Effect of crop residue management and weed management practices on nutrient content and nutrient uptakein wheat (*Triticum aestivum* L.).

ABSTRACT:

The field experiment was carriedout during two successive *Rabi* seasons of 2021-22 and 2022-23 at the Agronomy Research Farm of AcharyaNarendra Deva University of Agriculture & Technology, Kumarganj, Ayodhya (U.P.).The treatment combinations of 4 crop residue management, viz. conventional tillage without residue, conventional tillage with residue (3 t/ha rice residue), zero tillage without residue, zero tillage with residue (3 t/ha rice residue) and 5 weed management practices, viz. Triallate 50% EC @ 1250 gm a.i. ha^{-1}, Triallate 50% EC @ 2500 gm a.i. ha^{-1}, Clodinafop propargyl 15% + Metsulfuron methyl 1% (60 gm + 4 gm a.i. ha^{-1}), hand weeding at 20 and 40 DAS and weedy check in wheat were tested with 3 replications in split-plot design, keeping crop residue management in main plots and weed management practices in subplots. Among the different crop residue management, zero tillage with residue was found most effective in maximizing nutrient content and nutrient uptake followed by conventional tillage with residue. Conventional tillage without residue showed lowest values of on nutrient content and uptake by crop. While in case of weed management practices hand weeding at 20 and 40 DAS had a significant impact on maximizing nutrient content and nutrient uptake followed by post-emergence application of Clodinafop propargyl 15% + Metsulfuron methyl 1% (60 gm + 4 gm a.i. ha^{-1}).

Introduction

Wheat (*Triticum aestivum*L.) is a cereal crop belonging to the poaceae family. It is one of the most important cereals in terms of its antiquity and its use as a food source for human beings.The 2020 USDA report states that wheat is the most extensively cultivated crop worldwide, spanning around 220 million hectares and yielding a total of 764.4 million tons per year, averaging 3.53 tons per hectare. Its versatility in cultivation across various environments makes it a crucial nutrient source for human consumption.

China, India, United States, Russia, France, Canada, Germany, Turkey, Australia, Ukraine are the major wheat producing countries.Wheat is the second largest cereal crop in India after rice. It accounts for 33.84 % of India's food grain basket. It covers an area of 30.47 million hectares and has a production of 106.84 million tonnes.The top three wheat producing states in India are Uttar Pradesh, Madhya Pradesh and Punjab, with productions of 33.95 million tons, 22.42 million tons and 14.82 million tons respectively,MA&FW (2022).Wheat crop contributes significantly to the nation's food security as it provides more than half of the calories for the people who depend on it the most. Residue burning is major problem in Rice wheat cropping system that causes significant nutrient loss and also affect the nutrient uptake of next crop. Highest NPK content and uptake in wheat under the influence of zero tillage residue retention followed by conventional tillage residue incorporation, zero tillage without residueand the lowest in conventional tillage. Kumar *et al.* (2020).

MATERIALSANDMETHODS

The field experiment wascarriedoutduringtwosuccessive*Rabi*seasonsof2021-22and2022-23attheAgronomy Research Farm of Acharya Narendra Deva University of Agriculture & Technology, Kumarganj, Ayodhya (U.P.). The experimental plot was assigned in fairly uniform topography and well-drained soil which had homogenous fertility and textural arrangement. In general, the deep, level, well-drained alluvial soils of the Indo-Gangetic plains (IGP) have low available nitrogen and medium levels of accessible phosphate and potassium. The treatment combinations of 4 crop residue management, viz. conventional tillage without residue, conventional tillage with residue (3 t/ha rice residue), zero tillage without residue, zero tillage with residue (3 t/ha rice residue) and 5 weed management practices, viz. Triallate 50% EC @ 1250 gm a.i. ha^{-1}, Triallate 50% EC @ 2500 gm a.i. ha^{-1}, Clodinafop propargyl 15% + Metsulfuron methyl 1% (60 gm + 4 gm a.i. ha^{-1}), hand weeding at 20 and 40 DAS and weedy check in wheat were tested with 3 replications in split-plot design, keeping crop residue management in main plots and weed management practices in subplots on a fixed site. Treatment combinations were assigned to experimental units randomly employing Fisher and Yates random table method (Panse and Sukhatme, 1985). Sowing was done in rows 20 cm apart by respective seed drills as per treatment. Wheat variety HD-2967 was sown on 21/11/2021 and 22/11/2022 and field was fertilized with N: P_2O_5: K_2O @ 120:60:40 Kg ha^{-1} in the form of urea, di-ammonium phosphate and muriate of potash, respectively.Plant samples (straw and grain) were collected randomly from each experimental unit at the time of harvest for the evaluation of nutrient content and uptake. The samples were dried in oven at 65-70^{0}C for 8 hrs. Oven dried plant samples (grain and straw)

were ground in stainless steel grinder for analysis of nitrogen, phosphorus and potassium. Nitrogen content and uptake processed straw and grain samples were digested with conc. H_2SO_4 and H_2O_2 in presence of catalyst mixture. Modified Kjeldahl's method was adopted and for determination of nitrogen content in straw and grain as described by Jackson (1973). The percentage of nitrogen phosphorousand potassium was multiplied with grain and straw yield to obtain nitrogen phosphorous and potassium uptake in seed and straw, respectively.Phosphorus content and uptake grain and straw samples were digested with ternary acid mixture having nitric, per chloric and sulphuric acid in 10:4:1 ratio and the percentage of phosphorus was determined by vanadomolybdo phosphoric yellow colour method (Jackson, 1973). The percentage of phosphorus was multiplied with grain and straw yield to obtain phosphorus uptake in grain and straw, respectively. Potassium content and uptake: digested grain and straw samples with ternary acid were determined separately by using flame photometer (Jackson, 1973). The percentage of potassium was multiplied with grain and straw yield to obtain uptake of potassium in grain and straw, respectively.

The data recorded during the course of investigation were subjected to statistical analysis using analysis of variance (ANOVA) technique for SPD as prescribed by (Gomez and Gomez, 1984). Standard error of mean in each case was calculated at 5% levels of probability.

RESULTS AND DISCUSSION:

Nutrient content by grain and straw of wheat crop at harvest

N, P and K content in grain (%)

Data on N, P and K content in wheat grain as affected by crop residue management and weed management practices during both the year of experimentation are presented in Table 1, 2 and 3 respectively.

It is obvious from the data that variation in N, P and K content in grain of wheat was found non-significant due to various crop residue management treatments during both the year. Though the variation among treatments were found non-significant but numerically the maximum contentof N, P and K was observed in zero tillage with residue closely followed by conventional tillage with residue and the lowest in conventional tillage without residue.

Data indicated non-significant variation in P and K content in grain of wheat due to different weed management practices while, significant differences in N content of grain

were recorded due to various weed management practices during both the years. Significantly highest N content in grain was recorded under the effect of treatments where hand weeding at 20 and 40 DAS was executed being on par with post emergence application of Clodinafop propargyl 15%+ Metsulfuron methyl 1% (60 gm+ 4 gm a.i. $ha^{-1)}$ during both years. The lowest N, P and K contentin grain was associated with weedy check treatment.The similar findings were reported by Para *et al.* (2022).The interaction effect between crop residue management and weed management practices on N, P and K contentin grainwas found non-significant.

N,PandKcontentinstraw(%)

Data on N, P and K content in straw as influenced by crop residue management and weed management practices is presented in Table 1, 2 and 3 respectively.

Data clearly indicated non-significant variation in P and K content in strawof wheat due to differentcrop residue management treatments while, significant differences in N content of straw was recorded due to variouscrop residue management during both the years. Significantly highest N content in straw was recorded under the effect ofzero tillage with residue closely followed by conventional tillage with residue and the lowest in conventional tillage without residue.

Data indicated non-significant variation in P and K content in straw of wheat due to different weed management practices while, significant differences in N content of straw were recorded due to variousweed management practices during both the years. Significantly highest N content instraw was recorded under the effect of treatments where hand weeding at 20 and 40 DAS was executed being at par with post emergence application of Clodinafop propargyl 15%+ Metsulfuron methyl 1% (60 gm+ 4 gm a.i. ha^{-1}) during both years. The lowest N, P and K contentin straw was associated with weedy check treatment.The similar findings were reported by Para *et al.* (2022).The interaction effect between crop residue management and weed management practices on N, P and K contentin strawwas found non-significant.

N, P and Kuptakebygrain(kgha^{-1})

The data pertaining to N, P and K uptake by grain as influenced by various crop residue management and weed management practices during both the years

arepresentedinTable 1, 2 and 3 respectively.

Data clearly revealed that N, P and K uptake by grain varied significantly due to different crop residue managementandweedmanagementpractices during the course of investigation.

Amongst crop residue management treatments, zero tillage with residue recorded maximum N, P and K uptake in grain being on par with conventional tillage with residue but significantly superior to conventional tillage without residue and zero tillage without residue during both the years. The minimum N, P and K uptake by grain was recorded in the treatment where conventional tillage was practiced without residue. The results corroborate the findings of Dotaniya (2013).

It is evident from the data that maximum N, P and K uptake by grain in wheat was observed with the treatment where hand weeding at 20 and 40 DAS was done being on par with post emergence application of Clodinafop propargyl 15% + Metsulfuron methyl 1% (60 gm + 4 gm a.i. ha^{-1}) during both years. The lowest N, P and K uptake by grainwas recorded in weedy check treatment.N, P and K uptake by grain realized under the effect of pre emergence application of Triallate 50% EC @ 2500 gm a.i.ha^{-1} andTriallate 50% EC @ 1250 gm a.i.ha^{-1} was also significantly higher than weedy check. The findings are in accordance with that of Singh *et al.* (2019) who also reported highest N,P and K uptake in grain of wheat under the effect of two hand weeding being on par with post emergence application of Clodinafop propargyl 15% + Metsulfuron methyl 1% (60 gm + 4 gm a.i. ha^{-1}) and minimum in weedy check.The interaction effect between crop residue management and weed management practices on N, P and K uptake in grain was found non-significant during both the years.

N, P and Kuptakebystraw(kgha^{-1})

The data related to N, P and K uptake by straw as influenced by various crop residue management and weed management practices during both the years are presentedinTable 1, 2 and 3 respectively.Data clearly indicated that N, P and K uptake bystraw varied significantly due to different crop residue managementandweedmanagementpracticesduring

the course of investigation.

Amongst different crop residue management treatments, zero tillage with residue recorded maximum N, P and K uptake instrawbeing on par with conventional tillage with residue but significantly higher to conventional tillage without residue and zero tillage without residue during both the years. The minimum N, P and K uptake by straw was recorded in the treatment where conventional tillage was practiced without residue.The similar findings were reported by Dotaniya (2013).

It is also evident from the data that maximum N, P and K uptake by strawin wheat was observed with the treatment where hand weeding at 20 and 40 DAS was done being on par with post emergence application of Clodinafop propargyl 15% + Metsulfuron methyl 1% (60 gm + 4 gm a.i. $ha^{-1)}$ during both years. The lowest N, P and K uptake bystrawwas recorded in weedy check treatment.N, P and K uptake by strawrecorded under the effect of pre emergence application of Triallate 50% EC @ 2500 gm a.i.ha^{-1} andTriallate 50% EC @ 1250 gm a.i.ha^{-1} was also significantly better than weedy check. The findings are in accordance with that of Singh *et al.* (2019) who also reported highest N, P and K uptake in straw of wheat under the effect of two hand weeding being on par with post emergence application of Clodinafop propargyl 15%+ Metsulfuron methyl 1% (60 gm+ 4 gm a.i. ha^{-1}) and minimum in weedy check.The interaction effect between crop residue management and weed management practices on N, P and K uptake in straw was found non-significant.

Total N,P and K uptake by crop (kgha^{-1})

Data pertaining to total N, P and K uptake by crop as influenced by various crop residue managementand weed management practices are presented in Table 1, 2 and 3 respectively. Significant differences in total N, P and K uptake by crop was recorded due to different crop residue management and weed management practices during both the years of investigation.

Amongst different crop residue management treatments, zero tillage with residue recorded maximum total N, P and K uptake by crop being on par with conventional tillage with residue but significantly higher to conventional tillage without residue and zero tillage without residue during both the years. The minimum total N, P and K uptake by crop was recorded in the treatment where conventional tillage was practiced without residue.

It is also evident from the data that highest total N, P and K uptake by wheat was

observed with the treatment where hand weeding at 20 and 40 DAS was done being on with post emergence application of Clodinafop propargyl 15% + Metsulfuron methyl 1% (60 gm + 4 gm a.i. ha^{-1}) during both years. The lowest total N, P and K uptake bycrop was recorded in weedy check treatment.Total N, P and K uptake by croprecorded under the effect of pre emergence application of Triallate 50% EC @ 2500 gm a.i.ha^{-1} andTriallate 50% EC @ 1250 gm a.i.ha^{-1} was also significantly better than weedy check. Interaction effect of crop residue management and weed management practices on total N, P and K uptake by crop was found to be non-significant.

Table-1: Nitrogen content, uptake and total uptake by wheat as influenced by weed management practices under varying crop residue management of timely sown wheat (*Triticum aestivum* L.).

Treatment		N Content (%)				N uptake (kg ha^{-1})				Total N uptake (kg ha^{-1})	
		Grain		Straw		Grain		Straw			
		2021-22	2022-23	2021-22	2022-23	2021-22	2022-23	2021-22	2022-23	2021-22	2022-23
A. Main plot (Crop Residue Management)											
Conventional tillage without residue	**C_1**	1.54	1.55	0.49	0.49	60.23	63.25	26.61	26.79	86.84	90.04
Conventional tillage with residue (3.0 t ha^{-1} rice residue)	**C_2**	1.58	1.59	0.52	0.53	70.66	75.09	30.90	32.74	101.56	107.83
Zero tillage without residue	**C_3**	1.55	1.57	0.50	0.51	62.60	66.15	27.32	29.29	89.92	95.43
Zero tillage with residue (3.0 t ha^{-1} rice residue)	**C_4**	1.58	1.60	0.53	0.54	71.99	76.61	31.84	34.33	103.83	110.94
SEm±		*0.01*	*0.02*	*0.01*	*0.01*	*0.62*	*0.73*	*0.38*	*0.53*	*1.04*	*1.06*
C.D.(P=0.05)		*NS*	*NS*	*0.02*	*0.02*	*2.18*	*2.58*	*1.18*	*1.74*	*3.27*	*3.42*
B. Sub plot (Weed Management Practices)											
Triallate 50 % EC PE (1250 gm)	**W_1**	1.53	1.54	0.46	0.47	62.38	65.57	25.47	27.11	87.85	92.68
Triallate 50 % EC PE (2500 gm)	**W_2**	1.55	1.57	0.50	0.51	64.39	69.56	28.50	29.92	92.89	99.48
ClodinafopPropargyl 15% + Metsulfuron Methyl 1% WP PoE (60 gm + 4 gm a.i./ha)	**W_3**	1.62	1.63	0.56	0.56	74.95	78.80	34.93	36.99	109.89	115.79
Hand weeding at 20 and 40 days after sowing	**W_4**	1.64	1.66	0.59	0.59	77.17	81.61	37.01	39.23	114.18	120.84
Weedy Check	**W_5**	1.47	1.49	0.44	0.45	53.85	56.60	21.17	21.95	75.02	78.55
SEm±		*0.02*	*0.02*	*0.01*	*0.01*	2.37	*2.51*	*1.04*	*1.07*	*1.65*	*2.04*
C.D.(P=0.05)		*0.04*	*0.05*	*0.04*	*0.04*	*6.85*	*7.26*	*3.24*	*3.53*	*5.29*	*6.94*

Table-2: Phosphorus content, uptake and total uptake by wheat as influenced by weed management practices under varying crop residue management of timely sown wheat (*Triticum aestivum*L.).

Treatment		P Content (%)				P uptake (kg ha^{-1})				Total P uptake (kg ha^{-1})	
		Grain		Straw		Grain		Straw			
		2021-22	2022-23	2021-22	2022-23	2021-22	2022-23	2021-22	2022-23	2021-22	2022-23
A. Main plot (Crop Residue Management)											
Conventional tillage without residue	**C_1**	0.353	0.354	0.109	0.110	13.81	14.46	5.94	6.05	19.76	20.51
Conventional tillage with residue (3.0 t ha^{-1} rice residue)	**C_2**	0.356	0.356	0.111	0.112	15.92	16.72	6.60	6.92	22.52	23.64
Zero tillage without residue	**C_3**	0.355	0.357	0.110	0.111	14.36	15.08	6.06	6.43	20.42	21.50
Zero tillage with residue (3.0 t ha^{-1} rice residue)	**C_4**	0.360	0.361	0.114	0.114	16.38	17.28	6.81	7.21	23.19	24.50
SEm±		*0.003*	*0.003*	*0.001*	*0.001*	*0.19*	*0.22*	*0.11*	*0.13*	*0.34*	*0.38*
C.D.(P=0.05)		*NS*	*NS*	*NS*	*NS*	*0.62*	*0.71*	*0.32*	*0.39*	*1.01*	*1.14*
B. Sub plot (Weed Management Practices)											
Triallate 50 % EC PE (1250 gm)	**W_1**	0.354	0.355	0.110	0.111	14.43	15.07	6.05	6.40	20.48	21.47
Triallate 50 % EC PE (2500 gm)	**W_2**	0.356	0.357	0.110	0.112	14.77	15.86	6.25	6.59	21.02	22.44
ClodinafopPropargyl 15% + Metsulfuron Methyl 1% WP PoE (60 gm + 4 gm a.i./ha)	**W_3**	0.358	0.360	0.112	0.113	16.60	17.44	7.04	7.42	23.65	24.86
Hand weeding at 20 and 40 days after sowing	**W_4**	0.361	0.362	0.115	0.114	17.00	17.83	7.25	7.53	24.25	25.36
Weedy Check	**W_5**	0.351	0.351	0.108	0.109	12.82	13.35	5.22	5.37	18.03	18.71
SEm±		*0.003*	*0.003*	*0.001*	*0.001*	*0.42*	*0.53*	*0.22*	*0.27*	*0.45*	*0.47*
C.D.(P=0.05)		*NS*	*NS*	*NS*	*NS*	*1.45*	*1.56*	*0.71*	*0.82*	*1.37*	*1.43*

Table-3: Potassium content, uptake and total uptake by wheat as influenced by weed management practices under varying crop residue management of timely sown wheat (*Triticum aestivum* L.).

Treatment		K Content (%)				K uptake (kg ha^{-1})				Total K uptake (kg ha^{-1})	
		Grain		Straw		Grain		Straw			
		2021-22	2022-23	2021-22	2022-23	2021-22	2022-23	2021-22	2022-23	2021-22	2022-23
A. Main plot (Crop Residue Management)											
Conventional tillage without residue	C_1	0.364	0.365	1.41	1.42	14.24	14.91	76.89	78.11	91.13	93.02
Conventional tillage with residue (3.0 t ha^{-1} rice residue)	C_2	0.367	0.367	1.43	1.43	16.41	17.23	84.98	88.35	101.40	105.58
Zero tillage without residue	C_3	0.365	0.366	1.42	1.42	14.77	15.46	78.23	82.20	93.00	97.66
Zero tillage with residue (3.0 t ha^{-1} rice residue)	C_4	0.368	0.370	1.45	1.45	16.74	17.72	86.67	91.74	103.41	109.46
SEm±		*0.003*	*0.004*	*0.03*	*0.03*	*0.22*	*0.26*	*0.74*	*1.17*	*1.23*	*1.27*
C.D.(P=0.05)		*NS*	*NS*	*NS*	*NS*	*0.73*	*0.85*	*2.21*	*3.51*	*3.61*	*3.98*
B. Sub plot (Weed Management Practices)											
Triallate 50 % EC PE (1250 gm)	W_1	0.364	0.366	1.42	1.42	14.84	15.54	78.06	81.82	92.89	97.36
Triallate 50 % EC PE (2500 gm)	W_2	0.364	0.367	1.43	1.44	15.11	16.30	81.24	84.67	96.34	100.97
ClodinafopPropargyl 15% + Metsulfuron Methyl 1% WP PoE (60 gm + 4 gm a.i./ha)	W_3	0.369	0.368	1.45	1.45	17.11	17.83	91.16	95.25	108.28	113.08
Hand weeding at 20 and 40 days after sowing	W_4	0.371	0.370	1.46	1.46	17.47	18.22	92.10	96.45	109.57	114.67
Weedy Check	W_5	0.362	0.364	1.38	1.38	13.22	13.84	66.65	67.98	79.87	81.82
SEm±		*0.004*	*0.005*	*0.03*	*0.03*	*0.27*	*0.33*	*1.12*	*1.16*	*1.18*	*1.19*
C.D.(P=0.05)		*NS*	*NS*	*NS*	*NS*	*0.87*	*0.96*	*3.38*	*3.48*	*3.85*	*3.92*

SUMMARY AND CONCLUSIONS

Among different cropresidue management, zero tillage with residue was found most effective in maximizing nutrient content and nutrient uptake followed by conventional tillage with residue. Conventional tillage without residue showed lowest values of all above parameters of crop. While in case of weed management practices hand weeding at 20 and 40 DAS had a significant impact on maximizing nutrient content and nutrient uptake followed by post-emergence application of Clodinafop propargyl 15% + Metsulfuron methyl 1% (60 gm + 4 gm a.i. ha^{-1}).

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