Nutrient Content and their Uptake (Nitrogen and Potassium) by Wheat (*Triticum aestivum* L.) as Influenced by Split Application of Potassium and Nitrogen.

Abstract

An experiment was conducted during the winter (*rabi*) seasons of 2020-21 and 2021-22 at Krishi Vigyan Kendra, Budgam- Sher-e-Kashmir University of Agricultural Sciences and Technology, Kashmir, to evaluate the Nutrient Content (Nitrogen and Potassium) and their uptake by Wheat (*Triticum aestivum* L.) as influenced by split application of Potassium and Nitrogen. The experiment was set up in a split-plot design replicated thrice with Potassium splits as main plot factor and nitrogen splits as sub plot factor which resulted in 15 treatment combinations, viz. of potassium @ 30 kg/ha [K_1: 100% as basal dose-(RFP); K_2: 50% as basal dose + 50% at active tillering; K_3: 25 % as basal dose + 75% at active tillering] and 5 treatments of nitrogen @ 120 kg/ha in split ratios of [N_1 : 50% as basal + 25% at jointing + 25% at booting stage (RFP); N_2: 25% as basal dose + 75% at active tillering; N_3 : 25% as basal dose +50% at active tillering + 25% at booting; N_4 : 50% as basal + 50% at active tillering; N_5 : 0% as basal + 75% at active tillering + 25% at booting]. The results of pooled data (2 yrs.) revealed that nutrient content and uptake (nitrogen and potassium) of wheat crop at various phenological stages were significantly more with the application of Potassium in two equal splits in the ratio of 50:50 as compared to the treatment where potassium was applied in one split as 100% basal dose. With the application of potassium in two equal splits (50:50), increase in Nitrogen, Potassium content (%) their uptake and dry matter accumulation by wheat crop was significantly higher as compared to recommended fertilizer application (K_1). Application of nitrogen in three splits with reduced basal dose in the ratio of 25:50:25 resulted in an increase of Nitrogen, Potassium content (%), their uptake and dry matter accumulation at all phenological stages by wheat crop and at physiological maturity there was an increase by 2.40%, 7. 4%, 10.17 %, 8.83% in Nitrogen, Potassium content (%), their uptake and dry matter accumulation respectively, as compared to recommended practice.

Key words: Dry matter accumulation, Nitrogen Content and uptake, Nitrogen and Potassium splits, Potassium content, Wheat.

Introduction

Wheat crop by virtue of its potentiality is emerging as an important field crop under the Kashmir valley conditions. Globally wheat grain is grown on more land area than any other commercial food. It is the leading source of vegetable protein in human food, having a higher protein content (12-18%) than other major cereals, maize or rice and contains about 70% starch and is the source of approximately half of the food calories consumed worldwide (Khalid *et al*., 2023). Since the area under wheat is almost stagnating and there is little scope for horizontal expansion. Therefore, development of wheat agronomy is pre-requisite. Many factors are responsible for increasing growth, yield and quality of wheat. Among these proper and balanced application of fertilizers is one of the most important factor contributing towards higher grain quality and productivity (Wanjari *et al.,* 2022). Potassium and nitrogen plays a critical role for improving nutrient content and quality of wheat and potassium also improves water and nutrient use efficiency, improves stress tolerance, reduces incidence of pests and diseases, protect the plant against lodging, regulates the transport of water and nutrient, help in translocation and storage of photosynthates, promotes protein and starch synthesis (Seema and Singh., 2020). As the soils of Kashmir are dominated by illitic type of clay minerals which affects the availability of K by fixing it in the interlayers and wedge **sides** of soil clays and reduces the availability of K to growing plants (Seema and Singh., 2021) that affects the soil productivity in general and particularly depletes the essential nutrients in the soil (Akhter *et al*., 2017). So to reduce the fixation of potassium and to increase its availability, split application of K according to the demand of a growing crop is the best agricultural technique. Timing of N application at preplanting, stem elongation, heading and flowering or by increasing the number of split applications improves nutrient content and quality of wheat (Saeed *et al*., 2013 and Akram *et al*., 2014). Thus, the present study entitled "Nutrient Content and their Uptake (Nitrogen and Potassium) by Wheat (*Triticum aestivum* L.) as Influenced by Split Application of Potassium and Nitrogen" was carried out during *rabi* seasons of (2020-2021 and 2021-2022) at KVK Budgam, SKUAST-Kashmir, Shalimar.

MATERIALS AND METHODS

A field experiment was conducted during the winter (*rabi*) seasons of (2020–21 and 2021–22) at KVK Budgam, Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir (SKUAST-K), Srinagar. The experiment was conducted on silty clay-loam soil, neutral in pH (7.08), medium in nitrogen (380 kg/ha), available phosphorus (18.2 kg/ha), and potassium (160.1 kg/ha). The experiment comprised 2 factors viz. 3 treatments of potassium (K1 , 100% K basal dose-recommended fertilizer practice; K2 , 50% K as basal dose + 50% K at active tillering; K3, 25% K as basal dose + 75% K at active tillering) and 5 treatments of nitrogen [N1 , 50% N as basal + 25% N at jointing + 25% N at booting stages (RFP); N2 , 25% N as basal dose + 75% N at active tillering; N3 , 25% N as basal dose + 50% N at active tillering + 25% N at booting; N4 , 50% N as basal + 50% N at active tillering; N5 , 0% N as basal + 75% N at active tillering+ 25% N at booting] was laid out in a split-plot design with 3 replications. Sowing was done in the first week of October with row-to-row spacing of

30 cm. Recommended dose of nitrogen (120 kg/ha) and potassium (30 kg/ha) through urea and muriate of potash respectively, was uniformly applied to each subplot as per the treatments while full dose of phosphorus (60 kg P2 O5 /ha) through Diammonium phosphate was applied as basal dose. In place of DAP, Single Superphosphate (375 kg/ha) was applied in those plots where 0% N was used as basal dose. Sowing was done manually at a distance of 23 cm apart from row to row using seed rate of 120 kg ha^{-1} and seeds were placed 3-4 cm deep in furrows. Pre emergence herbicide Pendimethalein (30 EC) was applied plot wise @1kg *a.i* ha^{-1} three days after sowing and the first hand weeding was done after 35- 40 DAS to flush out the autumn weeds and second hand weeding was done in the month of March to flush out the spring weeds. There was no requirement of irrigation due to sufficient availability of moisture during the crop growth. Due to observance of sporadic attack of yellow rust during the first year ofexperiment, Propaconazole (25 EC) was sprayed on 26th March @ 1ml/lt. with the help of Knapsack sprayer. Harvesting was done at physiological maturity after excluding two border rows breadth wise on each side of the plot and half of the meter length wise from other two sides. The harvested crop was allowed to dry in field for 48 hours and was piled into bundles. Penultimate rows from each side were used to collect samples for dry matter accumulation. At 40 DAS, active tillering, booting and at physiological maturity whole wheat plants from each treatment were taken from an area of about 1 m^2. These samples were put in an electric oven, dried for 36 hours at 60-65 ^oC temperature. The oven dried plant samples were grinded with the help of Yarco grinder. Nitrogen content in plant tissue was determined by using Kjeldahl method after digesting the samples with concentrated sulfuric acid (Jackson, 1973) and K content was determined after digestion with tri-acid (HNO_3: H_2SO_4: $HClO_4$) by using Flame photometer. Plant sampling for analysis of N and K content at active tillering was done before application of nitrogen and potassium. N and K uptake at 40 DAS, active tillering,booting and at physiological maturity were calculated by multiplying N and K content with the respective dry matter accumulation at these stages. Standard cultural practices were followed until the crop matured but the crop was cultivated as rainfed. The statistical analysis of the data was performed using Microsoft Excel and “Indostat” softwares. Statistical significance between mean differences among treatments for various parameters was analyzed using critical differences (CD) at 0.05 probability level.

RESULTS AND DISCUSSION

Periodic nutrient content (%) (Nitrogen and potassium), dry matter accumulation (q/ha) and uptake of nutrients (kg/ha) by the crop.

Split application of potassium and nitrogen had a significant effect on periodic nitrogen and K content of wheat crop during the two growing seasons. The data indicated the decreasing trend of nutrient content (nitrogen and potassium) from 40 DAS to harvest, it is due to the dilution effect. During the early growth stages, the plant has a lower dry matter content, and the nitrogen is concentrated in fewer plant parts, leading to higher nitrogen content. As the plant grows, the dry matter content increases, and the nitrogen is distributed throughout the plant, leading to a decrease in nitrogen concentration (Yang *et al*., 2023). At 40 DAS to active tillering nutrient content with the application of potassium in one split (100% basal dose) was maximum in plant sample as compared to other two treatments where potassium was given in two splits in the ratio of 50: 50 (basal + active tillering) and 25: 75 (basal + active tillering). It might be due to application of 100% recommended dose of K as basal that results in more available potassium in soil solution during the early growth stages that leads to more potassium content in plant samples. However from boot stage to physiological maturity nutrient content, dry matter accumulation and uptake of nitrogen and potassium recorded with the application of potassium in two equal splits in the ratio of 50: 50 (basal + active tillering) was at par with the application of potassium in two splits in the ratio of 25: 75 (basal + active tillering) but significantly higher than the treatment where potassium was given in one split as 100% basal dose (Table 1 & 2). Application of 50 and 75 percent of recommended dose of potassium at active tillering might helped in maintaining the K availability in the root zone and thus enhanced the supply of potassium to the economical part of the crop (Bansal *et al*., 2001 and Lu *et al*., 2014). Significant effect on potassium content of grains was also registered by El-Ghany *et al*. (2013) with the application of potassium sulphate at elongation stage and before heading time in bread wheat. Similarly, split application of nitrogen significantly influenced the nitrogen and potassium content during both the years. From 40 DAS to boot stage nitrogen and potassium content in plant samples recorded with the application of nitrogen in three splits in the ratio of 50: 25: 25 (basal + jointing + booting) was higher as compared to other treatments. However at physiological maturity nutrient content, dry matter accumulation and uptake of nutrients recorded with the application of nitrogen in three splits in the ratios of 25: 50: 25 (basal + active tillering + booting) was found at par with 50: 25: 25 (basal + jointing + booting) but significantly superior as compared to the treatments where nitrogen was applied in two splits in the ratios of 25: 75 (basal + active tillering), 50: 50 (basal + active tillering) and 75: 25 (active tillering + booting).

Table 1: Pooled Data (2 Yrs) Of Nitrogen Content, Dry Matter Accumulation and Uptake of Nitrogen at Different Growth Stages Of Wheat as Influenced By Split Application Of Potassium And Nitrogen.

Treatments	**N Content (%)**	**Dry matter Accumulation (q/ha)**	**Uptake of N (Kg ha^{-1})**	**N Content (%)**	**Dry matter Accumulation (q/ha)**	**Uptake of N (Kg ha^{-1})**	**N Content (%)**	**Dry matter Accumulation (q/ha)**	**Uptake of N (Kg ha^{-1})**	**N Content (%)**	**Dry matter Accumulation (q/ha)**	**Uptake of N (Kg ha^{-1})**
	40 DAS			**Active tillering**			**Boot stage**			**Physiological Maturity**		
K_1	2.94	1.68	4.94	2.58	5.50	14.15	2.03	36.52	74.13	1.95	88.54	172.64
K_2	2.75	1.54	4.23	2.39	5.00	11.91	2.22	41.12	91.07	2.07	106.48	220.41
K_3	2.70	1.35	3.64	2.30	4.45	10.21	2.16	39.39	85.08	2.04	96.69	197.24
SEm±	0.03	0..04	0.09	0.03	0.20	0.01	0.02	0.70	0.01	0.02	3.26	7.74
CD (p=0.05)	0.09	0.11	0.28	0.11	0.61	0.07	0.08	2.16	0.17	0.07	9.99	23.87
N_1	2.84	1.63	4.63	2.49	5.42	13.46	2.18	39.77	86.49	2.08	102.91	214.05
N_2	2.80	1.53	4.29	2.41	5.03	12.10	2.15	39.63	85.00	1.98	90.28	178.74
N_3	2.81	1.49	4.18	2.45	4.90	11.97	2.13	39.90	84.78	2.13	110.72	235.82
N_4	2.84	1.60	4.53	2.46	5.15	12.63	2.12	37.74	79.81	1.90	87.55	165.90
N_5	2.70	1.38	3.72	2.31	4.42	10.18	2.14	38.03	81.18	2.01	94.72	190.39
SEm±	0.02	0.02	0.12	0.03	0.16	0.01	0.01	0.40	0.01	0.01	1.41	4.03
CD (p=0.05)	0.05	0.06	0.37	0.10	0.46	0.04	0.04	1.16	0.05	0.03	4.12	14.28

100% as basal dose K_1
50% as basal dose + 50% at active tillering K_2
25% as basal dose + 75% at active tillering K_3

50% as basal + 25% at jointing +25% at booting stages N_1
25% as basal + 75% at active tillering N_2
25% as basal + 50% at active tillering + 25% at booting N_3
50% as basal + 50% at active tillering N_4
0% as basal + 75% at active tillering+ 25% at booting N_5

Table 2: Pooled Data (2 Yrs) Of Potassium Content, Dry Matter Accumulation and Uptake of Potassium at Different Growth Stages Of Wheat as Influenced By Split Application Of Potassium And Nitrogen

Treatments	K Content (%)	Dry matter Accumulation (q/ha)	Uptake of K (kg ha^{-1})	K Content	Dry matter Accumulation	Uptake of K (kg ha^{-1})	K Content (%)	Dry matter Accumulation (q/ha)	Uptake of K (kg ha^{-1})	K Content (%)	Dry matter Accumulation (q/ha)	Uptake of K (kg ha^{-1})
	40 DAS			**Active tillering**			**Boot stage**			**Physiological Maturity**		
K_1	2.35	1.68	3.95	2.29	5.50	12.60	2.15	36.52	78.52	1.61	88.54	142.55
K_2	2.31	1.54	3.56	2.26	5.00	11.30	2.24	41.12	92.11	1.73	106.48	183.68
K_3	2.24	1.35	3.02	2.17	4.45	9.66	2.18	39.39	85.87	1.67	96.69	160.99
SEm±	0.02	0..04	0.00	0.02	0.20	0.00	0.02	0.70	0.01	0.02	1.53	0.03
CD (p=0.05)	0.06	0.11	0.01	0.07	0.61	0.04	0.06	2.16	0.13	0.06	3.69	0.23
N_1	2.39	1.63	3.90	2.30	5.42	12.47	2.23	39.77	88.69	1.73	102.91	178.03
N_2	2.28	1.53	3.49	2.23	5.03	11.22	2.19	39.63	86.79	1.60	90.28	144.45
N_3	2.27	1.49	3.38	2.22	4.90	10.88	2.19	39.90	87.38	1.75	110.72	193.76
N_4	2.35	1.60	3.76	2.28	5.15	11.74	2.19	37.74	82.65	1.59	87.55	139.20
N_5	2.22	1.38	3.06	2.17	4.42	9.59	2.15	38.03	81.76	1.66	94.72	157.24
SEm±	0.02	0.02	0.00	0.02	0.16	0.00	0.02	0.40	0.01	0.02	1.41	0.03
CD (p=0.05)	0.05	0.06	0.00	0.06	0.46	0.03	0.05	1.16	0.06	0.07	4.12	0.29

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