



Influence of seed rate and fertilizer levels on agro physiological parameters and yield of dual purpose wheat (*Triticum aestivum*)

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ABSTRACT

The experiment was conducted at Research Farm of Agronomy, CCS HAU, Hisar during *rabi* season of the year 2017-18 and 2018-19 to study the influence of seed rate and fertilizer levels on agro-physiological parameters and yield of dual purpose wheat (*Triticum aestivum* L.). Four treatments, viz. C 306 without cut (M_1), C 306 with cut at 60 DAS (M_2), WH 1105 without cut (M_3), WH 1105 with cut at 60 DAS (M_4) in main plot and six seed rate and fertilizer combinations, viz. 100 kg/ha seed rate + 100% RDF (S_1), 100 kg/ha seed rate + 115% RDF (S_2), 100 kg/ha seed rate + 130% RDF (S_3), 125 kg/ha seed rate + 100% RDF (S_4), 125 kg/ha seed rate + 115% RDF (S_5), 125 kg/ha seed rate + 130% RDF (S_6) in subplot with three replications were laid out in split plot design. Results of this study indicate that wheat plant population was not influenced by different cultivars and different dose of fertilizers, but it was significantly affected by seed rate and fertilizer levels. Plant population was significantly higher (55.11/m.r.l.) in wheat sown at 125 kg/ha seed rate with 130% RDF over wheat sown at 100 kg/ha seed rate with either dose of fertilizer during both the years. Significantly higher dry matter accumulation (400.76 g/m.r.l. at harvest), LAI and total tillers were recorded in WH 1105 under without cut management, whereas, significantly taller plants (138.37 cm at harvest) was recorded in C 306 under without cut management. While comparing the seed rate and fertilizer combination treatments, significantly higher dry matter accumulation (308.38 g/m.r.l. at harvest), plant height (114.47 cm at harvest), LAI and total tillers were recorded in wheat sown at 125 kg/ha seed rate with 130% RDF. Significantly higher grain yield (6203 kg/ha) was recorded in WH 1105 under without cut management sown at 125 kg/ha seed rate with 130% RDF over C 306 under either cut management sown at either seed rate with either fertilizer levels during both years, which was statistically at par with WH 1105 sown at 125 kg/ha seed rate with 115% RDF and WH 1105 sown at 100 kg/ha seed rate with 130% RDF.

Key words: Cultivars, Leaf area index, Seed rate, Wheat, Yield

In a country like India, where agriculture and animal husbandry are complimentary to each other and livestock rearing is integral part of rural economy, food security is directly linked with fodder availability.

India has about 536 million livestock population and 119 million milch animals, which require big quantity of good quality fodder for better milk production. Area under cultivated fodder crops is about 8.3 mha and it is static from last 3-4 decades, which is not sufficient to meet the fodder requirement of the large number of livestock (Agropedia.iitk.ac, 2015). India is deficit in dry fodder by about 26% and green fodder by about 35.6%. It is not possible to further increase the area under fodder crops. Therefore, there is only alternative to increase fodder production by taking grain

crops as dual purpose for both fodder and grain production.

Wheat (*Triticum aestivum* L.) is one of the most important food crops among cereals and also source of fodder for animals (Devi *et al.* 2017). India It contributes about 35% of the total food grains production in country. The area of 29.10 mha with production and productivity of 99.10 mt and 3408 kg/ha, respectively whereas, in Haryana, it covers about 2.55 mha area with production and productivity of 12.57 mt and 4925 kg/ha (Bhatia and Nimbrayan 2020)

The nitrogen fertilization is the most limiting factor in the production of grain and forage production of dual purpose wheat. The quantity and time of application of nitrogen fertilizer is very crucial for attaining the normal growth of the regenerated vegetative material in wheat after cut for fodder. Application of higher doses of fertilizers particularly nitrogen may not be always seen in the form of grain yield, but may be in form of production of vegetative parts such as plant height, number of leaves and number of tillers etc.

Many researchers have found that late season top dressed nitrogen addition as dry fertilizer material were most

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effective in attaining higher grain protein concentration, yield and increased fertilizer recovery and efficiency (Yousaf *et al.* 2015). Seed rate also plays a key role in the plant growth, development like nitrogen grain yield and quality of wheat. Seed rate governs inter and intra plant competition, the numbers of tillers per plant, spikelets per spike, grain size, grain shape etc.

MATERIALS AND METHODS

The present investigation was conducted at Research Farm of Department of Agronomy, CCSHAU, Hisar, during *rabi* season of the year 2017-18 and 2018-19. The soil of experimental field was slightly saline in reaction (pH 7.9), sandy loam in texture, low in organic carbon (0.44 %) and available nitrogen (128 kg/ha), medium in available phosphorus (28.5 kg/ha) and high in available potassium (378 kg/ha). Soil texture was determined by international pipette method (Piper 1966), pH by Glass electrode pH meter (Jackson 1973), organic carbon by Walkley and Black's rapid titration method (Walkley and Black 1934), available nitrogen by alkaline permanganate method (Subbiah and Asija 1956), available phosphorus by Olsen's method (Olsen *et al.* 1954) and available potassium by flame photometric method (Jackson 1958). Four treatments, *viz.* C 306 without cut (M_1), C 306 with cut at 60 DAS (M_2), WH 1105 without cut (M_3), WH 1105 with cut at 60 DAS (M_4) in main plot and six seed rate and fertilizer combinations, *viz.* 100 kg/ha seed rate + 100% RDF (S_1), 100 kg/ha seed rate + 115% RDF (S_2), 100 kg/ha seed rate + 130% RDF (S_3), 125 kg/ha seed rate + 100% RDF (S_4), 125 kg/ha seed rate + 115% RDF (S_5), 125 kg/ha seed rate + 130% RDF (S_6) in subplot with three replications were laid out in split plot design. Recommended doses of N:P:K @ 150-60-30 kg/ha were applied through urea, diammonium phosphate (DAP) and muriate of potash (MOP), respectively. N fertilizer was applied in 2 splits in without cut, *i.e.* 50% as basal dose and 50% after 1st irrigation, whereas, in cut management N was applied in 3 splits, *i.e.* 50% as basal dose, 25% after 1st irrigation and 25% after cut. After 60 days of sowing, dual purpose tall wheat crop was harvested for fodder at 10 cm stubble height and left for regrowth for grain purpose. The data of plant population, plant height and dry matter accumulation was recorded periodically. The leaf area of the selected leaves was measured using leaf area meter. Leaf area index (LAI) was calculated according to Watson (1952). The crop was harvested at maturity and grain yield was recorded after threshing. Data analyzed by the method of analysis of variance (ANOVA) as described by Panse and Sukhatme (1985).

RESULTS AND DISCUSSION

Plant population (No. of plants/m.r.l.)

Plant population at 15 DAS of dual purpose wheat was not significantly affected by wheat cultivars and dose of nitrogen fertilizer (Table 1), however, higher plant population (55.11/m.r.l.) were recorded in WH 1105 wheat

Table 1 Effect of different seed and fertilizer levels on plant population in dual purpose wheat (Pooled data of two years)

Treatment	Plant population (No./m.r.l.)
C 306 without cut	48.74
C 306 with cut at 60 DAS	48.84
WH 1105 without cut	51.78
WH 1105 with cut at 60 DAS	53.13
SEm $\pm$	1.71
CD at 5%	NS
100 kg/ha seed rate + RDF	45.77
100 kg/ha seed rate + 115% RDF	46.96
100 kg/ha seed rate + 130% RDF	47.52
125 kg/ha seed rate + RDF	53.79
125 kg/ha seed rate + 115% RDF	54.55
125 kg/ha seed rate + 130% RDF	55.11
SEm $\pm$	0.95
CD at 5%	2.98

cultivar as compared to C 306 during both the years of study which might be due to bolder seed size of C 306. While comparing the seed rate and fertilizer combination treatments, significantly higher (about 20 per cent) plant population was recorded in wheat sown with 125 kg/ha seed rate over wheat sown with 100 kg/ha with either dose of fertilizers. It may be due to the fact that plant population under lower seed rate was reduced. The result of present study was on the line of findings of Pandey (2005), Khalil *et al.* (2011), Naveed *et al.* (2014) and Atis and Akar (2018).

Dry matter accumulation (g/m.r.l.)

Before cutting for fodder (at 60 DAS), significantly higher dry matter accumulation was observed in no-cut plots as compared with cut-plots with either wheat cultivar during both the years of study (Table 2). In case of cultivars, higher dry matter accumulation was observed in C 306 at 30 and 60 DAS as compared with WH 1105 cultivar during both years. After fodder cut, significantly higher dry matter accumulation was observed in WH 1105 over C 306 during both years. The possible reason of more dry matter accumulation under no-cut treatment might be the absence of cutting shock with no interruption in normal plant growth. At maturity, 45.12 per cent higher dry matter accumulation was observed in WH 1105 over C 306 under without cut condition, whereas under with cut condition, 21.04 per cent higher dry matter accumulation at maturity was observed in WH 1105 over C 306 during both the years. In case of cultivars, significantly higher dry matter accumulation was observed in WH 1105 cultivar as compared to C 306 after cut at 60 DAS during both years which might be due to more number of tillers in WH 1105 as compared to C 306.

In case of seed rate and fertilizer combination treatments, significantly higher dry matter accumulation at 30 DAS and 60 DAS was observed in wheat sown with

Table 2 Effect of different seed rate and fertilizer levels on dry matter accumulation (g/m.r.l.) in dual purpose wheat (Pooled data of two years)

Treatment	Dry matter accumulation (g/m.r.l.)				
	30 DAS	60 DAS	90 DAS	120 DAS	At harvest
C 306 without cut	12.07	63.75	117.43	218.03	276.17
C 306 with cut at 60 DAS	11.72	60.82	99.17	184.14	227.14
WH 1105 without cut	11.10	62.42	132.17	296.93	400.76
WH 1105 with cut at 60 DAS	10.77	58.83	88.71	199.30	274.89
SEm ±	0.08	0.43	0.99	1.83	3.12
CD at 5%	0.25	1.37	3.57	6.12	10.44
100 kg/ha seed rate + 100% RDF	11.24	60.08	105.24	216.16	278.21
100 kg/ha seed rate + 115% RDF	11.45	61.46	109.46	224.80	295.26
100 kg/ha seed rate + 130% RDF	11.53	62.14	111.35	228.66	304.25
125 kg/ha seed rate + 100% RDF	11.25	60.70	106.54	218.83	283.63
125 kg/ha seed rate + 115% RDF	11.46	61.87	110.77	227.41	298.68
125 kg/ha seed rate + 130% RDF	11.56	62.48	112.88	231.74	308.38
SEm ±	0.06	0.31	0.67	1.57	2.68
CD at 5%	0.18	0.98	2.23	4.82	8.24

115% RDF over wheat sown with 100% RDF with either seed rate which was statistically at par with 130% RDF during both the years of study (Table 2). Abedi *et al.* (2011) also reported that increasing the N fertilization rate had a beneficial effect on grain yield and its quality. At maturity 10.84 per cent higher dry matter accumulation was observed in wheat sown at 125 kg/ha seed rate with 130% RDF over wheat sown at 100 kg/ha seed rate with 100% RDF during both the years. It may be due to the fact that poor plant growth under nitrogen stress conditions. Khalil *et al.* (2011), Naveed *et al.* (2014) and Atis and Akar (2018) also reported similar results.

Plant height (cm)

In case of cultivars, significantly taller plants were observed in C 306 cultivar as compared to WH 1105 throughout crop season before and after cut at 60 DAS during both years (Table 3). At harvest, 36.16 per cent, taller plant height was observed in C 306 over WH 1105 under without cut condition, whereas under with cut condition, 30.97 per cent taller plant height at harvest was observed in C 306 over WH 1105 during both the years. Reduction in plant height may be due to that cutting imposed stress causing termination of growth and new growth of shoot could not attain the same plant height. Similar results were

Table 3 Effect of different seed rate and fertilizer levels on plant height (cm) in dual purpose wheat (Pooled data of two years)

Treatment	Plant height (cm)				
	30 DAS	60 DAS	90 DAS	120 DAS	At harvest
C 306 without cut	22.66	47.30	96.50	126.66	138.37
C 306 with cut at 60 DAS	22.01	45.13	77.16	108.24	118.20
WH 1105 without cut	20.83	46.21	85.19	98.07	101.80
WH 1105 with cut at 60 DAS	20.21	43.55	69.16	85.13	90.22
SEm ±	0.15	0.32	0.79	0.95	1.14
CD at 5%	0.50	1.04	2.86	3.46	3.82
100 kg/ha seed rate + 100% RDF	21.09	44.53	78.87	100.46	109.61
100 kg/ha seed rate + 115% RDF	21.49	45.55	82.06	104.60	112.12
100 kg/ha seed rate + 130% RDF	21.65	46.05	83.50	106.47	113.07
125 kg/ha seed rate + 100% RDF	21.12	44.99	79.85	101.71	110.59
125 kg/ha seed rate + 115% RDF	21.51	45.85	83.06	105.93	113.03
125 kg/ha seed rate + 130% RDF	21.69	46.30	84.67	107.98	114.47
SEm ±	0.11	0.23	0.54	0.65	0.69
CD at 5%	0.35	0.75	1.79	2.15	2.29

observed by Jan *et al.* (2002), Khalil *et al.* (2011) and Iqbal *et al.* (2012).

In case of seed rate and fertilizer combination treatments, significantly taller plants were observed at 30 DAS and 60 DAS in wheat sown with 115% RDF over wheat sown with 100% RDF with either seed rate which was statistically at par with 130% RDF during both the years of study. This might be due to more nitrogen (N) availability resulting in taller plants and enhanced crop growth. Plant height showed direct relation with N and increased with increase of N availability. Similar trend were followed (after fodder cut at 60 DAS) at 90 DAS, 120 DAS and at harvest were observed in wheat sown with 115% RDF over wheat sown with 100% RDF with either seed rate remaining statistically at par with 130% RDF during both the years (Table 3). More than 4.0 per cent higher plant height at maturity was observed in wheat sown at 125 kg/ha seed rate with 130% RDF over wheat sown at 100 kg/ha seed rate with 100% RDF during both the years. Taller plants were observed with higher seed rate.

Leaf area index (LAI)

The data presented in Fig 1 shows that more leaf area was observed in C 306 at 30 and 60 DAS as compared with WH 1105 cultivar. After cutting for fodder at 60 DAS,

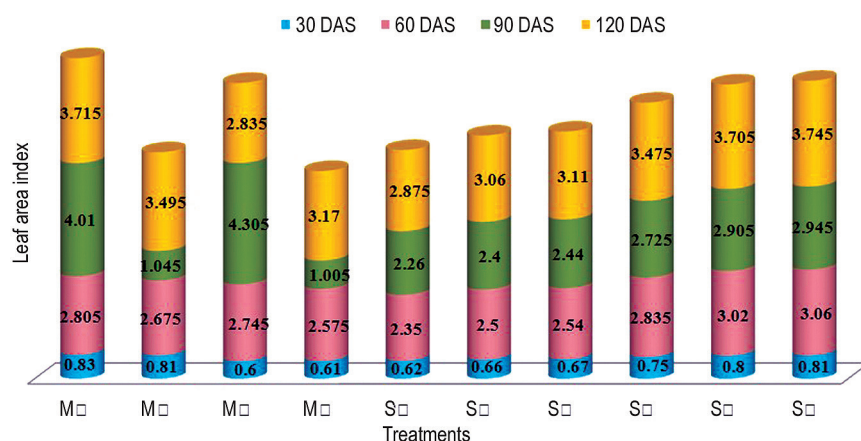


Fig 1 Effect of different seed and fertilizer levels on leaf area index (LAI) in dual purpose wheat (Pooled data of two years).

significantly more leaf area was observed under no-cut plots with either wheat cultivar at 90 and 120 DAS during both years. The possible reason of more leaf area obtained under no-cut treatment might be the absence of cutting shock with no interruption in which result in or helps in fully developed leaf with large leaf area normal plant growth. In case of cultivars, significantly more leaf area was observed in WH 1105 cultivar as compared to C 306 at 90 DAS which might be due to more number of tillers in WH 1105, while at 120 DAS, leaf area in C 306 was lesser as compared to WH 1105 during both years which might be due the fact that C 306 is longer duration variety as compared to WH 1105.

In case of seed rate and fertilizer combination treatments, significantly more leaf area was observed in wheat sown with 115% RDF at 30 DAS and 60 DAS over wheat sown with 100% RDF with either seed rate which was statistically at par with 130% RDF during both the years of study. Similar trend was followed by sown with 115% RDF over wheat sown with 100% RDF with either seed rate remaining at par with 130% RDF during both the years of study (after fodder cut at 60 DAS) at 90 DAS and 120 DAS wheat. At 120 DAS, 30.26 per cent higher leaf area index was observed in wheat sown at 125 kg/ha seed rate with 130% RDF over wheat sown at 100 kg/ha seed rate with 100% RDF during both the years. Wheat sown with higher seed rate recorded more leaf area during both years. The result collaboration with the finding of Guru *et al.* (1999) that the significant increase in leaf area was recorded which was found to be more responsive with the increase in the level of nitrogen. Somarin *et al.* (2009) also observed that with increasing nitrogen application number of leaf, tiller along with the leaf chlorophyll content were increased. Demari *et al.* (2018) also observed similar results.

Total number of tillers/m.r.l

The perusal of data presented in Table 4 show that among different cultivars, more number of tillers was observed in WH 1105 at 60 DAS as compared with C 306 cultivar during both years. After cutting for fodder at 60 DAS, significantly more number of tillers were observed

under no-cut plots with either wheat cultivar at 90, 120 DAS and at harvest during both years which might be due to the absence of cutting shock with no interruption in normal plant growth under no-cut situation. In case of cultivars, significantly more number of tillers was observed in WH 1105 cultivar as compared to C 306 throughout crop season before and after cut at 60 DAS during both years.

While comparing the seed rate and fertilizer combination treatments, significantly more number of tillers were observed in wheat sown with 115% RDF over wheat sown with 100% RDF at 60 DAS with either

seed rate which was at par with 130% RDF during both the years of study. Ali *et al.* (2010) also observed that enhanced dose of nitrogen led to an increased number of productive tillers. Similar trend of significantly more number of tillers (after fodder cut at 60 DAS) at 90 DAS, 120 DAS and at harvest were observed in wheat sown with 115% RDF over wheat sown with 100% RDF with either seed rate remaining at par with 130% RDF during both the years of study. Higher seed rate of wheat recorded more number of tillers during both years because more number

Table 4 Effect of different seed rate and fertilizer levels on total number of tillers /m.r.l. in dual purpose wheat (Pooled data of two years)

Treatment	Number of tillers/m.r.l.			
	60 DAS	90 DAS	120 DAS	At harvest
C 306 without cut	89.55	81.33	77.08	75.53
C 306 with cut at 60 DAS	86.62	78.67	74.55	73.07
WH 1105 without cut	107.98	101.30	96.00	94.08
WH 1105 with cut at 60 DAS	105.72	99.18	93.99	92.11
SEm ±	0.62	0.53	0.49	0.46
CD at 5%	1.98	1.68	1.57	1.50
100 kg/ha seed rate + 100% RDF	95.27	88.09	83.48	81.80
100 kg/ha seed rate + 115% RDF	97.49	90.14	85.42	83.72
100 kg/ha seed rate + 130% RDF	98.56	91.13	86.36	84.63
125 kg/ha seed rate + 100% RDF	96.24	88.99	84.33	82.64
125 kg/ha seed rate + 115% RDF	98.13	90.73	85.99	84.27
125 kg/ha seed rate + 130% RDF	99.12	91.65	86.86	85.12
SEm ±	0.45	0.38	0.35	0.34
CD at 5%	1.42	1.21	1.12	1.08

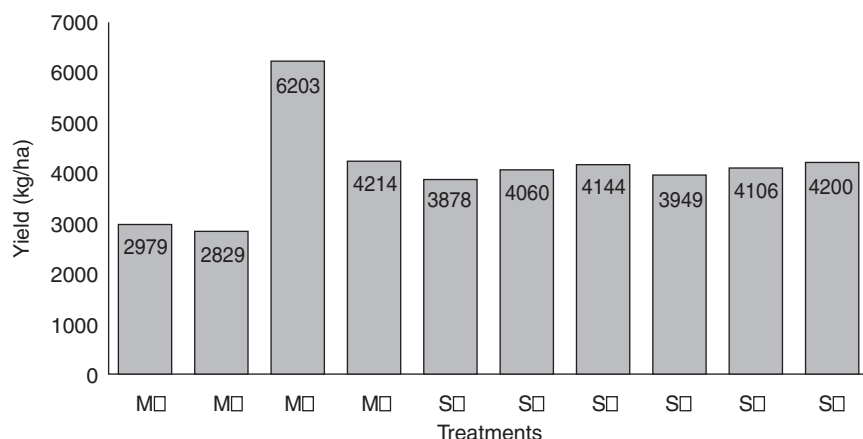


Fig 2 Effect of different seed and fertilizer levels on grain yield in dual purpose wheat (Pooled data of two years).

of seeds per unit area. Production of more total number of tillers per meter row length may be due to sufficient resources allocation in terms of time and nutrients needed for development of secondary tillers. These results are in agreement with Khalil *et al.* (2011), Iqbal *et al.* (2012) and Naveed *et al.* (2014).

Grain yield (kg/ha)

The perusal data presented in Fig 2 show the effect of different seed and fertilizer levels on grain yield of dual purpose tall and dwarf wheat. Significantly higher grain yield of both the wheat cultivars was observed in no-cut plots as compared with cut-plots with either seed rate. The reason for getting higher crop yield in no cut plots might be due to increased plant height, leaf area and CGR which ultimately increased total biomass of plant and hence straw yield.

Among cultivars, significantly more loss in grain yield due to cut (for green fodder) was observed in WH 1105 as compared with C 306. Result show the significantly 108.2 per cent higher grain yield, respectively were observed in WH 1105 over C 306 under without cut condition during both the years which might be due to lodging of tall wheat which resulted in reduction of partitioning and decreased translocation of assimilates to sink (Sangwan 2018). Significantly more loss in crop yield, particularly grain yield, due to cut (for green fodder) was observed in WH 1105 as compared with C 306 cultivar and it might be due to poor regeneration growth of WH 1105 as compared to C 306. In case of seed rate and fertilizer combination treatments, significantly higher grain yield was observed in wheat sown with 115% RDF over wheat sown with 100% RDF with either seed rate which remained significantly lower than 130% RDF. Higher N has a positive effect on dry matter production of wheat crop. Higher seed rate of wheat resulted in higher yield of wheat. Also, higher seed rate resulted into higher wheat yield with higher fertilizer levels during both the years. These findings are in collaboration with Afridi *et al.* (2010), Khalil *et al.* (2011), Choudhary and Suri (2014) and Atis and Akar (2018).

Conclusion

From the findings it can be concluded that cut management significantly reduced the grain yield of wheat. Production potential of tall wheat (C 306) is less than dwarf wheat (WH 1105). Whereas, among different seed rates and fertilizers levels, wheat sown at 100 kg/ha seed rate with 115 per cent RDF gave statistically at par yield of wheat sown at 125 kg/ha seed rate with 130 per cent RDF under either cut management.

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