0.05)	1.24	1.49	0.95	0.24	0.42	0.24	3.31	3.90	2.51	0.26	0.20	0.12

Thus, addition of more organic matter in terms of FYM/vermicompost cased more reduction in soil pH and EC. More reduction during second year might be the cumulative effects of treatments and addition of organic matter on post harvest soil. This may be supported the findings of Verma and Prasad (2002) [13]. Organic carbon and available NPK at post harvest soil showed considerable increase under organic treatments being maximum with FYM and vermicompost and minimum in no-organics (Table-9&10). Improvement in these properties might be due to addition of organic matter which after decomposition improved physical condition of soil resulting in increase of available plant nutrients. The results are in agreement to those of Verma and Prasad (2002) [13].

2. Effect of previously fertilized inorganic sources of N rates

Residual effect on yield attributes of wheat

Residual effect of inorganic sources of N rates applied in baby corn was observed in succeeding wheat. Growth parameters, yield attributes (spikelets/spike, grains/spike, grain weight/spike, ear length, ear weight and 1000-grain weight) and yields of wheat were significantly higher under 125% RDN applied to baby corn and it was significantly superior to 75 and 50% RDN while remaining statistically at par with 100% RDN (Table-5). The grain yield of wheat enhanced due to higher rates of N i.e. 125 and 100% RDN was to the tune of 5.31 and 10.10%, and 3.31 and 8.01% over 75 and 50% RDN, respectively. The increase in grain and straw yield of wheat might be owing to the increased availability of essential nutrients to the crop resulting from the cumulative effect of organic sources at nutrient applied to the preceding baby corn crop and RDF applied to wheat. Chaudhary *et al.* (2014) [3] also obtained similar carry over effect of different N rates on wheat in rice-wheat cropping system.

Residual effect on NPK uptake in wheat

Increasing level of N rates increased the uptake of N, P and K by grain and straw which maximized at higher N rates i.e. 125% RDN (Table-6&7). This was mainly due to the fact that better nutrients utilization by more healthy and vigorous plants under increasing level of fertilizers and resulting in more dry matter accumulation (Table-2), which ultimately increased the uptake of N, P and K per unit area. These results are in agreement to those of Verma and Prasad (2002), [13] Sarwar *et al.* (2012) [10] and Chate *et al.* (2012) [1].

Application of fertilizers at different rates differed significantly with the protein content in wheat during both the years and pooled basis. Application of various N rates has shown significantly grain protein which reduced with each reduction in N rates (Table-7). Application of 125% RDN have shown at par values of protein content in wheat over 100% RDN during both the seasons but on pooled basis, variation was significant in these two higher N rates. It is also due to more uptake of N in grains at higher fertilizers doses where more nitrogen was available to the plants. Thus, nitrogen concentration increased in grain which resulted more protein content. The results confirmed the findings of Kumar *et al.* (2001) [5].

Table 8: Cost of cultivation, gross return, net return and Benefit: cost ratio of wheat as affected by residual effect of organic and inorganic N fertilizers sources during 2015 and 2016

Treatment	Cost of cultivation (₹/ha)	Gross return (₹/ha)			Net return (₹/ha)			Benefit: cost ratio		
		2015	2016	Mean	2015	2016	Mean	2015	2016	Mean
Nitrogen through organic manures										
Control (No organic)	44200	95445	111543	103494	51245	67343	59294	2.16	2.52	2.34
FYM @ 25% RDN	44200	105535	120275	112905	61335	76075	68705	2.39	2.72	2.56
FYM @ 50% RDN	44200	107966	124663	116315	63766	80463	72115	2.44	2.82	2.63
VC @ 25% RDN	44200	102696	113192	107944	58496	68992	63744	2.32	2.56	2.44
VC @ 50% RDN	44200	104142	116726	110434	59942	72526	66234	2.36	2.64	2.50
S.Em±	-	274	486	279	369	591	349	0.05	0.05	0.04
CD (P=0.05)	-	893	1583	836	1203	1926	1045	0.15	0.17	0.10
Nitrogen through inorganic fertilizer										
50% RDN	44200	99131	110151	104641	54931	65951	60441	2.24	2.49	2.37
75% RDN	44200	102560	115461	109011	58360	71261	64811	2.32	2.61	2.47
100% RDN	44200	104917	120211	112564	60717	76011	68364	2.37	2.72	2.55
125% RDN	44200	106018	123296	114657	61818	79096	70457	2.40	2.79	2.60
S.Em±	-	219	400	228	260	410	243	0.03	0.03	0.02
CD (P=0.05)	-	632	1157	646	751	1185	686	0.09	0.09	0.06

Economics of wheat cultivation

Under fertilizer N, maximum mean gross (₹ 114657/ha) and net return (₹ 70457/ha) as well as benefit: cost ratio (2.60) values of wheat were significantly recorded under higher N rates i.e. 125% RDN which showed significant reduction with each lower dose of nitrogen (Table-8). It might be due to increased grain and straw yields with increasing levels of fertility which enhanced gross and net returns. Among N rates, 125% RDN being at par with 100% RDN gave significantly higher B:C ratio thant 75 and 50% RDN (Table-8). It seems to be associated with net return and cost which favoured higher doses. Higher gross and net returns from wheat cultivation with higher rates of N have also been reported by Verma and Prasad (2002) [13]. Chaudhary *et al.* (2014) [2] also obtained similar carry over effect of increasing level of RDN on economics of wheat in rice-wheat cropping system.

Residual Effect on soil properties assessed after harvest

In case of N rates, soil pH and EC both reduced while organic carbon and available N, P and K increased after wheat harvest from initial level but difference between doses remained only marginal in soil pH and EC and organic carbon (Table-9). It might be the residual effect of organic manures through FYM/vermicompost applied in preceding baby corn crop. The status of N, P and K was also affected by fertilizer doses being higher at increased rates. It might be due to the reason that applied quantity of N, P and K through fertilizers was not taken up by crops in full but some residues remained unutilized which enhanced the available N, P and K in post harvest soil that initial level. The results may be supported by Verma and Prasad (2002) [13].

Table 9: Residual effect of organic and inorganic N fertilizer sources on soil pH, EC and organic carbon after harvest of wheat crop during 2015 and 2016

Treatment	Soil pH			EC (ds/m)			Organic carbon (%)		
	2015	2016	Mean	2015	2016	Mean	2015	2016	Mean
Nitrogen through organic manures									
Control (No organic)	8.03	7.95	7.99	0.182	0.186	0.184	0.505	0.510	0.507
FYM @ 25% RDN	7.96	7.84	7.90	0.181	0.177	0.179	0.510	0.516	0.513
FYM @ 50% RDN	7.92	7.72	7.82	0.179	0.175	0.177	0.515	0.520	0.517
VC @ 25% RDN	8.00	7.93	7.97	0.185	0.181	0.183	0.507	0.513	0.510
VC @ 50% RDN	7.95	7.80	7.87	0.183	0.179	0.181	0.513	0.519	0.516
Nitrogen through inorganic fertilizer									
50% RDN	7.96	7.82	7.89	0.179	0.171	0.175	0.507	0.513	0.510
75% RDN	7.97	7.83	7.90	0.183	0.180	0.182	0.509	0.515	0.512
100% RDN	7.97	7.84	7.91	0.184	0.184	0.184	0.511	0.517	0.514
125% RDN	7.98	7.88	7.93	0.186	0.185	0.186	0.512	0.518	0.515
Initial values	8.04	-	-	0.190	-	-	0.49	-	-

Table 10: Residual effect of organic and inorganic N fertilizer sources on available N, P and K after harvest of wheat crop during 2015 and 2016

Treatment	Available N (kg/ha)			Available P (kg/ha)			Available K (kg/ha)		
	2015	2016	Mean	2015	2016	Mean	2015	2016	Mean
Nitrogen through organic manures									
Control (No organic)	222.02	228.30	225.16	13.10	14.26	13.68	170.24	173.73	171.99
FYM @ 25% RDN	227.04	232.31	229.68	14.32	15.53	14.93	173.38	177.27	175.33
FYM @ 50% RDN	229.43	236.04	232.73	15.15	17.16	16.16	176.11	180.11	178.11
VC @ 25% RDN	224.08	230.43	227.25	13.61	15.04	14.33	171.58	175.81	173.70
VC @ 50% RDN	228.35	234.11	231.23	14.75	16.44	15.60	175.14	179.09	177.12
Nitrogen through inorganic fertilizer									
50% RDN	223.35	229.37	226.36	14.25	14.85	14.25	173.29	176.89	175.09
75% RDN	225.41	231.46	228.44	14.67	15.65	14.67	174.38	177.41	175.90
100% RDN	227.47	233.53	230.50	15.21	16.48	15.21	175.58	178.63	177.11
125% RDN	228.51	234.57	231.54	15.35	16.67	16.01	176.23	179.16	177.70
Initial values	208.25	-	-	12.00	-	-	169.84	-	-

References

1. Chate SP, Khandekar BS, Suryavanshi VP, Suryawanshi SB. Effect of integrated nutrient management on soil properties and available nutrient status of soil at harvest of French bean (*Phaseolus vulgaris* L. Halics.). Adv Plant Sci. 2012;25(1):143-145.
2. Chaudhary SK, Singh SP, Singh Y, Dharminder. Influence of integrated use of fertilizers and manures on SRI grown rice (Oryza sativa) and their residual effect on succeeding wheat (*Triticum aestivum*) in calcareous soil. Indian J Agron. 2014;59(4):527-533.
3. Choudhary SK, Singh RN, Upadhyay PK, Singh RK, Choudhary HR, Pal Vijay. Effect of Vegetable Intercrops and Planting Pattern of Maize on Growth, Yield and Economics of Winter Maize (*Zea mays* L.) in Eastern Uttar Pradesh. Environ Ecol. 2014;32(1):101-105.
4. Kumar A. Direct and residual effect of nutrient management in maize (*Zea mays*) - wheat (*Triticum aestivum*) cropping system. Indian J Agron. 2008;53(1):37-41.
5. Kumar N, Verma LP, Singh R, Prasad K. Soil Properties, nutrient uptake and productivity of rice under integrated nutrient management system. Ann Plant Soil Res. 2001;3(1):54-57.
6. Manjhi RP, Yadava MS, Thakur R. Effect of integrated nutrient management on crop productivity and changes in soil fertility in maize (*Zea mays*)-wheat (*Triticum aestivum*) cropping sequence. Indian J Agron. 2014;59(3):371-376.
7. Naresh RK, Purushottam, Singh SP. Effects of integrated plant nutrient management (IPNM) practices on the sustainability of maize-based farming systems in western

Uttar Pradesh. Int J Res Biomed Biotech. 2013;3(1):510.
8. Ranjan JK, Ahmed N, Das B, Ranjan P, Mishra BK. Green technology for production of baby corn (*Zea mays* L.) under North-West Himalayan conditions. Int J Chem Technol Res. 2013;5(2):880-885.
9. Sarma A, Singh H, Nanwal RK. Effect of integrated nutrient management on productivity of wheat (*Triticum aestivum*) under limited and adequate irrigation supplies. Indian J Agron. 2007;52(2):120-123.
10. Sarwar M, Jilani G, Rafique E, Akhtar ME, Chaudhry AN. Impact of integrated nutrient management on yield and nutrient uptake by maize under rain-fed conditions. Pak J Nutr. 2012;11(1):27-33.
11. Singh DK, Pandey PC, Naiyar A, Gupta S. Stand establishment techniques of rice in conjunction with nutrient sources for soil health and productivity of rice (Oryza sativa)-wheat (*Triticum aestivum*) cropping system. Indian J Agron. 2015;60(1):31-37.
12. Singh MK, Singh RN, Singh SP, Yadav MK, Singh VK. Integrated nutrient management for higher yield, quality and profitability of baby corn (*Zea mays* L.). Indian J Agron. 2010;55(2):100-104.
13. Verma CP, Prasad K. Effect of soil conditioners and fertilizer doses on maize residue management. Ph.D. Thesis, C.S.A.U.A.T. Kanpur; c2002.