“EFFECT OF MULCH AND DIFFERENT TILLAGE PRACTICES ON YIELD& YIELD ATTRIBUTING CHARACTERS OFSORGHUM CROP”

***Abstratct*:**A field experiment was conducted for three *Kharif* seasons (2020-21 & 2021-22) at Regional Agricultural Research Station, Nandyala, Andhra Pradesh to study the effect of mulch and different tillage practices on yield& yield attributing characters of sorghum crop. Tillage practices, mulch practices and their interaction had no significant influence on growth parameters viz., plant height and dry matter production at harvest, days to 50 % population. Whereas, panicle weight, panicle length, grain yield, straw yield and harvest index were significantly higher with zero tillage and with residue mulch. The interaction between tillage and mulch practices was non significant. Maximum gross and net returns were observed with zero tillage with residue mulch practice in grain sorghum.The economic evaluation of mulching and tillage practices in sorghum crop revealed that maximum gross returns (Rs 1,18,659), net returns (Rs 78,579) and B:C ratio (2.96) were obtained with zero tillage practice with mulching practice. The study indicated that tillage and mulching had significant effect on soil fertility and grain yield of sorghum crop.

***Key Words*:** Sorghum crop, Tillage Systems,Mulching,Soil fertility& Economics

1. Introduction :The growing population has increased the competition for land, water, and other resources, whilst also raising the demand for food . Arid and semi-arid regions account for about half of the world’s total land area and could play a vital role in solving the world’s food security problems . Increasing the yield per unit of grain is an effective measure to ensure food security. As agricultural production from drylands is limited due to the scarcity of rainfall, therefore, it is essential to increase crop productivity and yields by optimizing agricultural field management practices. Sorghum is fifth economically important cereal crop in world after wheat, rice, barley and maize. It is an important feed, food and forage crop, which also provides raw material for the production of alcohol, biofuels, starch, fiber, dextrose syrup and many other products (ShahidMehmood*et al*., 2014).With rapidly increasing population the demand for food grains is continuously increasing in India. Sorghum as a grain crop can support wheat, rice, maize and other grain crops, as it is a staple food for millions of people in semiarid regions of the World (Shakoor, 1999).

Among different agricultural measures, mulching, tillage, and their combination are considered as most sustainable agricultural practices in arid and semi-arid regions as they retain water in the upper soil layers reducing the need for irrigation. Compared with traditional soil tillage measures, the implementation of mulching and reduced tillage techniques can significantly reduce soil surface water evaporation, surface runoff , and soil erosion and increase soil water storage. To an extent, it increases crop yield and water use efficiency and guarantees the sustainable development of agriculture . Straw mulching has been widely used for the cultivation of maize (*Zea mays* L.), spring wheat (*Triticum aestivum* L.), rice (*Oryza sativa* L.), potatoes (*Solanum tuberosum* L.) , vegetables and fruit trees . This farming method not only guarantees the production of crops but is also extremely friendly to the environment.

To attain this probability, soil erosion will have to be condensed. Mulches are loose coverings or sheet of organic material that is placed on the soil surface. It helps to preserve moisture, repression of weeds, improving soil consistency, insect pest assault and guard roots from severe temperature. Organic mulches improve soil, pleasant soil temperature, hinder weed growth, lessen soil moisture evaporation and improve the visual qualities of landscapes. A good layer of mulch will help to preserve moisture and suppress weed germination. Mulch enhanced root and increased maize grain yield by increasing plant N-uptake efficiency, falling N discharge losses and improving nutrient preservation over unmulched plots (Aulakh *et al.,* 2000). Straw mulch is practiced successfully in many advanced countries like America and Australia where it improved many soil aspect as support soil moisture retention ability, prevent wind erosion, control of weeds, nutrient return and soil structure improvement.

2. MATERIALS AND METHODS

The experiment was conducted during the Rabi season of 2020-2021 and 2021-2022 at Regional Agricultural Research Station Nandyal. This centre is located Scarce Rainfall zone at 15.47^0 N latitude and 78.48^0 E longitude. The experiment was conducted in an area of 90 m^2 plot size with 45 cm × 15 cm spacing and fertilizer application of 80-60-40 NPK kg/ha. The total 24 treatments were plotted by using strip plot design consisted of three horizontal practices, T_1 or CT : Conventional tillage (primary, secondary and tertiary tillage as per existing farmers/ researchers practice and sowing by seed cum ferti-drill), T_2 or ZT : Zero tillage (Sowing by seed cum-ferti-drill / cultivator; glyphosate spray to kill existing vegetation after sowing), T_3or MT : Minimum (Reduced) tillage (Basal fertilizer dose application followed by Disking and sowing by seed drill after running cultivator that incorporates basal fertilizers) and two vertical practices (residue mulch-M1 and without residue mulch-M2). All the six treatments were replicated by 4 times. Strip plot design was statistically analysed by using OPISTAT Software and NTJ 5 variety was selected for the experiment. The parameters like plant height, dry mass production, 100 seed weight, grain yield, straw yield & harvest index were recorded by using standerd procedures. Initial soil samples were collected from each plot every year from 0 to 30 cm deep. The samples were passed through a 2-mm sieve for analysis of available N, P, and K. For organic carbon analysis, samples were passed through a 0.2-mm sieve. The organic carbon was measured by wet oxidation (Walkley and Black 1934); available N by alkaline– potassium permanganate ($KMnO_4$) (Subbaiah and Asija 1956); available P by 0.5 M sodium bicarbonate ($NaHCO_3$) (Olsen *et al.* 1954); and available K using neutral normal ammonium acetate method (Jackson 1973).

3. RESULTS& DISCUSSION

3.1 Growth, yield attributes and yields under sorghum crop

Data present in Table 1 shows that there is no significant difference between any treatment for yield attributes like plant height, dry mass production and test weight. Highest plant height (317cm) was observed in CTM2 treatment. Lowest drymass production was observed in

CTM2 treatment (8278 kg) may be due to lower nitrogen fertilization than recommended dose of fertilization.These results were in accordance with the findings of Prasada Rao *et al*. (2013).

Tillage practices, mulch practices and their interaction had significant influence on yield parameters of sorghum like panicle weight, panicle length, grain yield, straw yield and harvest index. The interaction between tillage and mulch practices was non-significant. Yield attributes and yields of *rabi* sorghum as influenced by tillage and mulch as shown in Table 1. The highest pooled grain yield and straw yield was obtained at zero tillage and lowest pooled grain yield and straw yield at conventional tillage because of zero tillage was attributed to improvement in yield components namely, number of panicle weight and 1000 grain weight. In addition to mulching practices, the highest pooled grain yield and straw yield (3447 kg/ha) (8605 kg/ha) was obtained at zero tillage system compare to other tillage, because of mulching practices reduces the evaporation of water and increases the water holding capacity which results in higher yields. Although, harvest index was not affected by mulch rate, tillage system and their interaction (X. Wang and Dai, 2012) also obtained highest harvest index value on the zero-tillage system.This was due to mechanical modifications of soil profiles in Conventional Tillage system which could alleviate high subsoil strength, facilitating deeper rooting and, thus, the plant-availability of subsoil resources (Patil *et al*., 2016, Schneider *et al*. 2017& Mishra *et al*., 2019). Higher soil water availability in Conventional Tillage system compared to Reduced Tillage and No Tillage from sowing to harvest might be responsible for higher leaf area index, better crop growth, and dry matter accumulation and translocation to head at reproductive stage of crop growth producing higher sorghum grain yield (Patil 2013). Deep tillage has been reported to enhance earthworm activities and increase the abundance of plant growth-promoting rhizobacteria and mycorrhizae in the subsoil .Similar were the findings by Patil (2013), according to him the grain yield of sorghum was lowest in first year of experiment where minimum tillage operation was carried out as against the conventional tillage. In contradictory to this Agbede and Ojeniyi (2009) recorded higher sorghum yields in zero tillage against the conventional tillage. Similarly, Sen *et al*. (2002) also advocated the yield advantage of zero tillage against the conventional tillage. On the other hand, results depicted that mulch had affected the grain yield significantly are in line with Agbede and Ojeniyi (2009) and Shahid Mehmood*et al*., (2014), that sorghum grain yield was significantly higher in mulched sorghum than that in non mulched (control).

3.2Soil available nutrient status

Initial and final soil available nitrogen, phosphorous and potassium nutrients status was estimated in rabi sorghum crop and presented in table2. There is no significant difference between any treatment for soil pH, E.C and available potassium.Soil available nitrogen content was significantly highest (168 kg ha^{-1}), with Zero tillage with mulching treatment followed by Zero tillage without residue mulching treatmentafter two years of experimentation. However after two years of experimentation soil available nitrogen content was maintained without depletion. However soil available nitrogen content was significantly decreased due to application of 50% STCR fertilizer dose. Soil available phosphorous content values were significantly differing with tillage and mulching practices.Significantly highest available phosphorus recorded for zero tillage (43.6 kg ha^{-1}) and minimum tillage (40.8 kg ha^{-1}) was statistically similar. Mulch had significant effect on the soil available phosphorus. Relatively, greater soil available phosphorus was recorded for zero tillage as compared to conventional tillage and minimum tillage.Similar trend was followed in soil available potassium content as in available phosphorous content. But significantly higher values of available potassium were recorded with minimum tillage treatment followed by zero tillage treatment. Relatively, greater soil available potassium was recorded for zero tillage (438 kg ha^{-1}) as compared to conventional tillage and minimum tillage. Maximum increase of as compared to among mulching practices was recorded for poultry manure in all tillage treatments. These results are in agreement with Agbede and Ojeniyi (2009) , Shahid Mehmood*et al*. (2014) andPatil *et al*., (2016) who stated that in zero tillage and mulched plots, available potassium was higher compared to minimum and conventional tillage and unmulched plots. Similar results were noticed in secondary nutrients like calcium, magnesium and sulphur availability during two years of sorghum crop growth in soil.

3.3 Economics

The economic evaluation of mulching and tillage practices in sorghum crop revealed that maximum gross returns (Rs 1,18,659), net returns (Rs 78,579) and B:C ratio (2.96) were obtained with zero tillage and mulching practices. The cost incurred on mulching application and conventional tillage practices reduced the net returns and B: C ratio (1.75) in CTM1 treatment But the treatment CTM2 recorded lowest B: C ratio (1.64). Suitable tillage practices reduces cost of cultivation; increases income, reduces hazardous effects and increases water use efficiency of sorghum that stabilizes and/or improves the food production in the region.Similar economic benefits have been reported by Thavaprakash and Malligawad (2002) in sunflower and Schlegel*et al*., 2017 in sorghum crop.

4.CONCLUSION

The effect of different tillage practices and with mulch & without mulch on sorghum crop was conducted at Regional Agricultural Research Station, Nandyal. From this study it is concluded that tillage and mulching had significant effect on soil fertility and grain yield of sorghum.The results were observed with highest grain and straw yield was obtained at zero tillage system compare to conventional and minimum tillage system. The highest harvest index and benefit cost ratio was observed in zero tillage system compared to other treatments.

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Table 1. Yield & Yield attributing characters of Sorghum cropasinfluencedbytillageandmulch (Mean data of 4 replications)

	Plant Height (cm)	**Dry Mass production (Kg)**	**Days to 50% population**	**Test weight (g)**	**Grain yield (Kg/ha)**	**Stover yield (Kg/ha)**	**Harvest Index**
CTM_1	310	8650	75.75	32.55	3171	8379	27.46
CTM_2	317	8278	76.00	31.78	2838	8004	26.18
ZTM_1	312	8835	74.75	35.63	3447	8605	28.61
ZTM_2	311	8692	76.25	31.30	3267	8353	28.09
MTM_1	303	8800	75.50	33.88	3365	8568	28.19
MTM_2	306	8554	75.75	32.18	3205	8333	27.77
SEm±	28	223	7.3	3.04	201	257	
C.D(P=0.05)	NS	685	NS	NS	547	783	
C.V (%)	8.4	10.1	8.7	6.3	12.3	12.7	
Interaction(Mulch xTillage)							
SEm±	23.67	210.50	7.25	3.12	204	236	
CD(P=0.05)	NS	NS	NS	NS	NS	NS	
Interaction(TillagexMulch)							
SEm±	31.44	215.60	8.32	4.32	191	257	
CD(P=0.05)	NS	NS	NS	NS	NS	NS	

Table 2:Influence of Tillage & mulching on soil properties of sorghum crop

Treatment name	pH	E.C (d Sm^{-1})	O.C (%)	Available N (Kg/ha)	Available P_2O_5 (Kg/ha)	Available K2O (Kg/ha)	Ca (C mol (p+) kg-1)	Mg (C mol (p+) kg-1)	Sulphur (ppm)
CTM_1	8.31	0.10	0.30	146	41.2	398	9.0	3.2	13.1
CTM_2	8.33	0.14	0.30	142	40.2	404	8.8	3.2	12.8
ZTM_1	8.22	0.08	0.33	168	43.6	422	9.7	4.6	14.1
ZTM_2	8.30	0.14	0.33	165	42.9	434	9.5	4.3	14.4
MTM_1	8.28	0.12	0.30	154	39.3	438	9.2	4.5	15.2
MTM_2	8.30	0.17	0.30	158	40.8	447	9.4	3.9	15.1
S. Em ±	0.45	0.01	0.02	9.04	2.80	24.47	0.51	0.26	0.81
C. D (P=0.05)	NS	NS	0.057	26.23	7.10	NS	NS	0.79	NS
C V (%)	6.8	4.5	8.87	9.32	7.88	12.1	9.82	8.4	7.4
Interaction(Mulch xTillage)									
SEm±	0.42	0.01	0.01	7.88	2.04	23.61	0.34	0.17	0.74
CD(P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS
Interaction(TillagexMulch)									
SEm±	0.38	0.01	8.32	8.04	2.01	22.83	8.57	0.16	0.71
CD(P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS
Initial	**8.32**	**0.06**	**0.33**	**135**	**43.05**	**383**	**8.2**	**2.4**	**12.2**

Table 3. Economics of sorghum cropas influenced by tillage and mulch practices

Treatment name	Grain yield (Kg/ha)	Stover yield (Kg/ha)	Gross returns (Rs/ha)	Net returns (Rs/ha)	Benefit :cost ratio (B:C ratio)
CTM_1	3171	8379	97411	37623	1.63
CTM_2	2838	8004	104663	44875	1.75
ZTM_1	3447	8605	118659	78579	2.96
ZTM_2	3267	8353	107714	67634	2.69
MTM_1	3365	8568	104071	62036	2.48
MTM_2	3205	8333	113451	71416	2.70