

Original Research Article

<https://doi.org/10.20546/ijcmas.2020.908.153>

Effect of Field Topographic Conditions on Plant Height of *Rabi Sorghum* in Vertisols

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ABSTRACT

Keywords

Land levelling, Grid survey, Topographic condition, *Rabi sorghum*, Contours

Article Info

Accepted:
15 July 2020
Available Online:
10 August 2020

A field experiment was conducted in the research farms of Irrigation Water Management Research Center (IWMRC), Belvatagi, University of Agricultural Sciences (UAS) Dharwad during Rabi 2019 to study the effect of field topographic conditions on plant height of *Rabi Sorghum* in vertisols under rainfed situation. Grid survey (10 m X10 m) results in traditionally levelled field indicated that the average reduced level (RL) of field was 98.46 m with range of elevations 98.13 m to 98.80 m and standard deviation of grid elevations of 14.36 cm. The standard deviation of grid elevations (14.36 cm) and 3-D contours indicated more undulations in topographic conditions. The average grid-wise plant height of *Rabi sorghum* was 1.59 m with range of grid - wise average plant heights varying from 1.34 m to 1.81 m with standard deviation of 9.8 cm. It was found that variability of topographic conditions of the field resulted into variability in plant heights of *Rabi sorghum*. This calls for better land levelling methods to achieve more uniformity in the plant heights which would help in achieving uniform and higher crop yields.

Introduction

Environmental factors that affect plant growth include light, temperature, water, humidity, and nutrition. It is important to understand how these factors affect plant growth and development. In agriculture, with other parameters being same, land levelling plays a key role as undulating topography of the fields has a major impact on moisture conservation, water saving, the germination,

plant heights and crop yields. Traditional methods of levelling lands are not only more cumbersome and time-consuming but also more expensive. In irrigated agriculture, the quality of land development or land levelling is having huge impact on soil moisture distribution, storage and variability in the field both spatially and temporally, crop growth, yields and irrigation efficiency. A significant (20-25 %) amount of irrigation water is lost during its application at the farm

due to poor farm design and unevenness of the field (Cook and Peikert, 1960). Scientific land levelling saves irrigation water by facilitating field operations and increasing crop yields (Rickman, 2002). Dynamic levelling parameters such as standard deviation of elevations and levelling index determine the accuracy and quality of land levelling which affects soil moisture distribution and its variability and biometric growth of plants. For enhancing agricultural productivity the yield variability needs to be reduced. So, the present study during *Rabi* 2019 was conducted to assess effect of field topographic conditions on plant height of *Rabi* sorghum in vertisols under rainfed situation in the fields of Irrigation Water Management Research Center (IWMRC), Belvatagi, University of Agricultural Sciences (UAS) Dharwad, Karnataka. This calls for better land levelling methods / technology to achieve more precision and quality of land levelling to reduce spatial variability of plant heights and crop yields (Jat *et al.*, 2004).

Materials and Methods

Grid survey: In the present study, grid survey (10 m X 10 m) of topographic condition has been done. Grids were numbered 0 to 5 (X – Axis *i.e.* from North-South direction) and with letters A to L (Y–Axis *i.e.* West-East direction). Each grid was labelled with its 4 corners *e.g.* AB12 indicating Rows A and B with 1 and 2 points. A field topographic survey with the help of auto level was carried out to find quality of traditional land levelling by knowing range of elevations as well as standard deviation of grid elevations.

Crop variety M-35-1 of *Rabi* sorghum was sown in the first week of November 2019 in block A3 of IWMRC Belavatagi. Irrigation Water Management Research Center Belvatagi, with latitude 15° 34' N : longitude of 75° 21' E and an altitude of 578 m above

MSL, falls under Northern dry Zone (Zone-3) of Karnataka. The particulars of selected field are presented in Table 1. The experiment was taken up in deep black soils under rainfed situation. The crop was harvested in the first week of April, 2020. No irrigation was given as sufficient soil moisture was observed as frequent rains (15 rainy days) were received for the crop. The total rainfall received was 293 mm, 91 mm and 6 mm in the months of October, November and December 2019, respectively. Also, grid-wise average plant height (4 plants in each grid before harvesting) data was collected to know variability of biometric observations. Contour maps with 5 cm contour interval for elevations and plant heights were plotted using the Golden Surfer software.

Results and Discussion

During the present study emphasis was on assessing the effect of field topographic conditions on plant height of *Rabi* sorghum in vertisols.

A. Spatial variability of topographic conditions of the field:

The topographic survey readings (reduced levels in m) for all grid points are presented in Table 2. For a subjective assessment of accuracy of traditional land levelling and grid-wise yield variations, contour maps were plotted using the SURFER 8.0 package. The contour maps for grid elevations (3-D) were shown in Fig. 1. From contour maps it was observed that the land levelling was not so accurate as the undulations on the field were relatively more with closer contours. This was further confirmed with the results obtained from standard deviation of the surveyed readings. Results indicated that the average reduced level (RL) of entire field was 98.46 m with range of elevations 98.13 m to 98.80 m and standard deviation of grid elevations of

14.36 cm. Higher standard deviation (14.36 cm) of grid elevations (RLs) and contours (3-D) indicated more spatial variability with topographic undulations. The same inferences were observed by Kanannavar *et al.*, (2012). So, better land levelling methods / technology to achieve more precision and quality of

levelling to reduce spatial variability of topographic conditions and crop growth and yields. This is in agreement with the findings of Agarwal and Goel (1981)

B. Spatial variability of average grid-wise plant heights of *Rabi* sorghum:

Table.1 Particulars of selected field

Parameters	Values
Bulk density g/cc	1.40
Soil type	Deep black soil
Length of field, m	110
Width of field, m	60
Area of field, m ²	6600
Range of elevation of grid points, cm	-33 to 34
Maximum RL, m	98.80
Minimum RL, m	98.13
Standard deviation, cm	14.36

Table.2 Survey readings of grid points (RL, m) of the experimental plot

Grid point X-axis Y-axis	Reduced levels of grid points in m					
	0	1	2	3	4	5
A	98.80	98.60	98.61	98.69	98.56	98.55
B	98.59	98.54	98.60	98.58	98.52	98.56
C	98.59	98.49	98.63	98.57	98.52	98.61
D	98.60	98.54	98.61	98.60	98.48	98.64
E	98.56	98.51	98.62	98.53	98.49	98.59
F	98.51	98.45	98.52	98.50	98.45	98.54
G	98.52	98.49	98.54	98.50	98.47	98.54
H	98.49	98.42	98.5	98.45	98.40	98.48
I	98.56	98.47	98.42	98.41	98.34	98.38
J	98.25	98.34	98.36	98.29	98.28	98.14
K	98.33	98.26	98.28	98.32	98.34	98.16
L	98.32	98.20	98.21	98.23	98.17	98.13
Overall mean	98.46 m					

Table.3 Grid-wise plant heights of *Rabi Sorghum* (m) in the experimental plot

Grid No.	Average grid wise plant heights of <i>Rabi Sorghum</i> (m)				
	01	12	23	34	45
AB	1.59	1.52	1.60	1.62	1.49
BC	1.55	1.58	1.66	1.48	1.63
CD	1.67	1.50	1.69	1.51	1.58
DE	1.61	1.59	1.66	1.64	1.63
EF	1.68	1.60	1.50	1.52	1.55
FG	1.68	1.56	1.49	1.40	1.61
GH	1.63	1.56	1.70	1.71	1.52
HI	1.57	1.50	1.57	1.69	1.53
IJ	1.67	1.48	1.47	1.59	1.52
JK	1.56	1.76	1.65	1.68	1.49
KL	1.81	1.75	1.76	1.36	1.34
Overall mean	1.59 m				

Fig.1 Three dimensional (3-D) contours for grid elevations of experimental plot

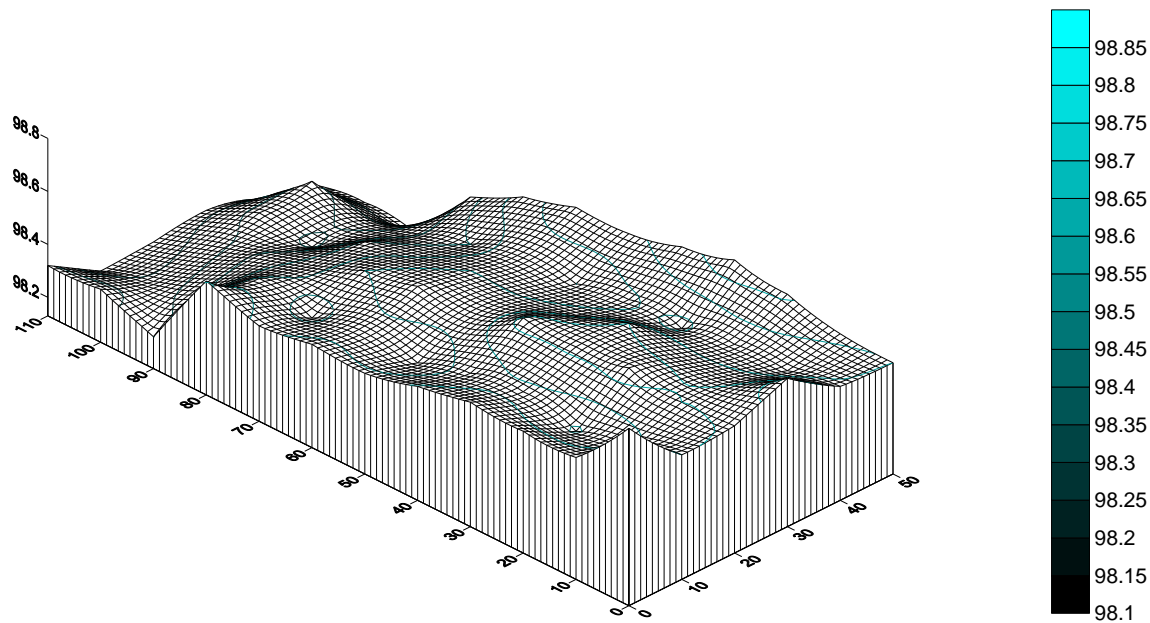
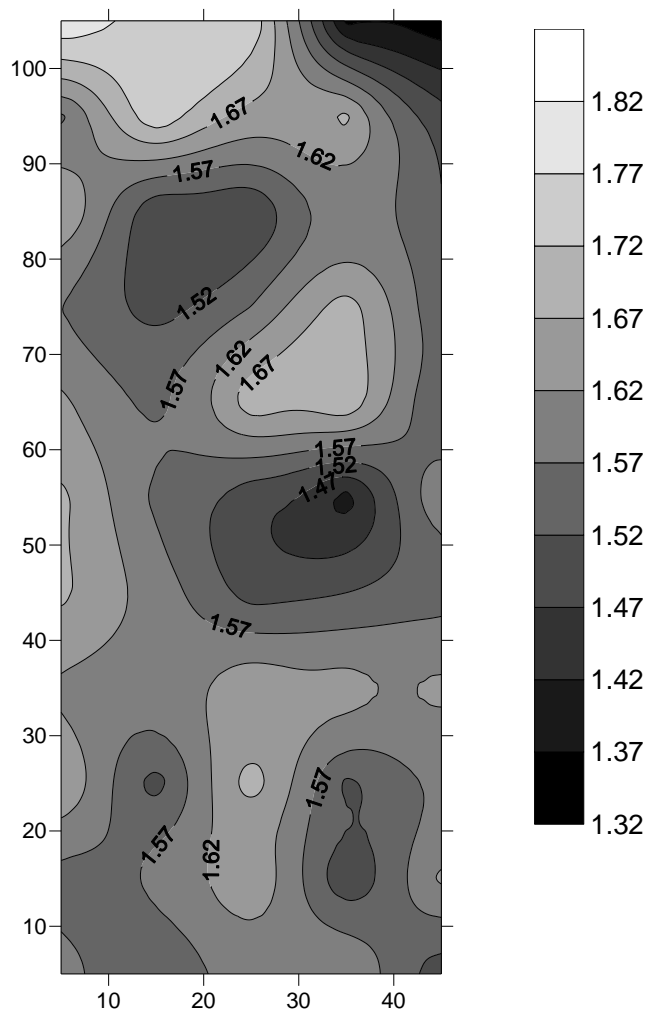


Fig.2 Two dimensional (2-D) contours for grid-wise plant height (m) of Rabi Sorghum



The results got from the study with respect to grid-wise plant heights of *Rabi* sorghum (m) in experimental plot are presented in Table 3. The contour maps for grid-wise plant height were shown in Fig. 2. The average grid-wise plant height of *Rabi* sorghum was 1.59 m with range of grid - wise average plant heights varying from 1.34 m to 1.81 m with standard deviation of 9.8 cm. With all agronomic practices being same, it was found that variability of topographic conditions of the field resulted into variability in plant heights of *Rabi* sorghum. This was due to non-uniform soil moisture conservation due to undulations in the field as observed with

higher spatial variability of topographic conditions (standard deviation of grid elevations as high as 14.36 cm). Thus the effect of microtopography of the field affects soil moisture distribution, crop growth parameters and ultimately crop yields. The same inferences were corroborated by Ramos and Casasnovas (2006).

Conclusions are as follow:

Quality of land levelling is very important in rainfed agriculture to ensure uniform and higher soil and water conservation for uniform crop growth.

It was observed from contour maps and from higher values of standard deviation of reduced levels that considerably lower accuracy in traditional land levelling as it depended on the skill of the driver.

Precise land development techniques are needed to address spatial variability of topographic conditions prevalent in agricultural fields and to achieve uniform crop growth.

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How to cite this article:

Kanannavar, P. S., B. C. Punitha and Shanawad, U. K. 2020. Effect of Field Topographic Conditions on Plant Height of Rabi Sorghum in Vertisols. *Int.J.Curr.Microbiol.App.Sci*. 9(08): 1349-1354. doi: <https://doi.org/10.20546/ijcmas.2020.908.153>