Growth and Quality Parameters Of Wheat (*Triticum aestivum* L.)as Influenced By Split Application Of Nitrogen And Potassium.

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 Growth and yield variability of wheat as effected 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 revealed that growth parameters like dry matter accumulation, leaf area index, SPAD reading at various phenological stages and quality parameters like nitrogencontent(%) of grain and straw,proteincontent of grain, yield andnutrogenuseefficiency 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. There was the non-significant effect of split application of potassium and Nitrogen on days taken to different phenological stages. Increase in Nitrogencontent(%) of grain was 5.76 and 5.73% during the year 2020-21 and 2021-22 respectively. Average Percent increase in Grain yield, Protein content of grain and nitrogen use efficiency (grain yield (kg)/ kgNapplied) with the application of potassium in two equal splits in the ratio of 50:50 during both the years was 12.46 %, 5.81 % and 12.46 % that was significantly higher as compared to recommended fertilizer application (K_1).

Key words: Grain yield, Nitrogen content, , Nitrogen Use Efficiency, Nitrogen and Potassium splits, Protein content, Wheat yield.

Introduction

Wheat crop by virtue of its potentiality is emerging as an important fieldcrop under the Kashmir valley conditions. Globally wheat grain is grown on moreland area than any other commercial food.It is the leading source of vegetableprotein in human food, having a higher protein content (12-18%) than other majorcereals, 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 andthere islittle scope for horizontal expansion. Therefore, development of wheat agronomyis pre-requisite.Many factors are responsible for increasing growth, yield andquality of wheat.Among these properand balanced application of fertilizers isone of the most important factor contributing towards higher grain quality andproductivity(Wanjari *et al.*, 2022).Potassiumandnitrogenplaysacriticalrolefor improving growth,yieldand qualityof 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 mineralswhichaffectstheavailabilityofKbyfixingitintheinterlayersandwedgesides ofsoilclaysandreduces the availability of K togrowingplants (Seema and Singh., 2021) thataffectsthesoil productivity ingeneral 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 bestagriculturaltechnique.TimingofNapplicationatpreplanting,stemelongation,headingandflowering or by increasing the number of split applications improves the growth, quality andgrainyieldofwheat(Saeed *et al.*, 2013 and Akram *et al*., 2014). Thus, the present study entitled **"**Quality and Growth Parameters of Wheat as Influenced By Split Application of Nitrogen and Potassium under Temperate Conditions of Kashmir**"** wascarried out during *rabi* seasons of (2020- 2021and 2021-2022) at KVK Budgam, SKUAST-Kashmir, Shalimarwith thefollowingobjective:

- Tostudythe effectofsplitapplicationofpotassiumandnitrogenongrowthandQuality ofwheat.

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 rowusingseedrate of 120kgha^{-1} and seeds wereplaced 3-4 cmdeep 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 themonthof March to flushout thespringweeds. There was no requirement of irrigation due to sufficient availability ofmoistureduringthecropgrowth. 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 thehelpof Knapsack sprayer. Harvesting was done at physiological maturity after excluding two borderrows breadth wise on each side of the plot and half of the meter length wise fromother two sides. The harvested crop was allowed to dry in field for 48 hours andwaspiled into bundles. For the purpose of recording non-destructive parameters, five plants wererandomly selected and tagged in each sub plot of replications and then the average for Leaf area Index (AccuparL-80), SPAD reading (SPAD-502 Konica Minolta Sensing) was worked out and recorded at various phenological stages. Penultimate rows from each side were used to collect samples for dry matteraccumulation.Number of days taken by crop to reach various phenological stages *viz*.emergence,crownrootinitiation,activetillering,jointing,booting,heading,anthesis, milk, dough and maturity were recorded from each sub plot during boththe years. Thegrainandstraw samples were oven dried, grinded and sieved through 1mm size sieve, the strawandgrainsampleswereanalyzedforNcontentfromeachsub-plotseparately. Theprotein contentof thegrainwasworkedoutas;

%protein =%Nx5.7(AACC, 2000)

Nitrogenuseefficiency(NUE)wascalculatedas;

NUE=Grainyield(kg)/kgNitrogenapplied(Sowers*et al*.,1994)

Standard cultural practices were followed until the crop matured but the crop was cultivated as rainfed. The grain yield data was adjusted at 14% moisture content. 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

Growth attributes and Grain Yield

Thedrymatteraccumulation, LAI and SPAD values weresignificantlyaffectedbysplitapplicationofboth potassiumandnitrogenatallthestagesofcropgrowth. Application of potassium in two equal splits in the ratio of 50: 50 (basal +activetillering)recordedsignificantlyhigherdrymatteraccumulationat maturity by2.51and 5.86 percent during the year 2020-21 and by 2.92 and 7.49 percent during the year 2021-22 respectively,over the treatment wherepotassium was givenin two splits in the ratio of 25: 75 (basal + active tillering) and the treatment wherepotassium was given in one split as 100% basal dose (recommended practice) (Table 1). The LAI and SPAD reading continued to increase upto anthesis and thereafterdeclinedtill harvest of thecrop in all thetreatments. It is because of the transition period fromvegetativeto reproductivephase as also reported by Alam, 2013. At anthesis the application of potassium in two splits in the ratios of 50: 50 (basal + active tillering) andin the ratio of 25: 75 (basal + active tillering)recorded significantly higher leaf area index (3.80; 3.78) and SPAD values (50.35 ; 47.91) during the year2020-21 while 3.90; 3.84 and 51.15; 48.68during the year 2021-22 as compared to the treatmentwherepotassiumwasgiveninonesplitas100%basaldosewhichrecordedLAI (3.54 and 3.61) and SPAD values (45.28 and 45.98) respectively during both the years (Table 2; Fig. 1a). The increased dry matter accumulation, LAI, SPAD values with application of K in 2 equal splits leads to greater availability of K and lower transformation of potassium into non-exchangeable pool, where its availability regulates numerous biochemical, phenological, and physiological responses in plants (Hasanuzzaman *et al*. 2018; Johnson *et al*. 2022) such as water uptake (Sardans and Peñuelas 2015); nutrient translocation (Xu *et al*. 2020), enzyme activation (Hasanuzzaman *et al*. 2020), photosynthesis (Siddiqui *et al*. 2021), protein synthesis (Sahi *et al*. 2021), osmoregulation (Wang *et al*. 2013) resultingintaller plants,more number of tillers and hence more dry matter accumulation (Wagnan*et al*.(2002), betterfoliagegrowthandhencehigherleafareaindex(Marschner,1995) and delay in leaf senescence that leads to higher SPAD values. Mathukia*et* *al.*(2014)alsoreportedsimilarresultswiththeapplicationofpotassiumin two equal splits as compared to 60 kgK_2O/haas basal. The days taken to different phenological stages by wheat are illustrated graphically in Fig. 2a and 2b and shows that split application of potassiumand nitrogen did not differ significantly. This is because days taken to different phenophases depends upon the twomostimportantfactorsthataffectrateofdevelopment in plants are photoperiod and temperature. These two factors wereuniformly experienced by wheat crop in different plots and thus the developmentin all plants was uniform and the days taken to different phenological stages werethesame. Similarwerethefindings of Nawab*et al.*(2011). Nitrogen content (grain and straw) and proteincontentingrainwiththeapplicationofpotassiumintwo equal splits in the ratios of 50: 50(basal + active tillering)wasat par with25:75(basal+activetillering)butsignificantly higherascomparedtothetreatmentwherepotassiumwasgiveninonesplitas100%basaldose(recommendedpractice)duringboththeyears (Table 3). Greater availability of K in case of split application of K had the role in increasing translocation of photo assimilates fromleaves to the grains (EL-Abady *et al.*, 2009) and attributed to improved utilizationofN and hence higher protein content (BhatiandSingh,2015)**.**Theseresultsareinconfirmationwith Fusheng(2006),Zou*et al.* (2006), El-AshryandEl-Kholy(2005). Potassiumin two equalsplitsin theratio of 50: 50 (basal + active tillering) recorded significantly maximum grainyieldof38.09qha^{-1} and nitrogenuseefficiency of 31.68 (kg grain yield/kgN applied)during theyear2020-21 andof45.35qha^{-1} and 37.79 (kg grain yield/kgNapplied)during theyear2021-22 ascomparedtothe treatments where potassiumwas appliedintwosplitsintheratioof25:75(basal+activetillering)andthetreatment where potassium was applied in one split as100% basal dose (recommendedpractice).Thegrainyield and nitrogenuseefficiencywiththeapplicationofpotassiumintheratioof25:75(basal+activetillering)wasatparwiththerecommendedpractice (Table 3). Application of potassium in split doses enhanced the enzymatic activities, these reactions resulted in higher mobilization of nutrients in soil and plant and increased translocation of photosynthates in plant system, helps to produce large amounts of starch due to K-mediated carbohydrate metabolism leading to higher grain yield. Similar findings were reported by Sharma and Singh (2020). Maximum NUE in two equal splits of potassium might be due toprolonged availability of K in soil that promoted the absorption of top-dressed and soil applied N by plant that resulted in higher yield from same amount of nitrogen applied (120kg/ha) and hence higher NUE. Yu *et al.*(2007)alsoreportedthatsplitapplicationofKinwheatpromotedtheabsorptionoftop-dressedand soil applied N byplant.

Further it is evident from the data, that the application of nitrogen in the ratio of 25: 50: 25 (basal + active tillering + booting) provedeffectiveinenhancing various growth parameters at all phenological stages like drymatterproduction,leaf area index (3.90 at anthesis) and SPAD values (48.92 at anthesis) during the year 2020-21 while 3.98 and 49.90 during the year 2021-22 respectively (Fig. 1b and Table 2), as compared to thetreatmentswherenitrogenwasappliedintheratiosof50:25:25(basal+jointing+booting),25:75(basal+activetillering),50:50(basal+activetillering)and 75: 25 (active tillering + booting). The increased drymatterproduction,leaf area index and SPAD values recorded withthe application of nitrogen inthree splitswithreduced basaldose inthe ratio of 25: 50: 25 might be attributed to the reduction in loss of nitrate by leaching during the wet growing season that results in adequate amount of nitrogen and its availability at critical growth stages of wheat improves photosynthetic activity by improving chlorophyll content which leads to increasing cell division and elongation ofcells that leads to higher dry matter production, increased leaf area and hence increased leaf area index (Haile *et al.*, 2012) and also SPAD values. Khan *et al.*, (2022) also reported the similar results with the application of nitrogen in splits who reported that nitrogen is considered as the prime nutrient and promote plant growth, and internode size result in increased plant height and hence dry matter accumulation. These results are in confirmation with the findings of Saeed *et al*. (2013) who also reported the increased leaf area index with the application of nitrogen in threesplitsas compared to twosplits. At harvest nitrogen content (straw and grain), Proteincontent % (grain) grain yield (38.09 and 45.35q ha^{-1}) and highestNUEof31.74and37.79 (kggrain/kgNapplied) (Table 3) was recordedwiththreesplits of nitrogen intheratiosof25:50:25(basal+ active tillering + booting) was found at par with 50: 25: 25 (basal + jointing +booting) but significantly superior as compared to the treatments where nitrogenwas applied in two splits in the ratios of 25: 75 (basal + active tillering), 50: 50(basal+activetillering)and 75: 25(activetillering+booting). The possible reason of higher grain and strawnitrogen content at harvest might be due to the adequate availability of nitrogenthroughout the crop growth period in the plots received nitrogen in three splits that resulted in translocation of more nitrogen to grains and straw. Masaka, (2006) and Khan *et al.* (2009) also registered increased nitrogen content in grain and straw bythewheat crop when nitrogenwasapplied in threesplits, further, splitting of nitrogen fertilizer to many doses increasedthe efficiency of the fertilizers by decreasing leaching losses of NO$_3$ to a largeextent and increased both yield and quality of crops (Gauer *et al.*, 1992; Patke *et al.*, 2003; Shalaby *et al*.,2006 and Ali, 2010).These results are in confirmationwiththefindings of Ali (2011) who reported that N inthreesplitswithreducedbasaldoseresults in efficient utilization by arresting the volatilization or leaching down of nitrogendue to which plants don't suffer any shortage in nitrogen throughout life cyclewhich led to an increase in yield component and consequently grain yield. Theseresultsregarding enhancedgrainyieldduetosplitapplicationofnitrogenareascertainedalsobyAbedi*et al*.(2011).

Conclusion;

Duetoilliticttypeofclaymineralsandadverseenvironmentalconditionsintemperate Kashmirduringwintermonths,which affects the availability of K by fixing it in the interlayer and wedge sides of soilclay, and higher basal nitrogen dose gets subjected to leaching losses before plantuptake. The current recommendation of 100% K as basal dose and50% N as basal dose is not adequate to synchronize K and N supply with actualcropKandNdemand. The increase in growth, yield, nitrogen content (Grain and straw), Protein content (Grain) and Nitrogen use efficiency with the split application of potassium and nitrogen with reduced basal dose had proved that the wheat croprequires potassium in two equal splits 50: 50 (basal + active tillering) and lowerdoseofnitrogenattheearlystages(25%Nasbasaldose)andmoreNduringits grand growth period (50% N at active tillering + 25% N at booting). Thus, splitapplicationofpotassium30 kg Kha^{-1} in two equal splits andnitrogen 120 kg ha^{-1} in three splits with reducedbasaldose(25: 50: 25) couldhelpinsynchronization of potassium and nitrogen requirements to its peak demand by the crop for increased nutrient, Protein content and yield in wheat.

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Table1: Drymatteraccumulation(qha^{-1})atvariousgrowthstagesofwheatcropasinfluencedbysplitapplicationofpotassiumandnitrogen

Treatments	Activetillering		Jointing		Bootstage		Anthesis		Milkstage		Dough		Maturity	
	2013	**2014**	**2013**	**2014**	**2013**	**2014**	**2013**	**2014**	**2013**	**2014**	**2013**	**2014**	**2013**	**2014**
K_1	5.04	5.95	13.12	16.70	34.55	38.48	50.39	64.39	85.72	102.92	99.68	114.53	102.72	120.32
K_2	4.78	5.21	14.15	18.63	38.75	43.48	51.85	67.78	88.88	108.08	105.72	123.01	108.74	129.34
K_3	4.25	4.65	13.61	16.99	35.73	43.05	51.23	66.23	88.25	106.45	103.58	119.27	106.07	125.67
SEm±	**0.31**	**0.09**	**0.23**	**0.23**	**0.25**	**1.14**	**0.27**	**0.44**	**0.55**	**0.55**	**0.76**	**1.40**	**0.66**	**0.70**
CD(p=0.05)	**0.91**	**0.31**	**0.70**	**0.70**	**0.75**	**3.56**	**0.82**	**1.33**	**1.76**	**1.76**	**2.21**	**4.33**	**2.01**	**2.16**
N_1	5.18	5.65	13.69	17.55	36.75	42.78	51.84	66.84	88.78	106.78	103.76	120.57	106.57	125.38
N_2	4.73	5.33	14.19	18.05	36.60	42.65	51.40	66.40	87.83	106.83	103.10	119.20	105.61	125.13
N_3	4.45	5.34	14.05	17.80	37.21	42.58	51.98	66.98	89.14	107.14	105.44	121.56	108.30	127.48
N_4	4.91	5.38	14.03	16.88	35.28	40.19	50.11	65.11	86.11	104.11	100.63	116.62	104.23	124.53
N_5	4.18	4.65	13.18	16.93	35.90	40.15	50.44	65.33	86.23	104.23	102.02	116.72	104.51	123.01
SEm±	**0.15**	**0.16**	**0.16**	**0.17**	**0.21**	**0.58**	**0.27**	**0.35**	**0.49**	**0.49**	**0.81**	**1.18**	**0.42**	**0.43**
CD(p=0.05)	**0.46**	**0.46**	**0.49**	**0.49**	**0.61**	**1.70**	**0.80**	**1.01**	**1.44**	**1.44**	**2.38**	**3.47**	**1.24**	**1.27**

100%asbasaldose	K_1	50%asbasal+25%atjointing+25% atbootingstages	N_1
50%asbasaldose+50%atactivetillering	K_2	25%asbasal+75%atactivetillering	N_2
25%asbasaldose+ 75%atactivetillering	K_3	25%asbasal+50%atactivetillering+25%atbooting	N_3
		50%asbasal+50%atactivetillering	N_4
		0%asbasal+75%atactivetillering+25%atbooting	N_5

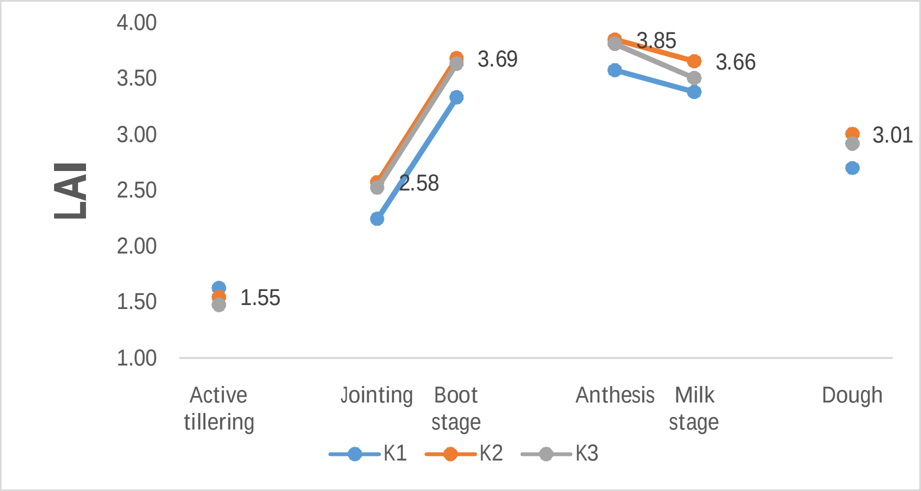

Fig. 1a: Leafareaindexatvariousgrowthstagesofwheat Crop asInfluencedbysplitapplicationofpotassium

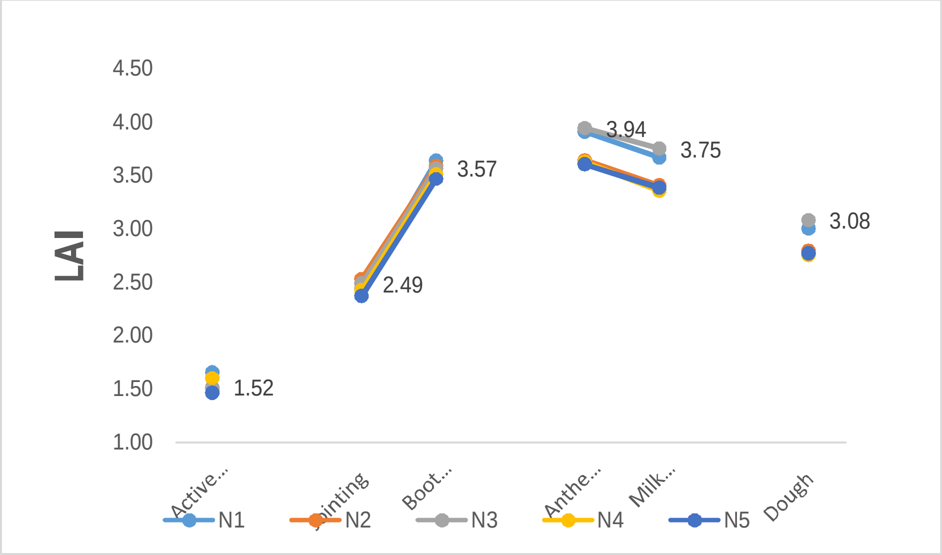

Fig. 1b: LeafareaindexatvariousgrowthstagesofwheatCropasInfluencedbysplitapplicationofnitrogen

Table2:SPADreadingofwheatcropasinfluencedbysplitapplicationofpotassiumandnitrogen

Treatments	Activetillering		Jointing		Bootstage		Anthesis		Milkstage		Dough		Maturity	
	2013	**2014**	**2013**	**2014**	**2013**	**2014**	**2013**	**2014**	**2013**	**2014**	**2013**	**2014**	**2013**	**2014**
K_1	39.79	40.94	43.24	44.70	44.12	45.43	45.28	45.98	39.68	40.40	34.88	36.61	25.54	26.91
K_2	35.87	37.82	48.30	50.30	49.87	50.45	50.35	51.15	43.87	45.39	38.43	40.46	31.50	32.65
K_3	32.60	34.52	45.36	46.29	46.96	48.38	47.91	48.68	41.04	42.26	36.94	38.64	27.91	29.28
SEm±	**1.34**	**1.36**	**1.18**	**0.98**	**0.71**	**0.62**	**0.82**	**1.13**	**0.95**	**0.51**	**0.67**	**0.64**	**0.82**	**0.81**
CD(p=0.05)	**4.06**	**4.17**	**3.57**	**3.00**	**2.13**	**1.88**	**2.46**	**3.39**	**2.86**	**1.54**	**2.04**	**2.01**	**2.46**	**2.44**
N_1	37.71	39.36	44.14	45.75	46.93	49.13	48.88	49.83	43.36	43.98	37.85	39.74	29.00	30.37
N_2	35.61	37.38	48.11	49.00	48.84	49.10	48.87	49.70	40.27	41.89	35.76	37.32	27.91	29.28
N_3	35.82	37.48	47.06	48.67	47.90	49.00	48.92	49.90	43.55	44.17	38.81	40.98	29.96	31.33
N_4	38.34	39.99	44.86	46.46	45.55	46.64	47.07	47.08	40.12	41.41	35.62	37.18	27.15	28.14
N_5	32.95	34.60	44.00	45.60	44.38	46.58	45.50	47.51	40.35	41.97	35.72	37.63	27.57	28.95
SEm±	**0.98**	**0.87**	**0.91**	**0.96**	**0.78**	**0.65**	**0.82**	**0.65**	**0.71**	**0.61**	**0.64**	**0.85**	**0.82**	**0.80**
CD(p=0.05)	**2.88**	**2.54**	**2.65**	**2.80**	**2.27**	**1.92**	**2.39**	**1.89**	**2.07**	**1.80**	**1.89**	**2.48**	**2.39**	**2.34**

100%asbasaldose	K_1	50%asbasal+25%atjointing+25% atbootingstages	N_1
50%asbasaldose+50%atactivetillering	K_2	25%asbasal+75%atactivetillering	N_2
25%asbasaldose+ 75%atactivetillering	K_3	25%asbasal+50%atactivetillering+25%atbooting	N_3
		50%asbasal+50%atactivetillering	N_4
		0%asbasal+75%atactivetillering+25%atbooting	N_5

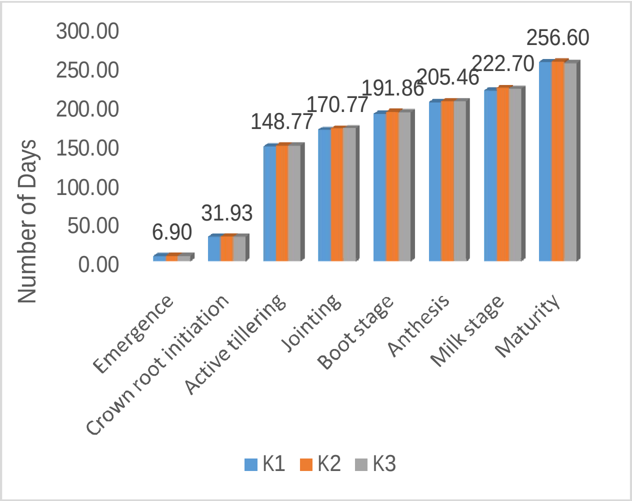

Fig. 2a: Daystaken todifferent phenologicalstages as influenced bysplitApplicationofpotassiumin wheat

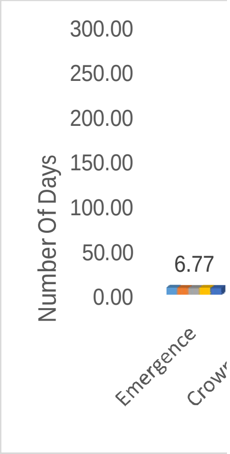

Fig. 2b: Daystaken todifferent phenologicalstages as influenced bysplitApplicationofNitrogen in wheat

Table3: Nitrogencontent(%),proteincontentandnutrientuseefficiency(kggrainyield/kgNappliedasinfluencedby split applicationofpotassiumand nitrogen

Treatments	**Nitrogencontent (%)**				**Protein contentin grain (%)**		**GrainYield (q/ha)**		**Nitrogen useefficiency(kg grain yield/kgNapplied**	
	2020 Grain	**Straw**	**2021 Grain**	**Straw**	**2020**	**2021**	**2020**	**2021**	**2020**	**2021**
K1	1.56	0.38	1.57	0.39	8.91	8.97	34.01	40.14	28.34	33.45
K2	1.65	0.41	1.66	0.42	9.43	9.49	38.09	45.35	31.74	37.79
K3	1.63	0.40	1.64	0.41	9.31	9.37	35.57	41.72	29.64	34.77
SEm±	**0.02**	**0.004**	**0.02**	**0.004**	**0.11**	**0.12**	0.70	0.40	**0.57**	**0.32**
CD(p=0.05)	**0.06**	**0.013**	**0.06**	**0.014**	**0.34**	**0.37**	2.13	1.21	**1.77**	**1.00**
N1	1.66	0.41	1.67	0.42	9.58	9.56	37.18	43.52	30.98	36.27
N2	1.58	0.39	1.59	0.40	8.96	9.03	34.09	40.60	28.40	33.84
N3	1.71	0.42	1.70	0.43	9.78	9.92	39.50	46.01	32.91	38.35
N4	1.51	0.37	1.52	0.39	8.60	8.66	33.42	40.10	27.85	33.42
N5	1.60	0.40	1.61	0.41	9.17	9.22	35.04	41.78	29.20	34.81
SEm±	**0.02**	**0.005**	**0.016**	**0.004**	**0.12**	**0.11**	0.70	0.68	**0.58**	**0.57**
CD(p=0.05)	**0.06**	**0.016**	**0.048**	**0.012**	**0.36**	**0.37**	2.06	2.00	**1.71**	**1.67**

100%asbasaldose	K1	50%asbasal+25%atjointing+25% atbootingstages	N1
50%asbasaldose+50%atactivetillering	K2	25%asbasal+75%atactivetillering	N2
25%asbasaldose+ 75%atactivetillering	K3	25%asbasal+50%atactivetillering+25%atbooting	N3
		50%asbasal+50%atactivetillering	N4
		0%asbasal+75%atactivetillering+25%atbooting	N5