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PERFORMANCE OF WHEAT CULTIVARS UNDER IRRIGATED LATE SOWN CONDITION

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ABSTRACT

Delay in time of sowing in rice-wheat cropping system is perhaps the one of the major factors responsible for low crop yield. An experiment on the wheat cultivars viz. DBW 14, BR 934, HI 1563, HD 2985 and NL was conducted on farmers field under irrigated late sown condition in Kishanganj district of Bihar, India during the *Rabi* season of 2014-15 & 2015-16. Results of study revealed that cultivar HD 2985 had highest grain yield (31.0 q/ha) as compared to the farmers local variety NL (23.20 q/ha). The improvement in yield of wheat under said treatment might be due to favorable growth and yield contributing characters (plant height, effective tillers/m², spike length, number of grains/spike and test weight). This treatment also recorded higher in net return (Rs. 25,500/ha) and B:C ratio (2.32). The cultivar HD 2985 required more number of days to attain development and accumulated maximum degree day at phenophases in wheat. The farmers under test were satisfied with the technology of improved seed of wheat HD 2985 for its cultivation in irrigated late sown condition (10-25 December) for obtaining higher yield and profit.

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1 Introduction

Wheat (*Triticum aestivum* L.) has a prominent position among the cereals that supplement nearly one third of the total world population's diet. It occupies an area of 31.19 million hectares with production of 95.91 million tones and productivity of 3075 kg/ha in India (Anonymous, 2014). It is an important crop of *Rabi* season in Bihar covering an area of 2.26 million hectares with production and productivity of 5.08 million tones and 2251 kg/ha, respectively during 2013-14 (Anonymous, 2014). Wheat has significant area of about 16670 ha in Kishanganj district of Bihar with an average productivity of 1693 kg/ha (Anonymous, 2016). The region specific significant efforts were carried out to reduce the enormous gap between actual production and production potential of wheat cultivars through available technological interventions in different agro-ecological environments. The level of self-sufficiency will not be achieved unless researchers and extension personals manage to make better use of resources in new arena of climate change and appropriate location specific transfer of agricultural technology.

Seasonal fluctuations in temperature have potential impact on the growth stages development and grain yield of crops. Wheat, being a winter cereal requires particular environmental condition for better emergence, growth and flowering and is more vulnerable if exposed to high temperatures during reproductive stages (Kalra et al., 2008). In India, terminal heat stress is a major reason of yield decline in wheat due to delay in planting (Joshi et al., 2007). Late planted wheat suffers drastic yield losses which may exceed to 40-50%. Global climate models predict an increase in mean ambient temperature between 1.8 and 5.8°C by end of this century (Anonymous, 2007). Hobbs & Morris (1996) observed 1% decrease for each day that wheat sowing was postponed after the optimum sowing date (15-20 November). Grain yield was negatively related to the thermal time accumulated above the base temperature of 31°C (Mian et al., 2007). High temperature above 32°C has been reported to reduce grain yield and grain weight (Wardlaw et al., 2002). Shrivelled small grains are produced and different yield associated traits such as tillering, grain weight and grains numbers/spike are reduced. Using this factor 3-4 % loss in yield was reported per 10°C temperature rises above from 15–20°C, it can be calculated that most commercially sown wheat cultivars in India would lose approximately 50 % of their yield potential when exposed to 32–38°C temperature at the crucial grain formation stage (Dwivedi et al., 2015)

The farmers of Kishanganj district generally make delayed in sowing of wheat (10Dec-10 Jan) mainly due to practice of growing long duration paddy varieties, late release of accumulated water and more time consumed for land preparation resulting into poor yield of the crop. In India terminal heat stress is a major

reason of yield decline in wheat due to delayed planting (Joshi et al., 2007). Selection of suitable crop varieties according to the agro-climatic conditions may play crucial role in realizing the optimum production of any crop commodity (Singh et al., 2008). Keeping in the view to improve the productivity of wheat in late sowing condition, this study was arranged to evaluate the new varieties of wheat on farmer's field under irrigated late sown condition in Kishanganj district of Bihar.

2 Materials and Methods

The present investigation was conducted on farmer's field during 2014-15 & 2015-16 for performance of wheat cultivars under irrigated late sown condition in Kishanganj district of Bihar. The experiment was laid out on farmer's field in randomized block design with 10 replications and plot size of 0.1 ha. The four (4) high yielding varieties of wheat namely DBW 14, BR 934, HI 1563 and HD 2985 were tested with farmer's local variety NL. The study area is situated under subtropical climate with extremes of temperature in summer 46°C and in winter 4°C and the area receives the annual precipitation of 1200 - 1400 mm. The crop was grown with recommended seed rate of 125 kg /ha and fertilizer dose of 120:60:40 kg N:P₂O₅:K₂O/ha under irrigated condition. The soil was sandy loam in texture having initial soil fertility status like, pH 6.8, organic carbon 0.48 per cent, available N, P₂O₅ and K₂O 224,18 and 116 kg /ha, respectively. Need based all the agronomic management practices were followed and kept uniform. Meteorological data in cropping period at the experimental site revealed the highest temperature (31.61°C) in March and the lowest (10.47°C) in January and maximum in April (34.70°C) and minimum in January (9.5°C) of 2014-15 and 2015-16, respectively. The crop received rain showers from October to September. Figure 1 and Figure 2 shows the climatic situation

Figure 1 Meteorological observations of rainfall during 2014-15 & 2015-16.

Figure 2 Meteorological observations of temperature during 2014-15 & 2015-16.

during the crop growth period. Plant samples were collected randomly to number of effective tillers/m², length of spike (cm), number of grain/spike, 1000-grain weight (g), grain yield (kg ha⁻¹). The data were analyzed statistically using analysis of variance (ANOVA) and significant means were separated using least significance difference (LSD) test. The heat unit requirement or growing degree day at phenophases of wheat was calculated considering mean maximum and minimum temperature during that day and base temperature (5°C) below which growth does not occur (Pal et al., 1996).

3 Results and Discussion

The cultivar HD 2985 recorded higher grain yield (31.0 q/ha) which was at par with the cultivar HI 1563 (30.20 q/ha) followed by DBW 14 (23.2 q/ha) in comparison to farmers local variety NL (23.20 q/ha). There was 7.2 q/ha (33%) more grain yield produced by cultivar HD 2985 in comparison to farmer's local variety NL. The cultivars showed their significant difference on all yield contributing parameters. The yield attributing characters were also significantly higher in cultivar of HD 2985 with respect to others and poor expression by farmers local variety. The cultivar HD-2985 produced the maximum number of effective tillers/m² (329), number of grain per spike (52), spike length (30cm) and 1000-grain weight (42.6g) are reported minimum in farmer's local variety NL (Table 1).

The different wheat cultivars influenced the days taken to phenophases, 50% flowering and maturity in wheat as a result the

Table 1 Performance of five wheat cultivars on yield and yield attributing characters

Sl. No.	Varieties	No. of effective tillers/m ²	Length of spike (cm)	No. of grain/spike	1000-grain wt. (gm)	Grain Yield (q/h)
1.	Farmers local(NL)	302	17	30	36.6	23.2
2.	DBW 14	305	16.5	34	37.2	25.2
3.	BR-934	314	20.0	39	41.0	26.8
4.	HI 1563	318	25.4	46	41.8	30.2
5.	HD-2985	329	30.0	52	42.6	31.0
	CD at 5%	3.5	2.7	1.7	0.8	6.3

Data given in table are mean of two years

heat unit requirement at respective phenophases. The cultivar HD 2985 and NL take 72 and 115 days for 50 % flowering and maturity stage, respectively. HD 2985 required more degree days (897.7 degree day) for 50% flowering and 1741.9 degree day at maturity in comparison to that of other cultivars (Table 2). Results of present study are in agreement with the findings of Sattar et al. (2010). High temperature induces modifications in plants may be direct as on existing physiological process or indirect in changing the pattern of development (Downton & Slatyer, 1972). High temperature affects the period of grain filling and fertilization process resulting in reduced development of grain ultimately decreasing the crop yield.

Table 2 Days taken to phenophases and heat unit requirement of wheat cultivars

Varieties	Days to Phenophase		Heat unit requirement (degree day)	
	50% Flowering	Maturity	50% Flowering	Maturity
Farmers Local(NL)	72	110	897.7	1634.9
DBW 14	71	108	878.0	1590.6
BR 934	70	106	860.4	1549.1
HI 1563	71	112	878.0	1677.0
HD 2985	72	115	897.7	1741.9

Maximum net return with B:C ratio was obtained under HD-2985 (Rs.25500/ha with 2.32) followed by HI 1563 (Rs.24390/ha with 2.25), BR934 (Rs.19490/ha with 2.01), DBW 14 (Rs.17140/ha with 1.88) and minimum by farmers variety NL (Rs. 15340/ha with 1.84)(Table 3).

The early sowing resulted in better development of the grain due to longer growing period. This is because of the fact that timely sown wheat had more time for dry matter accumulation to produce higher grain yield (Spink et al., 2000; Shahzad et al.,

2002). The differential behavior of wheat genotypes with heat stress environment in eastern indo-gangetic plains of Bihar have been reported by Dwivedi et al. (2015). It is believed to have a protected role under environmental stress in late planting wheat (Reynold et al., 2001). There is direct linear relationship of growth and rate of development of crop with temperature (Castillo & Santibanez, 1987). The concept of heat unit requirement is based on idea that plants have definite temperature regime for growth and development. Heat unit requirement is used to predict the onset of different phenophases of crop as a guide in planning strategies for realizing higher yield of the crops. Ghadekar et al. (1992) reported that wheat crop accumulated mean degree day of 1689.80 from sowing to maturity.

In summarizing the above result, it could be stated that cultivar HD-2985 out yielded others cultivar and performed well under late sown condition in rice-wheat cropping system. The farmers under test were satisfied with the technology of improved wheat cultivar HD 2985 for its cultivation in irrigated late sown condition (10-25 December) for obtaining higher yield and profit.

Conclusion

It is concluded from this study that wheat variety HD-2985 performed well under irrigated late sown condition under rice-wheat cropping system in Kishanganj district of Bihar.

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