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**Sumit Raj**

Department of Soil Conservation and Water Management, C S Azad University of Agriculture and Technology, Kanpur, Uttar Pradesh, India

**Amit Raj Singh**

Department of Soil Science and Agricultural Chemistry, CS Azad University of Agriculture and Technology, Kanpur, Uttar Pradesh, India

**Amar Kant Verma**

Department of Soil Conservation and Water Management, CS Azad University of Agriculture and Technology, Kanpur, Uttar Pradesh, India

**Vijay Kumar Rajpoot**

Department of Soil Conservation and Water Management, CS Azad University of Agriculture and Technology, Kanpur, Uttar Pradesh, India

**Avadh Narain Singh**

Department of Agronomy, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya, Uttar Pradesh, India

**AK Katiyar**

Department of Soil Conservation and Water Management, CS Azad University of Agriculture and Technology, Kanpur, Uttar Pradesh, India

**Corresponding Author:**

**Amar Kant Verma**

Department of Soil Conservation and Water Management, CS Azad University of Agriculture and Technology, Kanpur, Uttar Pradesh, India

## Performance of moisture conservation practices and hybrid varieties on growth and yield attributes of sorghum under rainfed condition

**Sumit Raj, Amit Raj Singh, Amar Kant Verma, Vijay Kumar Rajpoot, Avadh Narain Singh and AK Katiyar**

### Abstract

A field experiment was conducted during *kharif* season of 2015 at Soil Conservation and Water Management Farm of C S Azad University of Agriculture and Technology, Kanpur. The experiment consisted 12 treatment combinations of 3 soil moisture conservation practices *viz.* M<sub>1</sub>: Farmers practice, M<sub>2</sub>: Ridging and furrowing and M<sub>3</sub>: Organic mulching @ 4 t ha<sup>-1</sup> 25 DAS and 4 sorghum hybrids *viz.* V<sub>1</sub>: Suraj, V<sub>2</sub>: Virat, V<sub>3</sub>: Hi-tech 3201 and V<sub>4</sub>: Ratna-40 in factorial randomized block design with three replication. The results of experimental revealed that Organic mulching @ 4 t ha<sup>-1</sup> 25 DAS and 4 sorghum hybrids highest found in plant height, stem girth, dry matter accumulation number of days to panicle initiation, complete panicle emergence, number of days to crop maturity, panicle length (cm), panicle girth (cm), weight per panicle (g), number of grains per panicle and 1000-grain weight (g). It was followed by ridging and furrowing producing. Among hybrids, Ratna-40 produced highest found in plant height, stem girth, dry matter accumulation number of days to panicle initiation, complete panicle emergence, number of days to crop maturity, panicle length (cm), panicle girth (cm), weight per panicle (g), number of grains per panicle and 1000-grain weight (g). It was followed by Hi-Tech 3201 under rainfed condition of central Uttar Pradesh.

**Keywords:** Plant stand, plant height, stem girth, dry matter accumulation and yield attributes

### Introduction

Sorghum (*Sorghum bicolor* L.) is the third most important cereal crop in India and the fourth most important of the world. It is one of the major staple food crops of millions of people in semi-arid tropics. It is considered as the “king of millets” in India, sorghum is popularly grown as main source of food (grain) and fodder by poor people and forms an important component of dryland agriculture. Sorghum is being a widely adaptive and drought resistant in nature, so it is often called as “crop camel” Bhagat *et al.*, (2020) [2]. Sorghum is one of the major cereal crops consumed in India after rice and wheat. In India, the area under sorghum is approximately 7.38 million ha with an annual production of about 7.00 million tones and an average productivity of 949 kg ha<sup>-1</sup>. The important sorghum growing states of India are Maharashtra, Andhra Pradesh, Karnataka, Madhya Pradesh, Gujarat, Tamilnadu, Rajasthan and Uttar Pradesh. In the state of Uttar Pradesh, the sorghum crop is grown on about 2.47 lakh ha area and producer 2.52 lakh tone grain annually with average productivity of 1020 kg ha<sup>-1</sup>. Here crop cultivation is concentrated mainly in Bundelkhand and control plain zone of the state where irrigation facilities are very limited. Thus, due to limited soil moisture availability yields are generally poor. Besides, majority of sorghum formers use traditional cultivars which are tall growing, longer duration and low yielder. Under such situation, use of high yielding improved cultivars and adaptation of soil moisture conservation practices are necessary to improve the productivity of sorghum under rainfed condition (Anonymous, 2019) [1]. Improved rain water conservation measures increase infiltration of rain water into the soil enhances water availability to plants (Lipiec *et al.*, 2005) [7]. It has been reported by (Chandrasekharan and Pandian, 2009) [4]. That to increase moisture availability to agricultural crops under rainfed condition, *in situ* moisture conservation techniques like forming ridges and furrows, broad bed and furrows, basin tie ridging and water spreading must be adopted. The practice of ridges and furrows impressed the sorghum grain yield by 25.6% over flatbed sowing (Patil and Sheelavantar, 2005) [9]. Surface mulches are also used to increase infiltration, to keep down weeds, to improve soil structure and eventually to increase crop yields in rainfed farming. If proper soil moisture conservation measures are adopted in rainfed crops, the yields may centrally be improved.

## Materials and Methods

The experiment was conducted during *kharif* season of 2015 in Soil Conservation and Water Management Farm of C S Azad University of Agriculture and Technology, Kanpur in alluvial soil. Soil of the experimental plot was sandy loam in texture and slightly calcareous having organic carbon 0.31%, total nitrogen 0.03%, available P<sub>2</sub>O<sub>5</sub> 15.8 Kg ha<sup>-1</sup>, available K<sub>2</sub>O 203 kg ha<sup>-1</sup>, pH 7.7, electrical conductivity 0.26 dS m<sup>-1</sup>, permanent wilting point 6.3%, field capacity 18.83%, maximum water holding capacity 28.27%, bulk density 1.48 Mg m<sup>-3</sup>, particle density 2.56 Mg m<sup>-3</sup> and porosity 42.18%. The experiment was conducted in a factorial randomized block design with three replications and 12 treatment combinations of 3 soil moisture conservation practices *viz.* M<sub>1</sub>: Farmers practice, M<sub>2</sub>: Riding and furrowing and M<sub>3</sub>: Organic mulching @ 4 t ha<sup>-1</sup> 25 DAS and 4 sorghum hybrids *viz.* V<sub>1</sub>: Suraj, V<sub>2</sub>: Virat, V<sub>3</sub>: Hi-tech 3201 and V<sub>4</sub>: Ratna-40. A uniform dose of 40 kg N + 40 kg P<sub>2</sub>O<sub>5</sub> + 40 kg K<sub>2</sub>O ha<sup>-1</sup> was applied as basal at sowing through funnel attached with country plough used for seed sowing. The fertilizer used were urea DAP and muriate of potash. Additional 40 kg N ha<sup>-1</sup> through urea was top dressed in standing crop at optimum soil moisture condition. Available moisture at sowing time upto 100 cm soil profile was 282.5 mm. Whereas amount of rainfall received during the crop period was 318.2 mm against the average annual rainfall of about 800 mm. Recommended package of practices were applied in different treatments. Soil moisture was monitored gravimetrically using the sample collected from 0-25, 25-50, 50-75 and 75-100 cm soil depths at regular monthly intervals to quantify the soil moisture content and growth parameters by randomly selecting three plants for each plots till the harvest.

The data collected on growth and yield attributes were statistically analyzed (Fisher and Yates, 1958) [5]. Recommended package of practices and fertilizers doses were applied in different treatments.

## Results and Discussion

Plant stand per unit area was not influenced significantly by treatments. In all plots 15-16 plants m<sup>-2</sup> could be maintained. Plant height at harvest was recorded highest of 204.01 cm with mulching and lowest of 189.36 cm under farmer's

practice with significant differences. Among hybrids, Ratna-40 produced tallest plant of 205.03 cm height while dwarfest of 191.57 cm were measured in hybrid Suraj. Stem girth at 105 DAS was recorded maximum of 7.4 cm with mulching and minimum of 5.95 cm is farmers practice. Among hybrids, maximum stem girth was recorded in Hi-Tech 3201 (7.2 cm) while minimum of 6.13 cm was found in Suraj. Dry matter per plant at harvest was produced highest of 107.90g with mulching and lowest of 89.75 g under farmers practices. In case of hybrids, Ratna-40 accumulated highest dry matter of 100.53 g plant<sup>-1</sup> while lowest of 97.28 g plant<sup>-1</sup> was found in Suraj. Similar result were reported that Gabir *et al.*, (2014) [6], Verma *et al.*, (2016) [12] and Chaitanya *et al.*, (2018) [3].

The treatments of mulching took maximum number of days for complete panicle emergence (96.95) and crop maturity (139.49) against minimum and 133.23 days for maturity under farmer's practice. Among hybrids Ratna-40 took maximum days for panicle emergence (96.25) and maturity (137.72) while 93.05 days for panicle emergence and 135.51 days for maturity were taken by Suraj. Panicle length was recorded highest of 22.53 cm under mulching and lowest of 17.54 cm under farmer's practice. Among hybrids, Ratna-40 recorded highest panicle length of 22.07 cm and Suraj the lowest of 18.33 cm panicle length. Panicle girth was also recorded maximum of 19.25 cm under mulching and minimum of 14.99 cm in farmers practice. In hybrids, Ratna-40 recorded maximum panicle girth of 18.86 cm against minimum girth of 15.67 cm in Suraj hybrid. Mulching treatment produced highest panicle weight of 95.28 g against lowest of 74.20 g in farmers practice. Among hybrids, Ratna-40 produced heaviest panicle of 93.35 g against slightest of 77.58 g panicles in Suraj hybrid. Number of grains panicle<sup>-1</sup> were recorded maximum of 2965.6 in mulching and minimum of 2283.7 in farmers practice. Among hybrids, Ratna-40 produced maximum of 2905.3 grains per panicle against minimum of 2379.8 grains in hybrid Suraj. Weight of 1000-grains was recorded highest of 29.49 g under mulching and lowest of 22.96 g in farmer's practice. In case of hybrids, highest 1000-grain weight of 28.89 g was recorded in Ratna-40 and lowest of 24.00 g in Suraj hybrid. Similar result were reported that Rao *et al.*, (2010) [10], Mishra *et al.*, (2015) [8] and Verma *et al.*, (2017) [11].

**Table 1:** Effect of moisture conservation practices and hybrid varieties on plant stand, plant height and stem girth of sorghum crop under different treatments.

Treatments	Plant stand (m <sup>-2</sup> )		Plant height (cm)				Stem girth (cm)			
	Initial	Final	45 DAS	75 DAS	105 DAS	At harvest	45 DAS	75 DAS	105 DAS	At harvest
<i>Moisture Conservation Practices:</i>										
M <sub>1</sub>	15.89	15.65	118.69	165.70	185.59	189.36	3.25	4.98	5.95	5.63
M <sub>2</sub>	15.61	15.43	122.34	170.42	192.43	197.44	3.47	5.59	6.93	6.60
M <sub>3</sub>	15.28	15.13	124.61	174.99	199.33	204.01	3.68	5.93	7.41	7.08
S.E (d.) ±	0.69	0.73	2.11	2.32	2.54	3.16	0.08	0.13	0.27	0.23
C.D.(P=0.05)	NS	NS	4.37	4.81	5.28	6.56	0.17	0.27	0.56	0.48
<i>Hybrid Varieties:</i>										
V <sub>1</sub>	15.40	15.23	117.47	165.72	189.52	191.57	3.08	7.94	6.13	5.87
V <sub>2</sub>	15.32	15.07	123.27	171.76	191.63	198.20	3.22	5.33	6.70	6.30
V <sub>3</sub>	15.88	15.68	121.27	168.68	190.43	192.95	3.48	5.73	7.23	6.86
V <sub>4</sub>	15.77	15.62	125.52	175.32	198.20	205.03	4.07	5.98	6.98	6.70
S.E (d.) ±	0.80	0.84	2.43	2.68	2.94	3.65	0.09	0.15	0.31	0.27
C.D.(P=0.05)	NS	NS	5.04	5.55	6.09	7.58	0.19	0.31	0.64	0.56

M<sub>1</sub>: Farmers practice, M<sub>2</sub>: Riding and furrowing, M<sub>3</sub>: Organic mulching @ 4 t ha<sup>-1</sup> 25 DAS and 4 sorghum hybrids, V<sub>1</sub>: Suraj, V<sub>2</sub>: Virat, V<sub>3</sub>: Hi-tech 3201 and V<sub>4</sub>: Ratna-40.

**Table 2:** Effect of moisture conservation practices and hybrid varieties on dry matter accumulation and yield attributes of sorghum crop under different treatments.

Treatments	Dry matter accumulation (g)				No. of days to panicle initiation	Complete panicle emergence	No. of days to crop maturity	Panicle length (cm)	Panicle girth (cm)	Weight per panicle (g)	No. of grains per panicle	1000-grain weight (g)
	45 DAS	75 DAS	105 DAS	At harvest								
<b>Moisture Conservation Practices</b>												
M <sub>1</sub>	22.43	51.11	77.72	89.75	84.63	91.94	133.23	17.54	14.99	74.20	2283.7	22.96
M <sub>2</sub>	26.93	52.21	87.79	99.20	86.70	95.21	137.45	20.60	17.60	87.12	2712.1	26.97
M <sub>3</sub>	31.34	64.01	91.89	107.90	88.66	96.95	139.49	22.53	19.25	95.28	2965.6	29.49
S.E (d.) ±	0.60	0.59	0.70	0.87	0.45	0.46	0.47	0.51	0.47	1.55	44.6	0.57
C.D.(P=0.05)	1.25	1.23	1.44	1.80	0.93	0.95	0.98	1.06	0.98	3.21	92.5	1.19
<b>Hybrid Varieties</b>												
V <sub>1</sub>	25.38	56.75	84.08	97.28	85.20	93.05	135.51	18.33	15.67	77.58	2379.8	24.00
V <sub>2</sub>	26.18	57.07	85.35	98.41	86.30	94.20	136.70	18.77	16.04	79.37	2471.0	24.57
V <sub>3</sub>	27.48	58.07	86.30	99.57	87.45	95.30	136.97	21.72	18.56	91.86	2859.1	28.43
V <sub>4</sub>	28.53	59.23	87.47	100.53	87.70	96.25	137.72	22.07	18.86	93.35	2905.3	28.89
S.E (d.) ±	0.69	0.69	0.80	1.00	0.52	0.53	0.55	0.59	0.54	1.79	51.5	0.66
C.D.(P=0.05)	1.44	1.43	1.67	2.08	1.07	1.09	1.13	1.22	1.13	3.71	106.8	1.37

M<sub>1</sub>: Farmers practice, M<sub>2</sub>: Ridging and furrowing, M<sub>3</sub>: Organic mulching @ 4 t ha<sup>-1</sup> 25 DAS and 4 sorghum hybrids, V<sub>1</sub>: Suraj, V<sub>2</sub>: Virat, V<sub>3</sub>: Hi-tech 3201 and V<sub>4</sub>: Ratna-40.

### Conclusion

From the foregoing discussion it can be concluded that moisture conservation practice of organic mulching @ 4 t ha<sup>-1</sup> at 25 DAS and hybrid variety, Ratna-40 improved growth and yield attributes of all hybrids compared to other practices. Ridging and furrowing also proved superior over farmers practice in all aspects under rainfed condition of central Uttar Pradesh.

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