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Research Article

EFFECT OF BASIN LISTING TECHNOLOGY FOR *IN SITU* MOISTURE CONSERVATION IN VERTISOLS

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Abstract: One of the effective soil and water conservation practice is the preparation of basins in the field. The two adjacent side bunds running across the main slope are connected by cross bunds at regular intervals. Thus, the entire field is divided into number of basins. When rainfall occurs, the water is stored in the basins to infiltrate into the soil by preventing surface runoff. At the same times the loss of soil due to erosion is also prevented. At present the work of constructing basins is done manually which is laborious, time consuming and costly. In view of this the machine was developed which is operated by the tractor, which will form the side bunds and the cross bund simultaneously The tractor drawn basin lister is suitable to form a basin of 6 x 2 m size in dry land agriculture for *in situ* moisture conservation. The developed machine was evaluated for the *in situ* moisture conservation in the vertisols at Solapur (Maharashtra, India). The observation shows that the average soil moisture for the weekly interval at 0-15 cm soil depth for basin listing and flatbed are 29.10 % and 26.43 % respectively and the average soil moisture for the weekly interval at 15-30 cm soil for basin listing and flatbed was 33.69 % and 30.46 % respectively. The basin technology increased soil moisture by 10.12% over flatbed method with a coefficient of variation of 28.75 % at 0-15 cm soil depth whereas at 15-30 cm soil depth the soil moisture was increased by 10.61 %. This indicates that *in-situ* moisture conservation measures are effective to increase soil moisture compared to flatbed method.

Keywords: *In situ moisture conservation, Basin listing technique*

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Introduction

About 70% of the world's staple food continues and will continue to be harvested from rainfed areas, since the scope for further expansion of irrigation is limited due to growing competition for water and the high investment cost. The importance of rainfed agriculture varies regionally, and is most significant in Sub-Saharan Africa, where it accounts for about 93 % of farmed land, 87 % in Latin America, 67 % in the Near East and North Africa, 65 % in East Asia and 58 % in South Asia. Most countries depend primarily on rainfed agriculture for their food grains. About 30 % of the world's land surface, or 4.2 billion ha, is suitable for rainfed agriculture. In the absence of adequacy of water resources for irrigation, rainfed farming is practiced in nearly two third of the arable land (96 MHz) in India. The gross cropped area of the country is 182 Mha. Out of an estimated 142 Mha net cultivated area, about 67 % is rainfed. In this, 76 Mha is under irrigation. The National Commission on Agriculture in 1976 predicted that even when the full irrigation potential is tapped by 2013 AD, over 50 % of the arable land would continue to remain rainfed in the foreseeable future. So far much of the agricultural growth achieved in past decades occurred in irrigated areas. The potential for additional production gains in these areas may lessen with time from inherent problems. It is in the rainfed belt where cultivation of coarse cereals (91%), pulses (91%), oilseeds (80%) and cotton (65%) predominates. About 44% of the total production is contributed by rainfed region. Rainfed agriculture supports 40% of country's population. The rainfed areas are increasingly being warranted to help meet the rising demand for food, pulses, oilseeds, feed, fuel, fruits, vegetables etc. Thus, the country's economy depends on a sustained increase in the productivity from drylands [1]. These data emphasize the crucial role played by rainfed agriculture in India's food security.

Efficient conservation of rain water is the central issue in successful dry land farming. The most efficient and cheapest way of conserving rainfall is to hold it *in situ*. Evaporation losses can also be reduced greatly if rainfall is stored in soil rather than in structures with free water surface. The water available in soil is readily available to plants whereas a large investment would be necessary if water is collected elsewhere and brought to the place of use. One of the effective soil and water conservation practice is the preparation of basins in the field. The two adjacent side bunds running across the main slope are connected by cross bunds at regular intervals. Thus, the entire field is divided into number of basins. When rainfall occurs, the water is stored in the basins to infiltrate into the soil by preventing surface runoff. At the same times the loss of soil due to erosion is also prevented. The machine operated with tractor was developed to form the closed ended basins of 6 x 2 m size automatically. The basins are formed by the developed machine and the retention of soil moisture in the basins prepared with the traditional flatbed method was evaluated in the field.

Materials and Methods

The tractor operated basin listing machine was developed and the performance of the developed machine was evaluated for the *insitu* moisture conservation in the vertisols at Solapur. The Solapur district in Maharashtra State is bounded by 17005' North latitudes and 74°42' East of 76°15' East longitudes. The basins of size 6x2 m was prepared for rainwater conservation in the *Kharif* season and the monitoring of soil moisture was conducted in the experimental fields starting from 17 July 2017 to 25 January, 2018 in the experimental plots and in the traditional method of flat bed. Soil moisture, rainfall was recorded for analysis of soil moisture balance.

Rainfall received

Total rainfall received during the year 2017 was 589.6 mm which was deficit by 18.3 percent as against normal of 721.4 mm. The pre-monsoon rainfall of 17.7 mm (1st January to 3rd June 2017) was received in 05 rainy days which was deficit by 74.89 % against the normal rainfall of 70.5 mm. During the *kharif* season 23rd to 37th MW i.e. from 4th June to 16th Sept., the total rainfall received was 430.6 mm in 21 rainy days which was surplus by 2.35 percent as against normal rainfall of 420.7 mm.

The usual date of onset of monsoon in the state is 7th June, however during the year 2017 the monsoon arrived in Solapur on 4th June which was started in meteorological week no. 23rd (4th June- 10th June). During the year the amount of rainfall received in the month of June was 186.9 mm which was surplus by 74.50 % against normal of 107.1 mm and in the month of July it was 17.4 mm which was deficit by 84.50 % against normal of 115.8 mm. June and July rainfall was useful for regular sowing of all the *Kharif* crops. Further, in the month of August 151.3 mm rainfall received against the normal rainfall 139.5 which was surplus by 8.46 %.

The daily rainfall during the year 2017 was recorded, [Fig-1] shows the graph for daily rainfall received in 2017. The annual, *kharif* and *rabi* season rainfall and monthly rainfall is shown in [Fig-2] and [Fig-3] respectively.

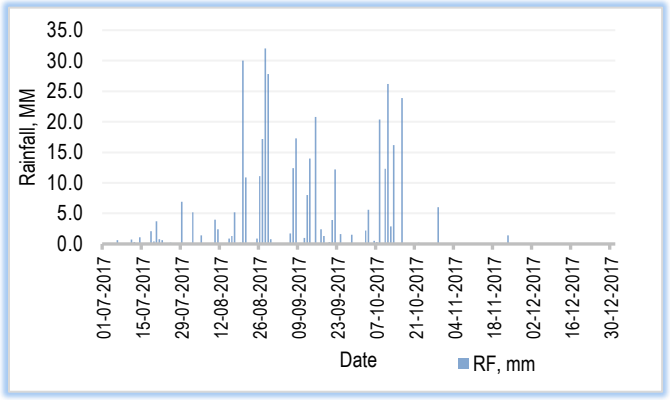

Fig-1 Daily Rainfall for the year 2017

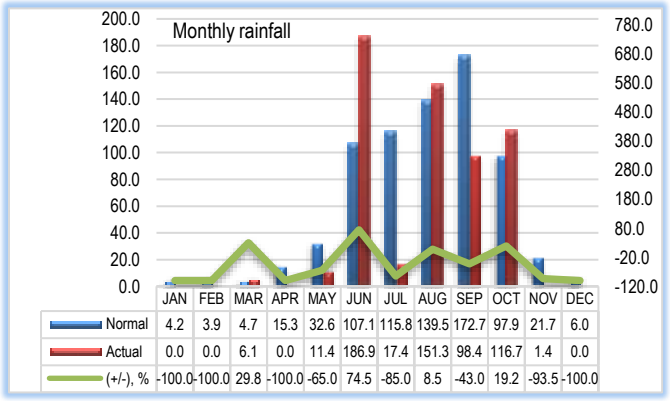

Fig-2 Monthly Rainfall at Solapur

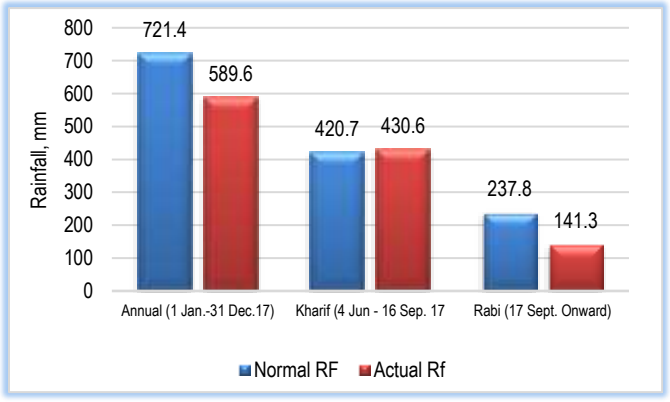

Fig-3 Annual, *Kharif* and *Rabi* season rainfall at Solapur

The moisture content measurements had been done in the laboratory by gravimetric method. Mean soil moisture variations at 15cm and 30 cm soil depth, obtained by variance analysis of the observed data are analysed.

Result and Discussion

Effect of conservation techniques on soil moisture

The observation shows that the average soil moisture for the weekly interval at 0-15 cm soil depth for basin listing and flatbed are 29.10 % and 26.43 % respectively and the average soil moisture for the weekly interval at 15-30 cm soil for basin listing and flatbed was 33.69 % and 30.46 % respectively. Soil moisture fluctuation in the effective soil depth of 15cm depth for basins listing formed by the developed machine and traditional plain flatbed method during the period is presented in [Fig-4]. The basin technology increased soil moisture by 10.12% over flatbed method with a coefficient of variation of 28.75 % at 0-15 cm soil depth whereas at 15-30 cm soil depth the soil moisture was increased by 10.61 %. This indicates that *in-situ* moisture conservation measures are effective to increase soil moisture compared to flatbed method. Results of dispersion of soil moisture from mean are given in [Table-1]. Among the conservation techniques, the flat bed treatment exhibits more fluctuation of soil moisture with coefficient of variation (Cv) of 33.45 % at 0-15 cm soil depth and 22.67 % at 15-30 cm soil depth.

Table-1 *Statistical parameters of soil moisture (%) for basin listing and flat bed*

	0-15 cm		15-30 cm	
	Basin listing	Flat bed	Basin listing	Flat bed
% Change over control	10.13	-	10.61	-
Mean	29.1	26.43	33.69	30.46
Std. Dev	8.37	8.84	7.64	8.12
Cv, %	28.75	33.45	22.67	26.65

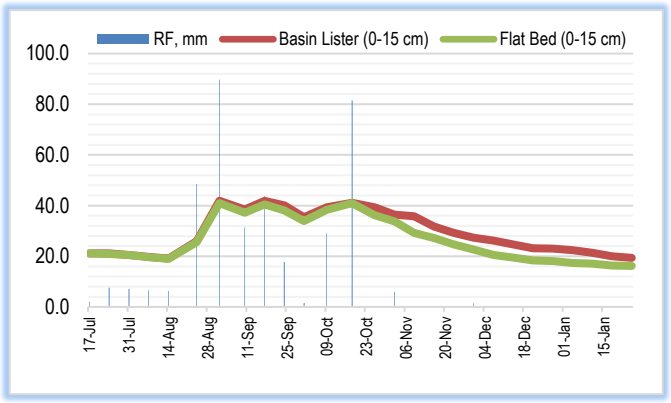

Fig-4 Soil moisture at 0-15 cm depth for basin listing and flat bed

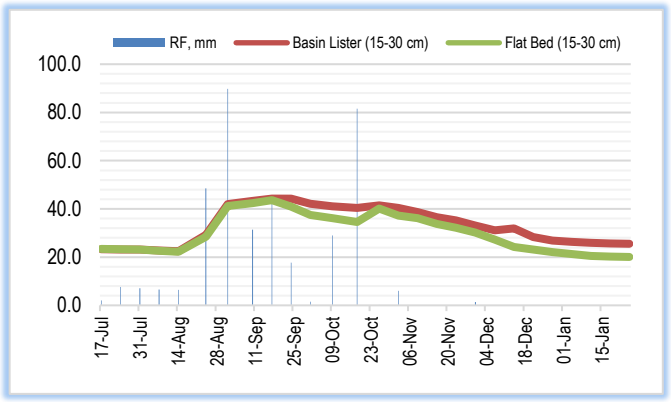

Fig-5 Soil moisture at 15-30 cm depth for basin listing and flat bed

Periodic variation of soil moisture in soil profile

Variation of mean soil moisture % at 15 cm and 30cm depths in both the experimental plots during period irrespective of type of moisture conservation technique is presented in [Fig-4] and [Fig-5]. The statistical data in [Table-1] for both the treatments shows that soil moisture variation in 15 cm and 30 cm is very marginal due to homogeneous soil profile.

Appreciable difference was found due to scattered rains in between the period. Little difference was found during rainy periods. Quantity and Pattern of rainfall influence soil moisture variation in the soil profile. Analysis of dispersion by coefficient of variation indicates that degree of mean soil moisture fluctuation is moderately more at 15 cm depth compared to 30cm irrespective of type of conservation technique.

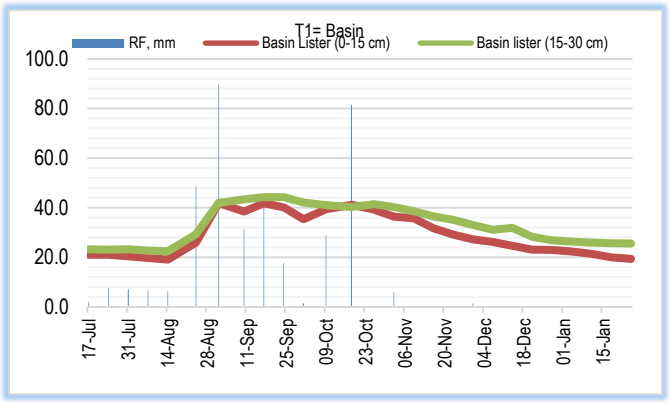

Fig-6 Soil moisture at 0-15 cm & 15-30 cm depth for basin listing

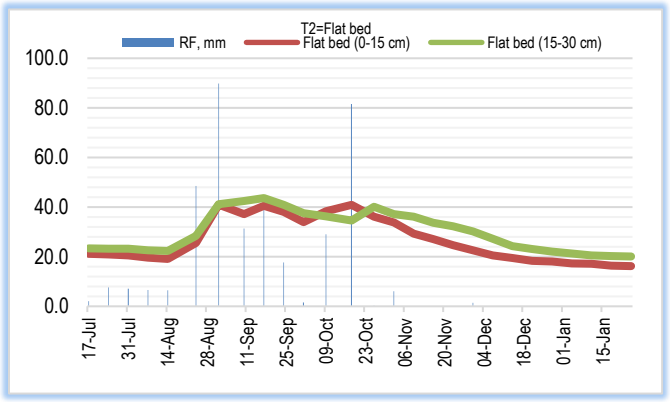

Fig-7 Soil moisture at 0-15 cm & 15-30 cm depth for flat bed

Conclusion

The annual, *kharif* and *rabi* rainfall in 2017 at Solapur (M.S.) recorded was 589.6, 430.6 and 141.3 mm respectively. The average percent change of periodical moisture content in basin listing technology over control method (flatbed) was observed to be 10.13 % and 10.61 % for 0-15 and 15-30 cm soil depth respectively. The coefficient of variance for basin listing technology was observed to be 28.75 and 22.67 % for 0-15 and 15-30 cm soil depth respectively and for control method (flatbed) it was observed to be 33.45 and 26.64 % for 0-15 and 15-30 cm soil depth respectively.

Application of research: The basin listing technology is one of the effective *insitu* moisture conservation technique in dryland agriculture. The basin listing is done by the newly developed tractor operated basin lister.

Research Category: Farm Machinery and Power Engineering

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Study area / Sample Collection: Mahatma Phule Krishi Vidyapeeth, Rahuri, 413722, Maharashtra, India

Cultivar / Variety / Breed name: Nil

Conflict of Interest: None declared

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.
Ethical Committee Approval Number: Nil

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