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Studies of Moisture Conservation Practices and Hybrid Varieties on Yield and Economics of Sorghum under Rainfed Condition

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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_1: Farmers practice, M_2: Riding and furrowing and M_3: Organic mulching @ 4 t ha^{-1} 25 DAS and 4 sorghum hybrids *viz.* V_1: Suraj, V_2: Virat, V_3: Hi-tech 3201 and V_4: Ratna-40 in factorial randomized block design with three replication. The results of experimental revealed that mulching practice produced highest grain yield of 26.07 q ha^{-1} and earned maximum net return of Rs. 23489 ha^{-1} with 1.71 B:C ratio. It was followed by ridging and furrowing producing 23.59 q ha^{-1} grain yield, earning Rs. 22531 ha^{-1} net return with 1.79 B:C ratio. Among hybrids, Ratna-40 produced highest grian yield of 25.28 q ha^{-1} and earned maximum of Rs. 24348 ha^{-1} net return with 1.80 B:C ratio. It was followed by Hi-Tech 3201 producing 24.87 q ha^{-1} grain yield, earning Rs. 23468 ha^{-1} net return with 1.78 B:C ratio. The treatment combination of organic mulching and Ratna-40 hybrid produced highest of 28.35 q ha^{-1} grain yield and earned maximum of Rs. 28417 ha^{-1} net return with 1.86 B:C ratio. It was followed by the treatment combination of Hi-Tech 3201 and mulching which produced 28.00 q ha^{-1} grain yield and earned Rs. 27660 ha^{-1} net return with 1.84 B:C ratio under rainfed condition of Central Uttar Pradesh.

Keywords: Seed yield, stover yield, net return and B:C ratio.

Introduction

Sorghum (*Sorghum bicolor* L.) is one of the five major food grain crops of the world. Millions of people in Africa and Asia depend on sorghum grain as the staple food. It's grain is eaten by human beings either by breaking the grain and cooking it in same way as rice or by grinding it into flour which is used in making 'chapattis'. To some extent, it is also eaten as perched and popped grain. The grain is also fed to cattle's, poultry and swine who give us the milk, egg and meat for consumption. Besides grain, it provides green fodder and Stover of batter quality which are fed to millions of animals providing milk and meat for human consumption. It also provides raw material for various industries. Sweet sorghum is an attractive bio-

fuel crop because of an easy accessibility of readily fermentable sugars combined with very high yields of green biomass suitable for production of more quantity of ethanol per unit time, per unit cost and per unit of water and nutrients used (Ratnavathi *et al.*, 2010).

Sorghum belongs to the C_4 family with a high photosynthetic activity and drought to prance therefore; it is cultivated in almost all temperate and tropical climatic areas (Miri *et al.*, 2012). It has potential to compete effectively with crops like maize under environmental and management conditions. The greatest merit with sorghum is that it has capacity to with stand drought. Its performance is better than maize in marginal lands under moisture stress or excessive soil moisture conditions. It does well even ink low rainfall areas. The crop is generally grown ink drier parts of USA, India, China, Nigeria, Sudan, Argentina and Australia. The sorghum grain constitutes the main food for over 750 million people who live in the semi-arid tropics of Africa, Asia and Latin America, and globally over half of all sorghum is used for human consumption.

Sorghum, the fifth most important co real crop on the globe, is traditionally grain for grain both as food (Africa and India) and as animal feed (developed countries like USA, China, Australia, etc.) is stalks as animal fodder, building material and fuel. Because of its drought adaptation capability, sorghum is preferred crop in tropical, warmer and semi-arid regions of the world with high temperature and water stress. With the thrust of climate change looming large on the crop productivity, sorghum being a drought hardy crop will play an important role in food, feed and fodder security in dry land economy (Mishra *et al.*, 2015).

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_2O_5 15.8 Kg ha^{-1}, available K_2O 203 kg ha^{-1}, pH 7.7, electrical conductivity 0.26 dS m^{-1}, permanent wilting point 6.3%, field capacity 18.83%, maximum water holding capacity 28.27 %, bulk density 1.48 Mg m^{-3}, particle density 2.56 Mg m^{-3} 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_1: Farmers practice, M_2: Riding and furrowing and M_3: Organic mulching @ 4 t ha^{-1} 25 DAS and 4 sorghum hybrids *viz.* V_1: Suraj, V_2: Virat, V_3: Hi-tech 3201 and V_4: Ratna-40. A uniform dose of 40 kg N + 40 kg P_2O_5 + 40 kg K_2O ha^{-1} 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^{-1} 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 yield were statistically analyzed (Fisher and Yates, 1958). Recommended package of practices and fertilizers doses were applied in different treatments.

Results and Discussion

Grain yield was produced highest of 26.07 q ha^{-1} under mulching treatment followed by ridging and furrowing (23.59 q ha^{-1}) while lowest of 20.09 q ha^{-1} grain was produced in farmers practice. In case of hybrids, Ratna-40 produced highest grain yield of 25.28 q ha^{-1} followed by Hi-tech 3201 (24.87 q ha^{-1}) and Virat (21.49 q ha^{-1}) while lowest of 21.36 q ha^{-1} was produced in hybrid Suraj. Though interaction between treatment factors was not found significant, numerically the combination of hybrid Ratna-40 and mulching practice produced highest of 28.35 q ha^{-1} grain yield closely followed by the treatment combination of hybrid Hi-tech 3201 and mulching practice 28.00 q ha^{-1} grain yield. The combination of hybrid Suraj and farmers practice could produce lowest of 18.90 q ha^{-1} grain yield. Similar result were reported that Chaitanya *et al.*, (2018) and Bhagat *et al.*, (2020).

Stover yield followed the same pattern of grain yield under different treatments. The practice of mulching produced highest of 86.21 q ha^{-1} Stover against lowest of 66.42 q ha^{-1} in farmers practice. Among hybrids, Ratna-40 produced highest of 83.59 q ha^{-1} Stover followed by 82.24 q ha^{-1} in Hi-tech 3201 against

Table-1: Effect of moisture conservation practices and hybrid verities on grain yield and stover yield of sorghum crop under different treatments.

Treatments	Moisture conservation practices							
	Grain yield (q ha^{-1})				Stover yield (q ha^{-1})			
	M_1: Farmers practice	M_2: Riding and furrowing	M_3: Organic mulching @ 4 t ha^{-1} 25 DAS	Mean	M_1: Farmers practice	M_2: Riding and furrowing	M_3: Organic mulching @ 4 t ha^{-1} 25 DAS	Mean
Hybrid Verities:								
V_1: Suraj	18.90	20.84	24.34	21.36	62.50	68.91	80.49	70.63
V_2: Virat	19.23	21.65	23.59	21.49	63.59	71.59	78.01	71.06
V_3: Hi-tech 3201	20.84	25.77	28.00	24.87	68.91	85.22	92.59	82.24
V_4: Ratna-40	21.37	26.11	28.35	25.28	70.67	86.34	93.75	83.59
Mean	20.09	23.59	26.07	-	66.42	78.02	86.21	-
Factors	Hybrids (H)	MCP (M)	HXM	-	Hybrids (H)	MCP (M)	HXM	-
S.E (d.) ±	0.83	0.72	1.44	-	2.02	1.75	3.51	-
C.D. (P=0.05)	1.72	1.49	N.S.	-	4.20	3.64	NS	-

Table-2: Effect of moisture conservation practices and hybrid verities

	Moisture conservation practices							
	Cost of cultivation				Gross income (Rs. ha^{-1})			
	M_1: Farmers practice	M_2: Riding and furrowing	M_3: Organic mulching @ 4 t ha^{-1} 25 DAS	Mean	M_1: Farmers practice	M_2: Riding and furrowing	M_3: Organic mulching @ 4 t ha^{-1} 25 DAS	Mean
Hybrid Verities:								
V_1: Suraj	29535	28461	32858	30285	40850	45042	52608	46167
V_2: Virat	29535	28461	32858	30285	41563	46793	50987	46448
V_3: Hi-tech 3201	29535	28461	32858	30285	45042	55699	60518	53753
V_4: Ratna-40	29535	28461	32858	30285	46189	56433	61275	54632
Mean	29535	28461	32858	-	43411	50992	56347	-

Table-3: Effect of moisture conservation practices and hybrid verities on net return and B:C ratio of sorghum crop under different treatments.

Treatments	Moisture conservation practices							
	Net return (Rs. ha^{-1})				B:C Ratio			
	M_1: Farmers practice	M_2: Riding and furrowing	M_3: Organic mulching @ 4 t ha^{-1} 25 DAS	Mean	M_1: Farmers practice	M_2: Riding and furrowing	M_3: Organic mulching @ 4 t ha^{-1} 25 DAS	Mean
Hybrid Verities:								
V_1: Suraj	11315	16581	19750	15882	1.38	1.58	1.60	1.52
V_2: Virat	12028	18332	18129	16163	1.41	1.64	1.55	1.53
V_3: Hi-tech 3201	15507	27238	27660	23468	1.53	1.96	1.84	1.78
V_4: Ratna-40	16654	27972	28417	24348	1.56	1.98	1.86	1.80
Mean	13876	22531	23489	-	1.47	1.79	1.71	-

lowest Stover of 70.63 q ha^{-1} in Suraj hybrid. The treatment combination of hybrid Ratna-40 with mulching practice produced highest of 93.75 q ha^{-1} Stover yield closely followed by the combination of hybrid Hi-tech 3201 and mulching (92.59 q ha^{-1}). The lowest of 62.50 q ha^{-1} Stover yield was recorded under hybrid Suraj and farmers practice combination. Similar result were reported that Gabir *et al.,* (2014) and Verma *et al.,* (2016).

Total cost of sorghum cultivation was computed highest of Rs. 32858 ha^{-1} with mulching followed by farmers practice (Rs. 29535 ha^{-1}) and by ridging and furrowing (Rs. 28461 ha^{-1}). Different hybrids recorded similar cost of Rs. 30285 ha^{-1} for cultivation. Gross income was recorded highest of Rs. 61275 ha^{-1} under combined effect of Ratna-40 hybrid and mulching practice closely followed by Hi-tech 3201 and mulching with Rs. 60518 ha^{-1}. Net return was computed maximum of Rs. 28417 ha^{-1} under combination of Ratna-40 and mulching closely followed by Hi-tech 3201 and riding and furrowing practice with benefit; cost ratio of 1.86 and 1.98, respectively. In general, B : C ratio was found higher under ridging and furrowing practice than mulching practice. Similar result were reported that Rao *et al.,* (2010), Mishra *et al.,* (2015) and Verma *et al.,* (2017).

Acknowledgments

The overall conclusion may be drawn that under rainfed condition of central Uttar Pradesh, sorghum hybrid Ratna-40 along with organic mulching @ 4 t ha^{-1} 25 DAS proved to be the best with 28.35 q ha^{-1} grain yield and Rs. 28417 ha^{-1} net return. This combination was closely followed by Hi-tech 3201 hybrid with mulching by producing 28.00 q ha^{-1} grain yield and earning Rs. 27660 ha^{-1} net return.

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