J. Agric. Res. Technol., 47 (3) : 268-271 (2022) https://doi.org/10.56228/JART.2022.47305

Effect of Straw Mulching on *In-situ* Moisture Conservation, Productivity and Profitability of Rainfed Soybean on Farmer's Field

M. S. Pendke[1], W. N. Narkhede[2], D. P. Waskar3 and P. H. Gourkhede[4]
Vasantrao Naik Marathwada Agricultural University, Parbhani - 431 402 (India)
Corresponding Author : M. S. Pendke, Email : mspendke1@rediffmail.com

Abstract

Soybean is a major *kharif* crop grown in Marathwada region of Maharashtra under rainfed condition and is being a preferred crop by the marginal and small rainfed farmers. Though, most of the part of the region is comes under assured rainfall zone but it suffers from occurrence of frequent dryspells. The region receives mean annual rainfall of 880 mm. Rainfall in uncertain and erratic in this region. The productivity of soybean particularly in Marathwada region is uncertain due Occurrence of 3 to 4 dryspells in July to September. The crop productivity decreases with either deficiency of rainfall or its distribution or due to moisture stress in critical growth period due to dryspells occurred in July and August. Thus, to conserve the rainwater and to reduce soil evaporation, straw mulching in inter row space was advocated to farmers to avoid moisture stress and to cope with dryspells. The research demonstrations were conducted on farmer's field for 3 year since 2019-20 to 2021-22. Results indicated that straw mulch was found effective in in-situ moisture conservation. It was observed that soybean productivity was increased by 21.77 per cent due to application of straw mulch. Similarly, GMR and NMR was increased by 22.25% and 30.84% respectively, due to application of straw mulch. Straw mulch was found effective in additional 22% moisture conservation and found effective in avoiding moisture stress particularly during dryspell period.

Key words : Dry spell, Evaporation, Moisture conservation, Rainfed, Straw mulch.

Marathwada region of Maharashtra state is characterized by rainfed and majoe part comes under assured rainfall zone. The climate of Marathwada experiences wide inters districts and intra districts variability. The region experiences wide variability within and in between districts in respect of rainfall situation and also different soil type predominant in various parts of region. Occurrence of frequent droughts, unseasonal rains and hailstorms are the features of climate change in the region. Total Agricultural production fails in every season due to occurrence of drought situation in any of the part of the region. The farmer in dry areas will suffer the most from climate change and will require a range of coping strategies to adapt to changing climates.

Soybean is grown on 13 lakh ha area in Marathwada region of Maharashtra state. Majority of the small and marginal farmers prefer to grow soybean during kharif season. The average productivity of soybean varies depending of monsoon behavior. Occurrence of frequent dryspells affects the productivity of soybean in the region. The region is dominated by medium black cotton soils (60 %) and followed by heavy and shallow soils 15-20% each. Assured rainfall zone covers 60-70% area followed by 10-15% by moderate to moderately high rainfall and 15-20% scarcity rain area. Though the majority area falls under assured rainfall zone, it is characterized by 2-3 prolonged dry spells during crop growth.

Decreased crop productivity in arid and semi-arid regions is due to water shortage (Tavakkoli and Oweis 2004) and thus water

1. Agril. Engineer, 2. Chief Scientist, 3. Director of Research and 4. Asstt. Professor.

availability is important for the stability of grain yield. The increase in soil water storage is possible with addition of straw mulch as a surface mulching material, which increases the soil water content, water use efficiency (WUE), and crop production (Wang *et al*. 2012). Generally, the addition of residues such as straw mulching increases the grain yield (Wang et al. 2012). It was also noted that straw mulching increased soil moisture content in the maize-wheat cropping system in the north-western regions of India, and thus enhanced crop productivity (Sharma *et al*. 2010). Gajri et al. (1994) reported that maize productivity was increased by mulching.

The limitation of water resources is the major constraint for crop production (Rockström et al. 2007). Keeping in view the importance of mulching and limited documentation of mulching effects on water storage, RWUE and soybean production in semi-arid regions, this study was planned to evaluate the effect of straw mulching on productivity and profitability of soybean with *in-situ* moisture conservation on farmer's field.

Materials and Methods

Research demonstrations were conducted on farmers' fields during 2019-20 to 2021-22 under FLD at village Babhulgoan in Parbhani District in Marathwada region of Maharashtra. Most of the farmers were cultivating soybean under rainfed condition. Farmers were advocated to apply straw mulch in inter row of soybean crop. Demonstration fields were selected based on the willingness of the farmers as participatory research to evaluate the science based strategy.

The rainfall data was collected from the nearest rain gauge station. The duration of dryspells and number of dryspells were recorded every year. The data on crop yield in both the field i.e. with straw mulch and without straw mulch were recorded. Accordingly, the gross and net returns (GMR and NMR), Rainwater use efficiency (RWUE) were worked out and thus the additional per cent increase in yield was analyzed. Similarly, the soil moisture was recorded periodically and additional moisture conservation due to straw mulch was analyzed.

Results and Discussions

Rainfall and dryspells : The data on annual rainfall, crop seasonal rainfall, numbers of dryspell, dryspell duration and period during 2019-20 to 2021-22 is presented in Table 1.

In the last three years, 4 dryspells were observed every year which has resulted moisture stress during crop growth period.

Table 1. Annual, crop seasonal rainfall, and dry spell details during 2019-20 to 2021-22

Year	Annual rainfall, mm	Crop seasonal rainfall, mm	No. of dry-spell	Dura-tion, Days	Dryspell period
2019	964.2	859.7	4	10	01/07/2019 to 10/07/2019
				13	14/07/2019 to 26/07/2019
				16	15/08/2019 to 30/08/2019
				18	02/10/2019 to 19/10/2019
2020	1098.7	1004.5	4	09	17/06/2020 to 25/06/2020
				12	30/07/2020 to 10/08/2020
				10	28/08/2020 to 06/09/2020
				09	02/10/2020 to 10/10/2020
2021	1610.8	1196.8	4	07	29/06/2021 to 05/07/2021
				22	25/07/2021 to 15/08/2021
				08	23/08/2021to 30/08/2021
				14	18/10/2021 to 31/10/2021

Crop productivity and Economics : The data on soybean productivity, GMR, NMR and BC ratio during 2019-20 to 2021-22 is presented in Table 2.

Data indicated that soybean grain yield was found significantly increase by 21.77 per cent due to application of straw mulch. The mean soybean grain yield with application of straw mulch was recorded as 1001 kg ha^{-1} as against the soybean grain yield of 822 without application of straw mulch.

Bu *et al*., (2013) studied the effects of mulching on maize growth, yield in a semi-arid region and found that grain yield was increased due to application of mulch. Similarly, Wang *et al*., (2012) studied the effect of tillage and crop residue on rainfed wheat and maize production in northern China and found that crop productivity was enhanced due to application of crop residue. Kumar *et al*. (1998) reported that different mulching materials resulted in increase in crop yield. Sekhon *et al*. (2005) studied the response of soybean (*Glycine max* Mer.) to wheat straw in different cropping seasons and found that soybean yield was increased due to application of straw mulch. Similar results are found in the present study.

Data indicated that gross and net monetary returns were found significantly increase by 22.25 and 30.84 per cent respectively, due to application of straw mulch. The mean gross and net returns in soybean production with application of straw mulch were found as Rs. 36725 ha^{-1} and Rs. 17062 ha^{-1} as against the mean GMR and mean NMR of Rs. 30040 ha^{-1} and Rs. 13040 ha^{-1} without application of straw mulch. The BC ratio of 1.87 was observed due to application of straw mulch as against the BC ratio of 1.78 without application of straw mulch.

The data on mean soil moisture during crop growth period during 2019-20 to 2021-22 is presented in Table 3.

Table 2. Soybean productivity, GMR, NMR and BC ratio during 2019-20 to 2021-22

Intervention	Soybean grain yield (kg ha^{-1})			
	2019-20	2020-21	2021-22	Mean
With mulching	1010	872	1121	1001
Without mulching	890	752	824	822
GMR, Rs. ha^{-1}				
With mulching	34330	32351	43495	36725
Without mulching	30251	27899	31971	30040
NMR Rs. ha^{-1}				
With mulching	14340	16351	20495	17062
Without mulching	13251	13899	11971	13040
BC ratio				
With mulching	1.71	2.02	1.89	1.87
Without mulching	1.77	1.99	1.60	1.78

Table 3. Mean soil moisture during crop growth period

Intervention	Mean soil moisture (%)			
	2019-20	2020-21	2021-22	Mean
With mulching	29.12	30.36	29.98	29.82
Without mulching	24.18	24.95	24.17	24.43

Data indicated that, with application of straw mulch, 29.82 per cent mean soil moisture was recorded during crop growth period as against the soil moisture of 24.43 per cent in the treatment of without mulching. Due to application of straw mulch, additional moisture of 22.06 per cent was conserved. Aulakh and Sur (1999), Jalota and Prihar (1979) conducted study on effect of mulching on soil moisture and found that due to mulching, additional soil moisture was conserved.

Conclusions

- Soybean grain yield was found significantly increase by 21.77 per cent due to application of straw mulch.

- The gross and net monetary returns were found significantly increase by 22.25 and 30.84 per cent respectively, due to application of straw mulch.
- The BC ratio of 1.87 was observed due to application of straw mulch as against the BC ratio of 1.78 without application of straw mulch.
- Due to application of straw mulch, additional moisture of 22.06 per cent was conserved.

References

Aulakh, P. S. and Sur, H. S. 1999. Effect of mulching on soil temperature, soil moisture, weed population growth and yield in pomograinate. Prog. Hort. 31: 131-133.

Bu, L. D., Liu, J. L., Zhu, L., Luo, S. S., Chen, X. P., Li, S. Q., Hill, R. L., Zhao, Y. 2013. The effects of mulching on maize growth, yield and water use in a semi-arid region. Agricultural Water Management, 123: 71-78.

Gajri, P. R., Arora, V. K. and Chaudhary, M. R. 1994. Maize growth response to deep tillage straw mulching farmyard manure in coarse textured soils of N.W. India. Soil use and Manage. 10: 15-20.

Jalota, S. K. and Prihar, S. S. 1979. Soil water storage and weed growth as affected by shallow tillage and straw mulching with and without herbicide in bare fallow. Indian J. Ecol. 6(1): 41-48.

Kumar, R., Srivastva, B. K. and Kumar, R. 1998. Influence of different mulching materials on yield and quality of winter tomato. Proc. National Aca Sci. India Biol Sci 68(3-4): 279-282.

Sekhon, N. K., Hira, G. S., Sidhu, A. S. and Thind, S. S. 2005. Response of soybean (*Glycine max* Mer.) to wheat straw in different cropping seasons. Soil use and manage 21: 422-426.

Sharma, A. R., Singh, R., Dhyani, S. K., Dube, R. K. 2010. Moisture conservation and nitrogen recycling through legume mulching in rainfed maize (*Zea mays*)-wheat (*Triticum aestivum*) cropping system. Nutrient Cycling in Agroecosystems, 87: 187-197.

Stagnari, F., Galieni, A., Speca, S., Cafiero, G., Pisante, M. 2014. Effects of straw mulch on growth and yield of durum wheat during transition to conservation agriculture in Mediterranean environment. Field Crops Research, 167: 51-63.

Sur, H. S., Ghuman, B. S. and Lal, Kulwant. 1995. Effect of mulching maize on the productivity of maize- wheat cropping system under rainfed conditions. J. Water Manage 3: 74-77.

Tavakkoli, A. R. and Oweis, T. Y. 2004. The role of supplemental irrigation and nitrogen in producing bread wheat in the highlands of Iran. Agricultural Water Management, 65: 225-236.

Wang, X., Xu, G. B., Ren, Z. G., Zhang, Z. J., Jian, Y. F., Zhang, Y. M. 2007. Effects of environment-friendly degradable films on corn growth and soil environment. Chinese Journal of Eco-Agriculture, 15: 78-81.

Wang, X. B., Wu, H. J., Dai, K., Zhang, D. C., Feng, Z. H., Zhao, Q. S., Wu, X. P., Jin, K., Cai, D. X., Oenema O. and Hoogmoed, W. B. 2012. Tillage and crop residue effects on rainfed wheat and maize production in northern China. Field Crops Res., 132: 106-116.