Effectoftillagepracticesandfertilization levels on nutrient uptake and content in grain and straw of wheat under rice- wheat cropping system

Abstract

The present investigation was conducted at Agronomy Research Farm, CSAUAT, during *rabi* 2021-22 and 2022-23. The experiment was laid out into Split plot design with threereplicates. The parameters were observed plant *viz.*nitrogencontent ingrain andstraw (%), nitrogenuptakeingrain andstraw(kgha^{-1}),phosphorus content ingrain andstraw (%),phosphorusuptakeingrain andstraw(kgha^{-1}), potassium content ingrain andstraw (%), nitrogenuptakeingrain andstraw(kgha^{-1}). Basis on the pooled data the results of study revealed that in case of tillage practices maximum nitrogencontent ingrain andstraw (1.80 and 0.53 %), Nitrogenuptakeingrain andstraw(93.34 and 36.26 kgha^{-1}). Phosphorus content ingrain andstraw (0.31 and 0.20 %) Phosphorusuptakeingrain andstraw(16.23 and 13.80 kg ha^{-1}), Potassium content ingrain andstraw (0.42 and 1.38 %), Potassium uptakeingrain andstraw(22.15 and 93.88 kgha^{-1}) respectively was reported in conventional tillage whereas in case of various fertility levels maximum nitrogencontent ingrain andstraw (1.83 and 0.59 %), Nitrogenuptakeingrain andstraw(100.31 and 35.06 kgha^{-1}). Phosphorus content ingrain andstraw (0.35 and 0.25 %) Phosphorusuptakeingrain andstraw(18.16 and 16.63kgha^{-1}) respectively, Potassiumcontent ingrain andstraw (0.45 and 1.41 %), Potassium uptakeingrain andstraw(24.97 and 101.03kgha^{-1}) respectivelywith the application of 125%RDF+tebunconzole.

Keywords: Tillage practices, fertilization levels, rice, wheat, growth stages, cropping system, India

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1. Introduction

"Wheat (*Triticum aestivum* L.) contributes substantially to the national food security by providing more than 50 % of the calories to the people who mainly depend on it. Its grains contain starch 60-68%, protein 8-15%, fat 1.5-2.0%, cellulose 2.0-2.5%, and minerals 1.5-2.0%"**(Kumar *et al.*,2019).**"Wheat is broadly cultivated across the world and China is the first producer of this cereal followed by India.Like wheat, rice is also a cereal and it largely grows across the world and China is the first producer followed by India" [30,31,32]. "Rice is one of the major contributors to the food grain production contributing approximately 43per cent of the total food grain production in India" **(Mondal *et al.*, 2020).**"Rice grainscontain 80% carbohydrates, 7-8% protein, 3% fat, and 3% fiber. India, being blessed and enriched with a diverse agro- ecological condition, ensuring food and nutritional security to a majority of the Indian population through production and steady supply particularly in the recent past, is the second largest producer of wheat worldwide. In India, wheat is grown on 33.64 million hectares area with 107.59 million tons production and 3206.30 kg ha^{-1} productivity during 2019-20. The global demand of wheat will increase to about 900 million tons of wheat by the year 2050. It has been estimated that India will need at least 140 million tonnes of wheat by 2050 as against present estimated production of 109.24 million tonnes. The world area under wheat crop accounts 216.18 million ha producing 763.6 million metric tonnes with an average of 3530 kg ha^{-1}. In India, it covers 29.32 million ha producing 103.6 million metric tonnes, one third of the total food grain production, with an average productivity of 3530 kg ha^{-1}. The current world population of 7.7 billion is expected to reach 9.7 billion by 2050. India is the second most populous country (1.3 billion) after China (1.41 billion) and expected to surpass China by touching a peak of 1.7 billion by 2050" **(Kar *et al.* 2021).**"Rice is one of the major contributors to the food grain production contributing approximately 43per cent of the total food grain production in India"**(Mondal *et al.*, 2020).**"In Indiarice is cultivated in an area of 44.38 million hectares with a production of 104.31million tons. The country has to produce about 130 million tons of rice by 2025 to meet the food requirement of the growing population. Over 2 billion people in Asia alone derive 80% of their energy needs from, rice which contains 80% carbohydrates, 7-8% protein, 3% fat and 3% fiber. Generally, conventional tillage aims at reversing and stirring a deep layer of soil; incorporating and destroying plant debris; exposing soil pests to sunshine for control; lump breaking and ground leveling. Conventional tillage involves many mechanical operations starting with deep ploughing, deep discing, ripping, shallow tyne workings, and fine seedbed preparation after the harvest of different grain crops, in both winter and summer production seasons. Thereafter, a fallow period is given to enable moisture capture before the planting of the next crop. This approach results in a bare soil surface exposed to wind and water erosion and high compaction after heavy rains which then needs to be loosened again to assist in weed control and to promote moisture absorption from subsequent rainfalls. Reduced tillage is designated as full-width tillage that disturbs the entire soil surface, leaving 15% to 30% of residue cover after planting. Other conservation tillage practices in the inland pacific north-west include minimum tillage, delayed minimum tillage, under cutter fallow, chisel, discs, and sweep tillage systems. The under cutter method of fallow management uses wide V blade sweeps that slice beneath the soil surface and simultaneously deliver nitrogen during primary spring tillage followed by one or two non-inversion rod weeding operations during the summer to control weeds"**(Pathania *et al.*, 2020)**. "Both minimum tillage and delayed minimum tillage use undercutterV-sweep as a primary tillage. Herbicides may be used to

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control weeds following primary tillage, but secondary tillage such as rod weedingis usedmore commonly. Delayed minimum tillage is similar to minimum tillageexcept primary spring tillage with undercutter V-sweep is delayed until at least mid-May" (**Ali *et al.*, 2021).**

Reduced tillage practices cannot be approached with "one size fits all." Reduced tillage options that you can choose will depend on conditions such as type of crop rotation, soil type, water availability for cover cropping, finance to purchase new soil management tools, and your goals for reducing tillage. It is advisable to discuss first with your cooperative

"Plant naturally takes time for growth and development and use of plant growth promoters provides nutrients for the soil microorganism, thus increasing the activities of microbes in soil, which in turn helps to convert unavailable plant nutrients into available form for faster plant growth promotion. Natural plant growth promoters (Phyto hormones) are involved in urging and stimulating root and shoot growth whereas organic plant growth promoters (PGPS) including soil fertility and productivity of crop also help in faster growth plant growth promotion and avoids grain disease. With improved chemistry plant growth promoters have multisite modes of action without being in contact only on leaf surface and are absorbed by the leaves and other plant parts and move within in treated plant" (**Menhenett, 1985).**

2. Material and Method

2.1 Description of study site

The experiment was conducted during *rabi* season of 2021-22 and 2022-23 at student'sInstructional farm, C.S.A. University of Agriculture and Technology, Kanpur Nagar (U.P.).The field was well leveled and irrigated by tube well. The farm is situated at main campus oftheuniversity,inthewestnorthernpartofKanpurcityundersub-tropicalzoneinvthagroclimaticzone(central plain zone).

2.2 EdaphicCondition

The soil was moist, well drained with uniform plane topography. The soil of the experimental field was alluvial in origin, sandy loam in texture and slightly alkaline in reaction having pH 7.68 and 7.69 (1:2.5 soil: water suspension method given by **Jackson, 1973**), electrical conductivity 0.243 and 0.244 dSm^{-1} (1:2.5 soil: water suspension method given by **Jackson, 1973**), Organic carbon in soil is 3.9 and 3.8g ka^{-1} (Walkley and Black's rapid titration method given by **Walkley and Black, 1934**), with available nitrogen 165.41 and 167.78 kg ha^{-1} (Alkaline permanganate method given by **Subbiah and Asija, 1956**), available phosphorus as sodium bicarbonate-extractable P was 8.12 and 8.15 kg ha^{-1}

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(Olsen's calorimetrically method**, Olsen *et al.*, 1954**) available potassium was 187.15 and 189.47 kg ha^{-1} (Flame photometer method given by **Hanwey and Heidel, 1952**)

2.3 Field experiment

The experiment was laid out into Split plot design with 3 replications. Two levels of tillage Conventional tillage (two ploughing followed by sowing), reduced tillage (one ploughing followed by sowing). These practices tillage were each randomly allotted to main plot with ten 10 fertilization levelsF_1- (Absolute Control), F_2- (RDF- 150:60:40 NPK kg/ha), F_3 - (75% RDF- 112.5:15:30 NPK kg/ha + 10t FYM/ha), F_4- (125% RDF- 187.5:75:50 NPK kg/ha) F_5– (RDF- 150: 60: 40 NPK kg/ha + two spray of chloromequate chloride- lihocine 0.2% at first node (45 Days) and flag leaf stage (80 DAS), F_6– (RDF- 150: 60: 40 NPK kg/ha + Two Spray of tebunconzole- Folicur 430 SC @ 0.1% at first node and flag leaf stage (80 DAS), F_7 – (75 % RDF 112:5:45:30 NPK kg/ha + 10t FYM/ha + two Spray of chloromequate chloride - lihocine 0.2% at first node (45 DAS) and flagleaf stage (80DAS), F_8– (75 % RDF 112.5:45:30 NPK kg/ha + 10t FYM/ha + two Spray to tebunconzole- folicur 430SC @0.1% at first node and flag leaf stage (80DAS), F_9– (125% RDF- 187.5:75:50 NPK kg/ha+ two spray of chloromequate chloride- lihocine 0.2% at first node (45 DAS) and flag leaf stage (80DAS), F_{10}– (125 % RDF- 187.5:75:50 NPK kg/ha + two spray of tebunconzole Folicur 430SC @ 0.1% - folicur 430 SC @ 0.1 % at first node and flag Leaf (80DAS). There fertilization levels were randomly allocated to sub plots. Standard culture practices recommended for wheat was followed uniformly in all experimental plots.

2.4 Harvesting

The wheat crop was harvested when grains were fully matured and straw turned yellow. Theborder lines and plants were removed first to eliminate border effect. The crop from net plotwas cut close to the ground and kept in respective plots for sun drying. Threshing was doneplot wise.Wheatgrain andstrawyieldwas recordedbyweighingas perthetreatment.

2.5N, P & K content and uptake in grain and straw of wheat

Grain uptake (kg ha^{-1}) = Grain yield (q ha^{-1}) ×Nutrient content (%) in grain

Straw uptake (kg ha^{-1}) = Straw yield (q ha^{-1}) × Nutrient content (%) in straw

2.6 Statistical analysis

The growth parameters and yields were recorded and analyzed as per Gomez and Gomez (1984) the tested at 5% level of significance to interpret the significant differences.

3. Results and Discussion

3.1 Nitrogencontentingrainandstraw(%)

The dataof nitrogen content in grain was not significantly affected but in straw was significantlyinfluenced by tillage practices and fertilization levels. The grain have higher

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amount ofnitrogen content than straw. The maximum nitrogen content in grain was recorded in theconventional tillage practice (1.80 and 1.76 %) followed by the reduced tillage (1.77 and1.75%)andmaximumnitrogencontentinstrawwasrecordedinconventionaltillage(0.53 and 0.50 %) followed by reduce tillage (0.51 and 0.48%) during 2021-22 and 2022-23 year of study. Among fertilization levels, The highest nitrogen content in grain (1.83 and1.80%) and straw (0.59 and 0.56 %) were recorded in 125% RDF+ tebunconzole and itwaswith125%RDF+chloromequatechloride(1.82and1.79%)and(0.57and 0.54 %) in grain and straw respectively. The minimum nitrogen contentin grain (1.73and1.69%)andstraw(0.47and0.45%)wererecordedinthecontrolandinteraction in nitrogen content in grain and straw between tillage practices and fertilizationlevelsduringbothyear of experimentation.Similar findings were also reported by **Verma *et al.* (2006) and Kacharoo and Razdan (2006)**

3.2 Nitrogenuptakein grainandstraw (kgha^{-1})

The data of nitrogen uptake ingrainwasnotsignificantly affected butinstraw wassignificantly influenced by tillage practicesand fertility levels. The grain have highest amount of nitrogen uptake than straw. Themaximum nitrogen uptake in grain was recorded in the conventional tillage practice(93.34 and 89.44 kg ha^{-1}) followed by the reduced tillage (88.69 and 85.56 kg ha^{-1})and maximumnitrogen uptake in straw was recorded in conventional tillage (36.26 and 33.90 kg ha^{-1}) followed by reducetillage(34.51and 32.13 kg ha^{-1}) during2021-22 and 2022-23year ofstudy.Among fertilization levels, The highest nitrogen uptake in grain (100.31 and 97.38 kg ha^{-1})and straw (35.06and 38.67 kg ha^{-1}) were recorded in125% RDF+ tebunconzole and it was atpar with 125% RDF + chloromequate chloride (98.89 and 95.57 kg ha^{-1}) and (40.36 and 37.88kg ha^{-1})ingrainandstrawrespectively.Theminimumnitrogenuptakeingrain(78.40and75.01 kg ha^{-1}) and straw (29.77 and 29.61 kg ha^{-1}) were recorded in the control. There were no significantinteraction in nitrogen uptake in grain and straw between tillage practices and fertilizationlevelsduringbothyear of experimentation.Similar findings were also reported by**Gholami *et al.* (2014), andShri *et al.*,(2021)**

3.3 Phosphoruscontentingrainandstraw(%)

The data of phosphorus contentin grain was not significantly affected but in straw was significantly influenced by tillagepractices and fertilization levels. The grain have higher amount of nitrogen content thanstraw.Themaximumphosphoruscontentingrainwasrecordedintheconventionaltillage practice (0.31 and 0.27 %) followed by the reduce tillage (0.28 and 0.24 %)andmaximumphosphoruscontentinstrawwasrecordedinconventionaltillage(0.20and 0.19 %) followed by reduced tillage (0.18 and 0.17 %) during 2021-22 and 2022-23yearofstudy.

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Among fertilization levels, The highest phosphorus content in grain (0.35 and 0.31 %)andstraw(0.25and0.23%)wererecordedin125 %RDF+tebunconzoleanditwaswith 125 % RDF + chloromequate chloride (0.33 and 0.30 %) and (0.23 and 0.22 %)in grain and straw. The minimum phosphorus content in grain (0.22 and 0.19 %) andstraw (0.12 and 0.12) were recorded in the control followed by RDF (0.26 and 0.23 %)and(0.16 and0.15%)ingrainandstraw. There were nosignificantinteractioninphosphorus content in grain and straw between tillage practices and fertilization levels duringbothyear of experimentation.Similar findings were also reported by **Bakhshandeh*et al.* (2018) and Seth and Singh (2020).**

3.4 Phosphorusuptakeingrainandstraw(kgha^{-1})

Thedataofnitrogenuptakeingrainwasnotsignificantlyaffectedbutinstrawwas significantly influenced by tillage practices and fertilization levels. The grain have higheramount of phosphorus uptake than straw. The maximum phosphorus uptake in grain wasrecorded in the conventional tillage practice (16.23 and 14.05 kg ha^{-1}) followed by the reduced tillage (14.24 and 12.23 kg ha^{-1})and maximum phosphorus uptake in straw was recorded inconventional tillage (13.80 and 12.87 kg ha^{-1}) followed by reduce tillage (12.47 and 11.56 kg ha^{-1})during2021-22and 2022-23year of study.Among fertilization levels, The highest phosphorus uptake in grain (18.16 and 15.99kg ha^{-1}) and straw (16.63 and 15.29 kg ha^{-1}) were recorded in 125% RDF+ tebunconzole and itwas with125% RDF + chloromequate chloride (17.38 and 14.97 kg ha^{-1}) and (15.36and14.38kg ha^{-1})ingrainandstraw.Theminimumphosphorusuptakeingrain(10.21and 8.40 kg ha^{-1}) and straw (7.52 and 7.36 kg ha^{-1}) were recorded in the control. There were no significantinteraction in phosphorus uptake in grain and straw between tillage practices and fertilizationlevelsduringbothyear of experimentation.Similar findings were also reported by**Gupta*et al.* (2020) and Saini*et al.* (2020)**

3.5 Potassiumcontentingrainandstraw(%)

The data of potassium content ingrain was not significantly affected but in straw was significantly influenced by tillagepractices and fertilization levels. The grain have higher amount of potassium content thanstraw. The maximum potassium content in grain was recorded in the conventional tillagepractice(0.42and0.41%)followedbythereducetillage(0.41and0.40%)andmaximumpotassium contentinstrawwas recorded inconventionaltillage(1.38and1.36 %) followed by reduced tillage (1.36 and 1.35%) during 2021-22 and 2022-23 year ofstudy.Among fertilization levels, The highest potassium content in grain (0.45 and 0.45 %)and straw (1.41 and 1.39%) were recorded in 125% RDF+ tebunconzole and it was with125% RDF + chloromequate chloride (0.44 and 0.44 %) and (1.40 and 1.39%) ingrain and straw. The minimum

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potassium content in grain (0.37 and 0.36 %) and straw(1.31 and 1.30 %) were recorded in the control followed by RDF (0.39 and 0.38 %) and(1.35and 1.33 %) ingrain and straw.There were no significant interaction in potassium content in grain and strawbetween tillage practices and fertilization levels during both year of experimentation andpooled.Similar findings were also reported by**Gupta*et al.* (2007), Kumar*et al.* (2015) and Singh*et al.* (2018)**

3.6 Potassiumuptakeingrain andstraw (kgha^{-1})

Thedataofpotassiumuptakeingrainwasnotsignificantlyaffectedbutinstrawwassignificantly influenced by tillage practices and fertilization levels. The grain have higheramount of potassium uptake than straw. The maximum potassium uptake in grain wasrecorded in the conventional tillage practice (22.15 and 21.09 kg ha^{-1}) followed by the reducedtillage (20.84and19.56 kg ha^{-1}) andmaximumpotassiumuptake instraw wasrecordedinconventionaltillage (93.88and91.03 kg ha^{-1}) followedby reduce tillage (91.52and88.73 kg ha^{-1})during2021-22and 2022-23year of study.Among fertilization levels, The highest potassium uptake in grain (24.97 and 23.74 kg ha^{-1})and straw (101.03 and 98.12 kg ha^{-1}) were recorded in 125% RDF+ tebunconzoleand it was with125% RDF + chloromequate chloride (24.11 and 22.90 kg ha^{-1}) and (99.11 and 96.58 kg ha^{-1})in grain and straw. The minimum potassium uptake in grain (16.99 and 15.93 kg ha^{-1}) and straw(82.41 and 80.07 kg ha^{-1}) were recorded in the control.There were no significant interaction in potassium uptake in grain and strawbetween tillage practices and fertilization levels during both year of experimentation andpooled.Similar findings were also reported by**Singh*et al.* (2019), Yadav*et al.* (2019) and Puniya*et al.* (2019)**

4. Conclusion

With rice management the management varied significantly in respect of soil organiccarbon and available nutrients as NPK in soil and soil organic matter improve with treatmentBio-decomposer Treated Residue statically at par with Urea Treated Residue (5 % urea) Thetreatmentandatdifferent stageofwheatduringboththeyearsofstudy. Different nutrient management option varied significantly in respect of soil organiccarbon and available nutrients as NPK in soil and soil organic matter improve with treatment75 % RDF + 10 t FYM + Growth Regulator (Chlormequat chloride @0.2 % + Tebuconazole@0.1 %)staticallyatparwithtreatment125 %RDF +GrowthRegulator(Chlormequat chloride@0.2 %+Tebuconazole@0.1 %).Thetreatmentandatdifferentstageofwheatduringboth theyears ofstudy.

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Table-1:Effectoftillagepracticesandfertilizationlevelsonnitrogen contentand uptake ingrain and straw of wheat

Treatment	Nitrogencontent(%)						Nitrogenuptake(kgha^{-1})					
	Grain			Straw			Grain			Straw		
Tillagepractices	**2021-22**	**2022-23**	**Pooled**	**2021-22**	**2022-23**	**Pooled**	**2021-22**	**2022-23**	**Pooled**	**2021-22**	**2022-23**	**Pooled**
Conventionaltillage	1.803	1.76	1.78	0.53	0.50	0.52	93.34	89.44	91.59	36.26	33.90	35.08
Reducedtillage	1.774	1.75	1.76	0.51	0.48	0.50	88.69	85.56	87.12	34.51	32.13	33.32
S.E(m)±	0.007	0.001	0.012	0.002	0.002	0.002	0.133	0.556	0.203	0.159	0.197	0.092
C.D. (5 %)	NS	NS	NS	0.016	0.005	0.016	0.872	3.646	1.327	1.042	1.293	0.605
FertilizationLevels												
F_1	1.73	1.69	1.71	0.47	0.45	0.46	78.40	75.01	76.70	29.77	29.61	28.69
F_2	1.75	1.72	1.74	0.50	0.47	0.48	83.56	80.28	81.92	32.01	29.78	30.89
F_3	1.76	1.73	1.75	0.51	0.48	0.49	85.82	82.51	84.17	33.07	30.81	31.94
F_4	1.77	1.74	1.76	0.52	0.49	0.50	88.01	84.65	86.33	34.25	31.96	33.11
F_5	1.78	1.75	1.77	0.53	0.50	0.51	90.28	86.88	88.58	35.51	32.85	34.18
F_6	1.79	1.76	1.78	0.54	0.51	0.52	92.33	89.12	90.73	36.75	34.38	35.56
F_7	1.80	1.77	1.79	0.55	0.52	0.53	95.13	91.87	93.50	37.98	35.57	36.78
F_8	1.81	1.78	1.80	0.56	0.53	0.54	97.01	93.71	95.36	39.09	36.65	37.87
F_9	1.82	1.79	1.81	0.57	0.54	0.55	98.89	95.57	97.23	40.36	37.88	39.12
F_{10}	1.83	1.80	1.82	0.59	0.56	0.57	100.31	97.38	99.05	35.06	38.67	40.86
S.E(m)±	0.017	0.017	0.023	0.006	0.007	0.005	1.154	0.971	0.979	0.388	0.346	0.319
C.D. (5 %)	NS	NS	NS	0017	0.019	0.014	3.322	2.795	2.818	1.118	0.995	0.329

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Table- 2:Effectoftillagepracticesandfertilizationlevelsonphosphorus content and uptakeingrain andstraw of wheat

Treatment	Phosphoruscontent(%)						Phosphorusuptake(kg ha^{-1})					
	Grain			Straw			Grain			Straw		
Tillagepractices	**2021-22**	**2022-23**	**Pooled**	**2021-22**	**2022-23**	**Pooled**	**2021-22**	**2022-23**	**Pooled**	**2021-22**	**2022-23**	**Pooled**
Conventionaltillage	0.31	0.27	0.293	0.20	0.19	0.19	16.23	14.05	15.14	13.80	12.87	13.34
Reducetillage	0.28	0.24	0.266	0.18	0.17	0.18	14.24	12.23	13.24	12.47	11.56	12.02
S.E(m)±	0.003	0.001	0.001	0.001	0.001	0.001	0.068	0.030	0.038	0.067	0.012	0.065
C.D. (5 %)	0.019	0.008	0.004	0.007	0.009	0.004	0.444	0.200	0.246	0.440	0.081	0.424
FertilizationLevels												
F_1	0.22	0.19	0.20	0.12	0.12	0.12	10.21	8.40	9.31	7.52	7.36	7.44
F_2	0.26	0.23	0.24	0.16	0..15	0.15	12.63	10.71	11.67	10.244	9.40	9.82
F_3	0.27	0.24	0.25	0.17	0.16	0.16	13.38	11.42	12.40	11.02	10.16	10.59
F_4	0.28	0.25	0.26	0.17	0.17	0.17	14.14	12.13	13.14	11.86	10.97	11.42
F_5	0.29	0.26	0.27	0.19	0.18	0.18	14.93	12.88	13.90	12.73	11.82	12.28
F_6	0.30	0.27	0.28	0.20	0.19	0.19	15.70	13.64	14.67	13.61	12.68	13.14
F_7	0.31	0.27	0.29	0.021	0.20	0.20	16.61	14.25	15.43	14.50	13.55	14.02
F_8	0.32	0.28	0.30	0.22	0.21	0.21	17.38	14.97	16.79	15.36	14.38	14.87
F_9	0.33	0.30	0.31	0.23	0.22	0.22	18.16	15.99	17.07	16.63	15.29	15.96
F_{10}	0.35	0.31	0.33	0.25	0.23	0.24	19.21	17.01	18.11	17.91	16.53	17.23
S.E(m)±	0.003	0.003	0.003	0.002	0.002	0.002	0.159	0.137	0.151	0.144	0.120	0.141
C.D. (5 %)	0.010	0.007	0.008	0.006	0.006	0.006	0.457	0.394	0.436	0.415	0.346	0.406

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Table-3:Effectoftillagepracticesandfertilizationlevelson potassiumcontent andingrain and straw of wheat

Treatment	Potassiumcontent(%)						Potassiumuptake(kgha^{-1})					
	Grain			Straw			Grain			Straw		
TillagePractices	**2021-22**	**2022-23**	**Pooled**	**2021-22**	**2022-23**	**Pooled**	**2021-22**	**2022-23**	**Pooled**	**2021-22**	**2022-23**	**Pooled**
Conventionaltillage	0.42	0.41	0.420	1.38	1.36	1.375	22.15	21.09	21.62	93.88	91.03	92.46
Reducetillage	0.41	0.40	0.408	1.36	1.35	1.360	20.84	19.56	20.20	91.52	88.73	90.13
S.E(m)±	0.003	0.001	0.001	0.006	0.004	0.006	0.097	0.025	0.067	0.113	0.259	0.191
C.D. (5 %)	0.008	0.003	0.005	0.019	0.010	0.019	0.637	0.166	0.193	0.743	1.700	1.253
FertilizationLevels												
F_1	0.37	0.36	0.368	1.31	1.30	1.310	16.99	15.93	16.46	82.41	80.07	81.24
F_2	0.39	0.38	0.385	1.35	1.33	1.343	18.81	17.45	18.13	86.70	83.37	85.04
F_3	0.40	0.40	0.398	1.36	1.34	1.353	19.69	18.55	19.12	88.17	85.44	86.80
F_4	0.41	0.41	0.410	1.37	1.34	1.358	20.57	19.65	20.11	90.23	86.82	88.85
F_5	0.42	0.41	0.415	1.37	1.35	1.365	21.49	20.05	20.77	92.12	89.01	90.56
F_6	0.42	0.42	0.420	1.38	1.37	1.378	21.86	20.96	21.41	94.25	91.43	92.84
F_7	0.43	0.43	0.428	1.38	1.37	1.380	22.92	21.75	22.34	95.62	93.13	9.37
F_8	0.44	0.43	0.433	1.39	1.38	1.390	23.52	22.31	22.92	97.37	94.86	96.11
F_9	0.44	0.44	0.438	1.40	1.39	1.395	24.11	22.90	23.50	99.11	96.58	97.85
F_{10}	0.45	0.45	0.448	1.41	1.39	1.403	24.97	23.74	24.36	101.03	98.12	99.58
S.E(m)±	0.004	0.005	0.004	0.013	0.015	0.014	0.204	0.177	0.193	1.130	1.051	0.827
C.D. (5 %)	0.013	0.014	0.012	0.037	0.041	0.041	0.587	0.510	0.555	3.254	3.027	2.381

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1. **References**

2. **Ali,I.,Khan,A.,Ali,A.,Ullah,Z.,Dai,D.Q.,Khan,N.,andSher,H.(2021).** Ironandzincmicronutrients and soil inoculation of Trichoderma harzianum enhance wheat grainqualityandyield.*Frontiers in Plant Science*, **13**:960948.
3. **Bana, A., Rana, K. S., Singh, R., Godara, S., Grover, M., ... & Yogi, A. K. (2022).** No-tillage with residue retention and foliar sulphur nutrition enhances productivity, mineral biofortification and crude protein in rainfed pearl millet under Typic Haplustepts: Elucidating the responses imposed on an eight-year long-term experiment. *Plants*, *11*(7), 943.
4. **Gholami,A.,Asgari,H.R.,andZeinali,E.(2014).**Effectofdifferenttillagesystemsonsoilphysicalpropertiesandyieldofwheat(Casestudy:AgriculturallandsofHakimAbadvillage,Chenaran township, Khorasan Razavi province).
5. **Gomez, K. A., & Gomez, A. A. (1984).** *Statistical procedures for agricultural research*. John wiley & sons.
6. **Gupta, M., Bali, A. S., Sharma, B. C., Kachroo, D., & Bharat, R. (2007).** Productivity, nutrient uptake and economics of wheat (*Triticum aestivum*) under various tillage and fertilizer management practices. *Indian Journal of Agronomy*, *52*(2), 127-130.
7. **Gupta, R. K., Kaur, J., Kang, J. S., Singh, H., Kaur, S., Sayed, S., ... & Hossain, A. (2022).** Tillage in combination with rice straw retention in a rice–wheat system improves the productivity and quality of wheat grain through improving the soil physio-chemical properties. *Land*, *11*(10), 1693.
8. **Hanway, J.J; and Heidel, H. (1952).** Soil analysis methods as used in Iowa State College, Soil Testing Laboratory. *Iowa Agriculture* **54**: 1-31.
9. **Jackson, M.L. (1973).** Soil chemical analysis. Prentice Hall of India Pvt. Ltd, New Delhi.
10. **Kachroo,D.,andRazdan,R.,(2006).**Growth,nutrient1uptakeandyieldofwheat (*Triticumaestivum*) as influenced n by biofertilizers and nitrogen. *Indian Journal of Agronomy*.51(1): 37-39
11. **Kar,S., Pramanick,B.,Brahmachari,K.,Saha,G.,Mahapatra,B.S.,Saha,A.,&Kumar, A. (2021).** Exploring the best tillage option in rice based diversified cropping systemsinalluvial soil ofeasternIndia.*Soiland Tillage Research*,*205*, 104761.
12. **Kumar S, Pandey ID, Rather SA, Rewasia H. (2019).** Genetic variability and inter-traitassociation for cooking and micronutrient (Fe and Zn) traits in advance lines ofkalanamak aromatic rice (*Oryza sativa* L.). Journal of Animal and Plant

UNDER PEER REVIEW

Sciences.**29**(2):1232 1239

13. **Kumar, V., Kumar, M., Singh, S. K., & Chandra, S. K. (2015).** Impact of conservation agriculture on yield, nutrient uptake and quality of wheat crop in Calciorthents. *Plant Archives*, *15*(1), 371-376.
14. **Menhenett, R. (1985).** Development and use of plant growth regulators on glasshouse ornamentals and bulbs. *Monograph-British Plant Growth Regulation Group*.
15. **Mondal, S., Naik, S. K., Haris, A. A., Mishra, J. S., Mukherjee, J., Rao, K. K., & Bhatt, B. P. (2020).** Effect of conservation tillage and rice-based cropping systems on soil aggregation characteristics and carbon dynamics in Eastern Indo-Gangetic Plain. *Paddy and water environment, 18*(3), 573-586.
16. **Olsen, S.R, Cole, C.V., Watanable, F. S. and Dean, L. A. (1954).** Estimation of available phosphorous in soil by extraction with sodium bicarbonate. *USDA, Cric*. **930**:19- 23
17. **Pathania, P., Rajta, A., Singh, P. C., & Bhatia, R. (2020).** Role of plant growth-promotingbacteria in sustainable agriculture. *Biocatalysis and Agricultural Biotechnology, 30*,101842.
18. **Puniya, R., Pandey, P. C., Bisht, P. S., Singh, D. K., & Singh, A. P. (2019).** Effect of long-term nutrient management practices on soil micronutrient concentrations and uptake under a rice–wheat cropping system. *The Journal of Agricultural Science*, *157*(3), 226-234.
19. **Rajeev,R.,Singh,V.,Singh,S.S.,Kumar,V.,Hazra, K.K.,Nath,C.P.,andMcDonald, A.(2014).**Impactofconservationtillageinrice–basedcroppingsystemsonsoilaggregation,carbonpools andnutrients.*Geoderma*, ***340***: 104-114.
20. **Rashid, M. H., Alam, M. M., Rao, A. N., & Ladha, J. K. (2012).** Comparative efficacy of pretilachlor and hand weeding in managing weeds and improving the productivity and net income of wet-seeded rice in Bangladesh. *Field Crops Research*, *128*, 17-26.
21. **Saini, A., Manuja, S., Kumar, S., Hafeez, A., Ali, B., & Poczai, P. (2022).** Impact of cultivation practices and varieties on productivity, profitability, and nutrient uptake of rice (*Oryza sativa* L.) and wheat (*Triticum aestivum* L.) cropping system in India. *Agriculture*, *12*(10), 1678.
22. **Seth, M., Manuja, S., & Singh, S. (2020).** Effect of tillage and site specific nutrient management on yield, nutrient uptake and status of soil in wheat in rice-wheat cropping system. *Journal of Crop and Weed*, *16*(3), 32-37.

UNDER PEER REVIEW

23. **Shoomro, A. S., Soomro, A. S., and Mazari, S. N. (1999).** Impact of plant growth regulatorsonyieldandyieldcomponentsinrice(*Oryzasativa*L.)under fieldconditions. *International Journal of Applied Sciences and Biotechnology*, **8**(3): 318-322.
24. **Shri, A., Kumari, P., Kumari, C., Kumar, D., and Choudhury, S. R. (2021).** Effect ofdifferent levels of nitrogen and plant growth regulators on yield and nutrient uptakeofwheat (*Triticumaestivum*L.).*Journal of foodscience*, **83**(1):237-245
25. **Singh, M., Singh, O., & Singh, R. (2019).** Impact of Wheat Establishment Methods and Weed Management Practices on Weed Flora, Yield and Nutrient Uptake of Wheat in Rice-Wheat Cropping System: Establishment methods and weed management practices on weed dynamics nutrient uptake of wheat. *Journal of Agri Search*, *6*(2), 73-77.
26. **Singh, S. K., Kumar, M., Singh, R. P., Bohra, J. S., Srivastava, J. P., Singh, S. P., & Singh, Y. V. (2018).** Conjoint application of organic and inorganic sources of nutrients on yield, nutrient uptake and soil fertility under rice (*Oryza sativa*)-wheat (*Triticum aestivum*) system. *Journal of the Indian Society of Soil Science*, *66*(3), 287-294.
27. **Subbiah, B.V. and Asija, C.L. (1956).** A rapid procedure for the estimation of available N in Soil. *Curr. Sci.* **25**:259-260.
28. **Verma, A., Nepalia, V., and Kanthaliya, P. C. (2006).** Effect of integrated nutrient supplyongrowth,yieldandnutrientuptakebymaize(*Zeamays*)–wheat(*Triticumaestivum*)croppingsystem.*Indian journal of Agronomy*, **51**(1): 3-6.
29. **Walkley, A. and Black, C. S.A. (1934).** Old piper, S.S. soil and plant analysis. Soil Sci. 37:29- 38.
30. **Yadav, G. S., Lal, R., Meena, R. S., Babu, S., Das, A., Bhowmik, S. N., ... & Saha, P. (2019).** Conservation tillage and nutrient management effects on productivity and soil carbon sequestration under double cropping of rice in north eastern region of India. *Ecological Indicators*, *105*, 303-315.
31. Ansari, M. A., Osmani, K. S., Payenda, P., & Yonusi , M. M. (2023). Influence of Tillage Systems on the Productivity of Wheat Varieties in the Conditions of Balkh Afghanistan. International Journal of Plant & Soil Science, 35(3), 160–169. https://doi.org/10.9734/ijpss/2023/v35i32788

I. K. , I., & O. G. , D.-O. (2023). Evaluating the Long-Term Effect of Integrated Nutrients of Pome, Cow Dung and NPK on Soil Chemical Properties under a Garden-Egg Field. Asian Journal of Advances in Agricultural Research, 23(1), 79–88. https://doi.org/10.9734/ajaar/2023/v23i1454

32. Bhaduri, D., & Purakayastha, T. J. (2014). Long-term tillage, water and nutrient management in rice–wheat cropping system: Assessment and response of soil quality. Soil and Tillage Research, 144, 83-95.
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