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Harender
Department of Agronomy, CCS Haryana Agricultural University, Hisar, Haryana, India

VS Hooda
Department of Agronomy, CCS Haryana Agricultural University, Hisar, Haryana, India

Amit Sodhi
Department of Agronomy, CCS Haryana Agricultural University, Hisar, Haryana, India

Kavinder
Department of Agronomy, CCS Haryana Agricultural University, Hisar, Haryana, India

Kavita
Department of Soil Science, CCS Haryana Agricultural University, Hisar, Haryana, India

Corresponding Author:
Harender
Department of Agronomy, CCS Haryana Agricultural University, Hisar, Haryana, India

Effect of seed rate and fertilizer levels on crop growth rate (CGR) and quality of dual purpose wheat (*Triticum aestivum* L.)

Harender, VS Hooda, Amit Sodhi, Kavinder and Kavita

Abstract
The experiment was conducted at Research Farm of Department of Agronomy, CCSHAU, Hisar during *rabi* season of the year 2017-18 and 2018-19 to study the effect of tall and dwarf wheat (*Triticum aestivum* L.) for dual purpose under different seed and fertilizer levels on CGR, protein and crude protein content. The field experiment was conducted in split plot design with two varieties i.e. C 306 and WH 1105 with cut management taken as main plot and different seed with various fertilizer levels as sub plot. Among various cultivars treated with different cut condition, significantly higher protein (12.03 and 11.85%) and crude protein (11.85 and 11.22%) content were obtained in WH 1105 cultivar under without cut condition over C 306 cultivar without cut during 2017-18 and 2018-19, respectively. Significantly higher crop growth rate 2.03 and 8.81; 1.99 and 8.42 g/m^2/day for the period between 0-30 and 31-60 DAS, respectively was observed in C 306 cultivar over WH 1105 during subsequent years. Whereas for the period between 61-90, 91-120 DAS and 121-at harvest significantly higher crop growth rate (12.16, 28.51 and 13.72; 11.09, 26.41 and 13.23 g/m^2/day, respectively) was observed in WH 1105 over C 306 during 2017-18 and 2018-19, respectively. In case of seed rate and fertilizer combination treatments, significantly higher protein (11.53 and 11.24%) and crude protein (11.28 and 10.76%) content and crop growth rate (1.95, 8.68, 8.82, 20.57 and 10.10; 1.91, 8.30, 7.98, 19.05 and 9.80 g/m^2/day for the period between 0-30, 31-60, 61-90, 91-120 DAS and 121 DAS-at harvest, respectively) was observed in wheat sown at 125 kg/ha seed rate with 130% RDF during 2017-18 and 2018-19, respectively.

Keywords: Crude protein, CGR, fertilizer, Protein content and Seed rate

Introduction
In India, agriculture remains the pre-dominant occupation for vast sections of the population. Several new challenges have emerged before the sector over the years. In the past few years the contribution of agriculture and allied sector has steadily come decline from 36.4 per cent in 1982-83 to 14.46 per cent in 2018 (Planning commission, GOI year, 2016-17), however, this sector still provides employment to a large chunk of workforce i.e. 43.86 per cent (FAO STAT, 2018). On the other hand, the population of India is steadily on the rise. Thus, agriculture in India is facing dual challenge of steadily making provisions of food security to a burgeoning population along with generating income for a majority of workforce. 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.

Wheat (*Triticum aestivum* L.) is one of the most important crops among cereals. India is the second largest producer of wheat in the world next to China contributes about 35 per cent of the total food grains produced in the country. India constitutes 13 per cent of the global wheat sown area and about 12.5 per cent of the global production. The area, production and productivity of wheat is 2.44 mha, 10.76 mt and 4413 kg/ha, respectively in Haryana and 29.95 mha, 99.87 mt and 3368 kg/ha, respectively in India (FAO STAT, 2017-18). India's wheat production and area under cultivation has become relatively stagnant in the recent years. Further, the wheat export has declined by 79 per cent over previous years' as pointed out by 2015-16 report of department of commerce.

Dual purpose crops are an attractive management option for farmers because the forage is of high nutrition, which is conducive to livestock weight gain, it provides an alternative source of feed during a feed gap period, the reduced stubble load can benefit the sowing operation of the

following crop, and the dual incomes from grain and livestock improve farm profit compared with a grain-only system (Harrison *et al*., 2011) [10]. Wheat can be grown for three very important Purposes: a) cool-season forage for livestock, b) used as a regular crop for grain and straw, c) used for dual purpose green fodder during vegetative stage as well as regular crop. In India, wheat is usually grown as stable food but can be additionally grown for green fodder for livestocks as well (Shuja *et al*., 2010).

Materials and Methods

The present investigation entitled "Evaluation of tall and dwarf wheat (*Triticum aestivum* L.) for dual purpose under different seed and fertilizer levels" was studied at Research farm of Department of Agronomy, CCSHAU, Hisar during Rabi season of the year 2017-18 and 2018-19. The field experiment was conducted in split plot design with two varieties i.e. C 306 and WH 1105 taken as main plot with cut management and different seed with various fertilizer levels as sub plot.

Protein content in grain was determined from the percent N determined in the grain by Kjeldahl method (Bremner, 1996) with the following relationship:

Grain protein content = N% × 6.25

Crude protein was determined from the percent N determined in the grain by Kjeldahl method (Bremner, 1996) with the following relationship:

Crude protein content = N% × 5.83

Result and Discussion

Protein and crude protein content in grain (%)

The perusal data on the effect of different seed and fertilizer levels on protein content and crude protein content in grain of dual purpose tall and dwarf wheat in 2017-2018 and 2018-19 is presented in Table 2. Protein content and crude protein content in grain was significantly influenced by different seed rates and fertilizer levels. Among various cultivars treated with different cut condition, significantly higher protein (12.03 and 11.85%) and crude protein (11.22 and 11.06%) content were obtained in WH 1105 cultivar without cut over either cultivar sown at with or without cut during 2017-18 and 2018-19, respectively. While minimum protein (10.87 and 10.64%) and crude protein (10.13 and 9.92%) content were recorded in C 306 cultivar with cut at 60 DAS over rest of other combination during 2017-18 and 2018-19, respectively. Reduction in protein content in grain might be due to removal of photosynthetic organs by clipping which negatively affects the source sink relationship. Similar results were observed by Fisher *et al.* (1993), Atis and Akar (2018) and Waheddullah *et al.* (2018).

Table 1: Effect of different seed and fertilizer levels on protein content and crude protein in grain of dual purpose tall and dwarf wheat (2017-18 and 2018-19)

Treatment	Protein content in grain (%)		Crude protein in grain (%)	
	2017-18	2018-19	2017-18	2018-19
C 306 without cut	11.45	11.26	10.68	10.50
C 306 with cut at 60 DAS	10.87	10.64	10.13	9.92
WH 1105 without cut	12.03	11.85	11.22	11.06
WH 1105 with cut at 60 DAS	11.04	10.77	10.30	10.05
S.E m ±	0.06	0.05	0.05	0.05
C.D.at 5%	0.20	0.18	0.18	0.17
100 kg/ha seed rate + 100% RDF	11.22	11.01	10.46	10.27
100 kg/ha seed rate + 115% RDF	11.38	11.16	10.61	10.41
100 kg/ha seed rate + 130% RDF	11.53	11.28	10.77	10.52
125 kg/ha seed rate + 100% RDF	11.11	10.98	10.37	10.24
125 kg/ha seed rate + 115% RDF	11.33	11.15	10.57	10.40
125 kg/ha seed rate + 130% RDF	11.51	11.24	10.74	10.48
S.E m ±	0.02	0.01	0.01	0.01
C.D.at 5%	0.05	0.04	0.03	0.03

In case of seed rate and fertilizer combination treatments, significantly higher protein (11.53 and 11.28%) and crude protein (10.76 and 10.52%) content were obtained in wheat sown at 125 kg/ha seed rate with 130% RDF over wheat sown at rest of the either seed rate with either fertilizer levels during 2017-18 and 2018-19, respectively.

Crop growth rate (CGR)

The perusal data presented in Table 1 shows the effect of different seed and fertilizer levels on crop growth rate of dual purpose tall and dwarf wheat for period between 0-30, 31-60, 61-90, 91-120 DAS and 121 DAS-at harvest during 2017-18 and 2018-19. In case of both cultivars, significantly higher crop growth rate(2.03 and 8.81; 1.99 and 8.42 g/m^2/day) was observed in C 306 cultivar without cut over WH 1105 for the period between 0-30 and 31-60 DAS (before harvest), respectively whereas during 61-90, 91-120 and 121-at harvest significantly higher crop growth rate (12.16, 28.51 and 13.72; 11.09, 26.41 and 13.23 g/m^2/day, respectively) was observed in WH 1105 over C 306.

In case of seed rate and fertilizer combination treatments, significantly higher crop growth rate (1.95, 8.68, 8.82, 20.57 and 10.10; 1.91, 8.30, 7.98, 19.05 and 9.80 g/m^2/day) was observed in wheat sown at 125kg/ha seed rate with 130% RDF for the period between 0-30, 31-60, 61-90, 91-120 DAS and 121 DAS-at harvest, respectively which was statistically at par with wheat sown at 125 kg/ha seed rate with 115 RDF and wheat sown at 100 kg/ha seed rate with 130% RDF during both the years except for the period between 61-90 DAS during 2017-18 and lowest crop growth rate (1.89, 8.32, 7.92, 19.20 and 9.99; 1.85, 7.96, 7.14, 17.78 and 7.88 g/m^2/day) was observed in wheat sown at 100 kg/ha seed rate

with 100% RDF for the period between 0-30, 31-60, 61-90, 91-120 DAS and 121 DAS-at harvest, respectively. It may possible due to lesser competition amongst crop plant occurs with improvement in availability of nutrients. These results are in agreement with Rai *et al.* (2018) [13] and Demari *et al.* (2018) [5].

Table 2: Effect of different seed and fertilizer levels on crop growth rate (g/m$^{2/}$day) of dual purpose tall and dwarf wheat

Treatment	Crop growth rate (g/m^2/day)									
	2017-18					2018-19				
	0-30 DAS	0-30 DAS	31-60 DAS	61-90 DAS	91-120 DAS	121 DAS-at harvest	31-60 DAS	61-90 DAS	91-120 DAS	121 DAS-at harvest
C 306 without cut	2.03	8.81	9.39	17.42	7.72	1.99	8.42	8.50	16.11	7.37
C 306 with cut at 60 DAS	1.97	8.37	6.74	14.71	5.73	1.93	8.00	6.04	13.61	5.43
WH 1105 without cut	1.87	8.74	12.16	28.51	13.72	1.83	8.36	11.09	26.41	13.23
WH 1105 with cut at 60 DAS	1.81	8.19	5.28	19.13	9.91	1.78	7.83	4.68	17.73	9.72
S.E m ±	0.01	0.06	0.10	0.15	0.18	0.01	0.06	0.09	0.14	0.16
C.D.at 5%	0.04	0.19	0.38	0.44	0.59	0.04	0.18	0.35	0.41	0.53
100 kg/ha seed rate + 100% RDF	1.89	8.32	7.92	19.20	8.23	1.85	7.96	7.14	17.78	7.88
100 kg/ha seed rate + 115% RDF	1.93	8.52	8.41	19.96	9.33	1.89	8.15	7.59	18.48	8.96
100 kg/ha seed rate + 130% RDF	1.94	8.62	8.62	20.30	9.99	1.90	8.25	7.79	18.80	9.63
125 kg/ha seed rate + 100% RDF	1.89	8.43	8.03	19.44	8.56	1.86	8.06	7.25	18.00	8.26
125 kg/ha seed rate + 115% RDF	1.93	8.59	8.56	20.19	9.42	1.89	8.21	7.74	18.69	9.08
125 kg/ha seed rate + 130% RDF	1.95	8.68	8.82	20.57	10.10	1.91	8.30	7.98	19.05	9.80
S.E m ±	0.01	0.04	0.06	0.16	0.15	0.01	0.04	0.06	0.14	0.14
C.D.at 5%	0.03	0.14	0.22	0.45	0.46	0.03	0.13	0.20	0.42	0.42

Conclusion

From the finding it was concluded that cut treatments significantly reduced the crop growth rate (CGR), protein and crude protein content in wheat grain

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