RAINFALL PATTERN AND WHEAT PRODUCTIVITY IN UTTARAKHAND (INDIA)

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ABSTRACT

⊕ The rainfall pattern aberrations during Rabi (winter) season (December to March) in north India has become frequent and is a cause of concern to administrators and researchers. Field experiments were laid down in Factorial Design during 2013-14 and 2014-15 at the Demonstration Farm of IIT Roorkee with treatment combinations including four wheat varieties (PBW-292 (V1), HD-2967 (V2), PBW-154 (V3) and PBW-550 (V4)), three sowing dates (20 November (D1), 5 December (D2) and 20 December (D3)) and three replication.

⊕ Wheat crop was grown under best management practices. Weather data was recorded from Automated Weather Station installed at the Farm. The total rainfall during the growing season was recorded as 223.7 mm (Jan, 98 mm; Feb 52 mm) during 2013-14 and 234.1 mm (Mar, 115 mm; Apr 62 mm) during 2014-15 .

⊕ The experimental results showed that the average productivity of wheat during 2013-14 was 43.7 q/ha whereas during 2014-15 it was reduced to 37.8 q/ha. Loss in productivity ranged from 11.4% in late sown to 42.1 % in timely sown crop and was caused due to untimely occurrences of rainfall events.

⊕ Yield was also simulated using DSSAT CERES model and the yield recorded compared well with the observed yield during 2013-14 but during 2014-15, the rainfall of March & April caused severe lodging problem in timely sown wheat. Yield loss due to lodging could not be detected by the model.

INTRODUCTION

In the recent years, the climate of Uttarakhand has observed a phenomenal change particularly in the occurrence of rainfall and its pattern (Tripathi et al 2008; Dubey et al 2015). Mode of impacting crop production due to climate change could be innumerable but change coinciding with the unwanted rain at critical growth stages is highly deleterious.

In North India, heavy rainfall during the end of Feb. 2014 deteriorated the keeping quality of potato due to water logging in the fields whereas during the end of March 2015 the rainfall caused substantial damage (15-45%) reduction of wheat grain yield due to lodging.

In view of the above the study entitled " Rainfall Pattern and Wheat Productivity in Uttarakhand (India)" was undertaken to compare the rainfall variability scenario during the growing season and its impact on productivity under field condition and model study.

MATERIALS & METHODS

The field experiment was conducted during 2013-14 and 2014-15 on the Demonstration Farm, Department of Water Resources Development and Management, Indian Institute of Technology Roorkee (India) located at 29.87° N, 77.89° E, The experiment was laid down in Factorial Design with the treatments including 3 dates of sowing (Nov. 20 (D1), Dec 05 (D2) and Dec 20 (D3)) and 4 varieties (PBW 292 (V1), HD 2967 (V2), PBW 154 (V3) and PBW 550 (V4)) and 3 replications.

The soil was well drained sandy loam and normal (pH,7.8; OC, 0.45%, clays 12.5%, soil deep & free from boulders, water table below 5m) in fertility. The crop was grown adopting best agronomic management practices (20 cm apart furrow sown, irrigation as and when required, fertilizer in basal and top dressings, mechanical weed control and pesticides used for aphid control).
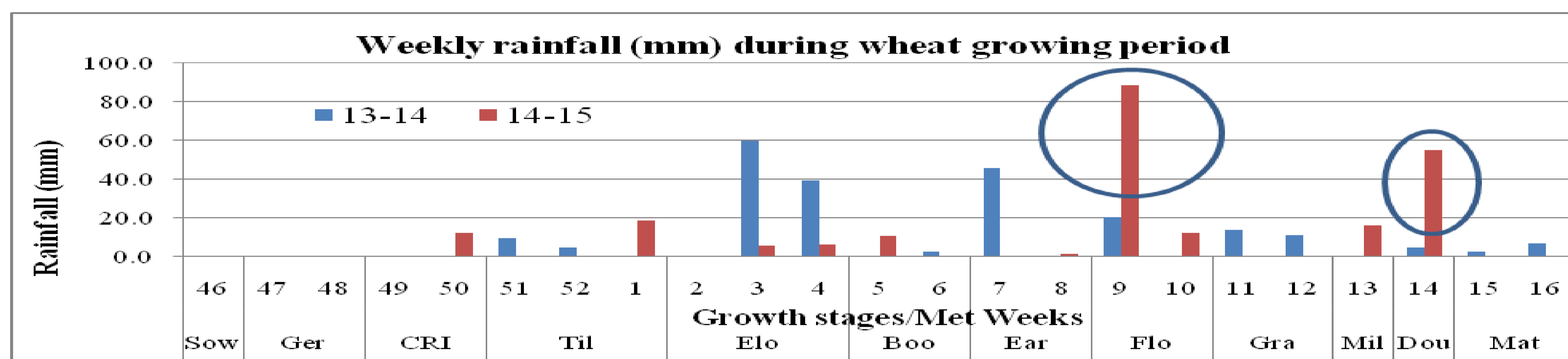
Observations were recorded on crop growth and development, yield (straw & grain) and yield attributes (harvest index, grains/ear head, grain test weight and

RESULTS

YIELD AND YIELD ATTRIBUTES OF WHEAT

Treatment	Observed								DSSAT Predicted Grain Yield (q/ha)	
	Grain Yield (q/ha)		HI		Grains/ear head		Height at Harvest (cm)			
	2013-14	2014-15	2013-14	2014-15	2013-14	2014-15	2013-14	2014-15	2013-14	2014-15
V1D1	52.5	41	0.39	0.26	42.0	41.8	94.7	85	44.9	51.5
V1D2	47.4	30.8	0.37	0.27	46.7	35.4	80.0	69.7	41.7	46.8
V1D3	31.5	30.1	0.32	0.21	47.3	32.1	78.7	82.3	37.4	40.3
V2D1	58.0	54.5	0.29	0.32	44.0	41.9	87.7	87.3	48.9	57.6
V2D2	36.8	36.1	0.31	0.29	45	47.4	84.7	80.7	48.6	56.4
V2D3	40.9	43.2	0.43	0.26	47	48.3	84	78.7	45.6	48.4
V3D1	49.2	43.4	0.42	0.24	46.3	46.4	95.3	81.7	47.4	54.7
V3D2	36.0	25.3	0.31	0.22	46.7	30.4	80.7	72.7	45.3	48.8
V3D3	35.1	31.1	0.34	0.21	50.7	28.8	74.0	74.3	40.3	43
V4D1	62.1	35.9	0.5	0.24	50.7	50.3	92.0	74	52.7	61.4
V4D2	41.0	41.4	0.35	0.33	44.3	45.8	82.0	71.3	53.2	64.5
V4D3	35.6	34.3	0.32	0.22	39.7	43.2	83.0	77.3	51.6	55.1
Mean	43.6	37.7	0.36	0.26	45.9	41	84.7	77.9	46.5	52.4
Test of Significance (p=0.05)									-	-
Dates	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	-	-
Variety	NS	NS	NS	NS	NS	NS	NS	NS	-	-
Interaction	NS	NS	NS	NS	NS	NS	NS	NS	-	-
LSD	3.6	3	0.05	0.04	4.6	5.9	6.4	3.8	-	-

D1= Nov 20, D2= Dec 05, D3= Dec 20; V1=PBW-292, V2= HD-2967, V3= PBW-154 ,V4= PBW-550

Weekly rainfall (mm) during wheat growing period

plant height at harvest etc). This was utilized for validate the Decision Support System for Agro technology Transfer (DSSAT) CERES wheat crop model.

Fig. 2a: Soil misture regime in the root zone of wheat sown on Nov 20

Fig. 2b: Soil misture regime in the root zone of wheat sown on Dec 05

Fig 2c: Soil misture regime in the root zone of wheat sown on Dec 20

Observed and DSSAT simulated grain yield loss/ gain in Wheat during 2014-15 over 2013-14

CONCLUSIONS

The study entitled field and model study of "rainfall pattern and wheat productivity in Uttarakhand (India)" was undertaken with the objectives to compare the rainfall variability pattern during the two growing seasons of wheat (2013-14 & 2014-15) and its impact on productivity of four wheat varieties (PBW-292, HD-2967, PBW-154 and PBW-550) sown on three dates (Nov. 20, Dec.05 and Dec. 20) under field condition and simulating the same using DSSAT CERES wheat model. The total rainfall recorded was 222 mm and 227 mm during 2013-14 and 2014-15 respectively. But the distribution pattern recorded was totally different in two years. Rainfall received from sowing to boot leaf stage was 113.2 mm and 54 mm and flowering to maturity was 109 mm and 173.1 mm during 2013-14 & 2014-15 respectively. Rainfall of 173.1 mm during flowering to maturity during 2014-15 proved to be deleterious by recording 13.6% loss (-2.1% - 42.1%) in wheat productivity. Nov. 20 and Dec. 05 sown crop were severely damaged as compared to Dec. 20 sown crop. Wheat cv HD 2967 was adversely affected only slightly as compared to PBW 292, PBW 154 & PBW 550. Adverse effect was noticed only due to the lodging problem. DSSAT model study of 2013-14 predicted very close to the observed yield. However the model during 2014-15 predicted very high yield which was contrary to the field observation. This is because the model could only account the adequacy of soil moisture in the root zone due to rainfall and was unable to account for the crop lodging situation. These findings suggest planners and administrators to popularize HD2967 cv wheat that has good potential to withstand the rabi season weather aberrations of this area.

REFERENCES

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