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Research Article

Performance of different mulching materials on soil moisture content, weed infestation and growth of maize (*Zea mays* L.)

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Abstract

Two field experiments were conducted at Yezin and Sepin research farms, Yamethin, Myanmar to investigate the effect of different mulching materials on growth, soil moisture and weed infestation of maize and to identify the most suitable mulching materials for maize cultivation in the study areas during the dry season (October, 2019 to March, 2020). The experiments used randomized complete block design (RCB) with three replications. No mulching and six mulching materials, including rice straw mulching, rice husk mulching, maize stover mulching, mung bean stover mulching, soybean stover mulching and white plastic polyethylene mulching were tested. NK-621 (120 days) was used as the tested variety. Different mulching materials showed higher plant height and SPAD value than no mulching whereas rice straw mulching was highest at both locations. The highest LAI was achieved from rice straw mulching at Yezin. At Yamethin, the maximum LAI (2.19) was recorded from rice straw mulching at maximum growth stage (MGS), LAI (2.71) observed from maize stover mulching at tasseling stage (TS). The maximum crop growth rate (CGR) (13.31 $gm^{-2}day^{-1}$) was achieved from rice straw mulching at Yezin and (14.19 $gm^{-2}day^{-1}$) at Yamethin. Soil moisture content and weed infestation were significantly different among different mulching materials at two locations. White plastic polyethylene mulching and rice straw mulching were observed as the most suitable for soil moisture content and minimal weed infestation. According to the results, rice straw mulching is the best in all parameters among the treatments for Yezin and Yamethin areas.

Introduction

Maize (*Zea mays* L.) is a major cereal crop of the world and ranked as the third most important cereal crops followed by rice and wheat in the world (Gao et al., 2020). It is a cereal crop that can readily be grown effectively

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under rainfed conditions and requires little management procedures and money, allowing it to fulfill the world's increased food demand but moisture availability is a major problem in maize cultivation during dry season. Maize is Myanmar's second most important cereal crop, utilized for human food, animal feed for livestock husbandry, and as one of the country's primary agricultural exports. Hence, more production of maize is needed through expansion of cultivable area and increased production per unit area. In Myanmar, the average maize yield was 3.91 t ha^{-1} in 2019 - 2020, with a total sown area of 520,000 ha and a production of 2,018,000 MT (Ministry of Agriculture, Irrigation and Livestock, 2020).

Mulch is any material placed on the soil surface to avoid erosion, reduce weed growth, obtainable soil moisture (Awe et al., 2014) and soil temperature (Khan et al., 1988), both of which effect plant growth and yield and compensates for water limits, low temperatures, gravel mulches, and are the critical traditional methods that farmers have used in many dry areas (Lithourgidis et al., 2011). Mulches are made up of both organic and inorganic materials (Meyer et al., 1970). Crop residue and plastic mulches have been efficiently used to recover fallow efficiency and increase the amount of stored soil water obtainable for plant use (Unger et al., 2006). However, selecting the appropriate mulching materials is vital for the farmer to benefit from mulches (Kader et al., 2017).

The increase in yield is normally credited to increased soil moisture content because of reduced evaporation by mulching. However, the choice of appropriate mulch according to the environment, location, and weather is of great significance as it influences the overall efficiency and cost of the mulching mechanism. It is essential to know how different mulching materials influence soil conditions, crop growth, and resource utilization for optimizing water management and improving maize yield. However, research concerning with different mulching materials is relatively scarce on growth and weed infestation performance of maize in Myanmar. Therefore, the experiments were carried out to investigate the effect of different mulching materials on growth, soil moisture content and weed infestation of maize and to identify the most suitable mulching material for maize cultivation in Yezin and Yamethin areas.

Materials and methods

The field experiments were conducted at the upland field of Department of Agronomy, Yezin Agricultural University and Sepin Research Farm, Yamethin Township from October 2019 to March 2020 by using randomized complate block design with 3 replications. Yezin is located at 19° 49' 59.6'' N latitude, 96° 16' 30.4'' E longitude and 129 meters above sea level. It is situated in Nay Pyi Taw Union Council. Sepin is located at 20° 56' N latitude, 96° 05' E longitude and 203 meters above sea level. It is situated in Mandalay region. The experimental area was 883.5 m^2 (46.5 m × 19 m) and each plot size was 5.5 m × 5 m. The most widely sown variety, NK-621 (120 days) was used as the tested variety in both locations. Row and plant spacing were 75 cm and 25 cm respectively. There were seven different treatments in both experiments including: T1: control, T2: rice straw mulching, T3: rice husk mulching, T4: maize stover mulching, T5: mung bean stover mulching, T6: soybean stover mulching, T7: white plastic polyethylene mulching. The dry organic mulches of 10 ton ha^{-1} (10,000 kg ha^{-1}) were applied as the mulching materials on the surface of soil.

Land preparation and crop management

Land preparation was carried out to ploughing and harrowing of leveling in both experimental sites. The fertilizers were applied according to Department of Agricultural Research (DAR) recommended guidelines at the rate of 123.5 kg Urea ha^{-1}, 123.5 kg Triple super phosphate ha^{-1} and 61.75 kg Muriate of potash ha^{-1} as basal, 61.75 kg Urea ha^{-1} and 30.88 kg Muriate of potash ha^{-1} at 20 DAS (days after sowing) and 61.75 kg Urea ha^{-1} and 30.88 kg Muriate of potash ha^{-1} at 40 DAS. Thinning was done at 2 weeks after sowing and left one healthy seedling per hole. AT 21 DAS, different mulching materials were covered after earthing up the experimental plots and irrigation was done before one day of applying mulches at experimental sites. Four times of irrigation was applied throughout the whole season at the experimental sites. When the plants from no mulching began to wilt and the leaf started to roll, irrigation was applied. Pesticides and insecticides were sprayed as necessary at Yezin and Sepin research farm, Yamethin throughout the whole season of the crop.

Data collection

Plant height and SPAD value were recorded from randomly selected five plants in each plot at two weeks interval starting from 14 DAS (days after sowing) to 70 DAS. The percent of soil moisture content was recorded before water application, 1 DAI (Days after Irrigation), 3 DAI, 7 DAI and 14 DAI at Yezin and Yamethin. Weed infestation was determined by harvesting weeds within a 50 cm × 50 cm quadrat placed randomly in two locations within each plot at 45 DAS and 90 DAS. The leaves areas were measured at maximum growth stage (MGS), tasseling stage (TS) and grain filling stage (GFS). Leaf area index (LAI) and crop growth rate (CGR) were calculated by using the following formulas.

$$\text{LAI} = \frac{\text{Sum of the leaf area of all leaves (cm}^2\text{)}}{\text{Ground area of field where the leaves have been collected (cm}^2\text{)}}$$

(Keshavare & Farahbakhsh, 2012)

$$\text{Crop Growth Rate(CGR)} = \frac{\text{Total dry matter at second sampling-Total dry matter at first sampling}}{\text{Time between second and first sampling} \times Gound\ Area}$$

(Oikeh et al., 2003)

Data analysis

The data analyses were carried out by using Statistix (version 8th) software and the data visualization is showed by using R program (version 4.1.2) and treatment means were compared by using least significant difference (LSD) test at 5% level of significance (Gomez & Gomez, 1984).

Results and discussion

Plant height and SPAD value

Plant height of maize was significantly differed in different mulching materials at Yezin and Yamethin (Figure 1A & 1B). In all mulching materials, plant heights increased continuously from 14 to 70 DAS. There was a significant difference in plant height among different mulching materials at both locations. At 56 and 70 DAS, the tallest maize plant was recorded in T2 followed by T3, T4 and T7 was not significantly different with T1, which was the shortest. Similar to the Yezin experimental results, the maximum plant height was observed from T2 and the minimum plant height was recorded from T1 at Yamethin. At the experimental sites, different mulching materials showed superior performance in plant height than no mulching, indicating that mulching has positive effect on the growth and development of maize. The increased plant height in mulched plants was possibly due to better availability of soil moisture and optimum soil temperature provided by the mulch. These results are in agreement with Saif, Maqsood, Farooq, Hussain & Habib (2003) who also gave the similar findings as moisture stress resulted in a reduction in plant height. Kefale and Ranamukhaarachchi (2004) also found that moisture deficiencies during early vegetative stage reduced plant height and ear height leading to shorter internodes.

The mean SPAD value recorded from 14 to 70 DAS at Yezin and Yamethin was significantly different among different mulching materials (Figure 2A & 2B). At 70 DAS, the minimum SPAD value (17.28) was obtained from T1 while the maximum SPAD value (35.30) was obtained from T2 followed by T6 > T3 > T5 > T4 > T7 at Yezin. At 70 DAS, the highest SPAD value (51.74) was observed from T2 followed by T4 > T5 > T7 > T3 > T6 while the lowest SPAD value (43.68) was resulted from T1 at Yamethin. A decrease in leaf greenness values may be as a result of a water shortage and environmental circumstances. Kante, Revilla, De La Fuente, Caicedo and Ordas (2016) showed that a reduction in the chlorophyll content of plant leaves was directly linked with root growth. The reduction of leaf chlorophyll values due to a water deficit has been observed for squash (Ors, Ekici, Yildirim & Sahin, 2016), cabbage, cotton (Iqbal et al., 2019), and wheat (Talebi, 2011).

Moisture content

The soil moisture content was measured at 1 DAI, 3 DAI, 7 DAI and 14 DAI (Day After Irrigation) intervals in every irrigation time. Effects of different mulching materials on soil moisture content at 45 DAS (first time of irrigation), 68 DAS (second time of irrigation) and 84 DAS (third time of irrigation) at Yezin are shown in Table 1. At 45 DAS (first time of irrigation), the soil moisture content was significantly different among different mulching materials at 7 DAI and 14 DAI while T2 was resulted the maximum soil moisture content (13.81 %) followed by T7 > T4 > T5 > T3 > T6 whereas the minimum soil moisture (4.47 %) was recorded from T1 at 14 DAI. At 68 DAS (second time of irrigation), there were not significantly different among the different mulching materials at 1 DAI and 3 DAI. At 14 DAI, the maximum soil moisture content (7.51 %) was observed from T2 > T4 > T6 > T5 > T7 >T3 while the minimum soil moisture content (3.81 %) was achieved from T1. At 84 DAS (third time of irrigation), soil moisture contents were not significantly different among the different mulching materials at 1 DAI and 3 DAI. At 14 DAI, the maximum soil moisture content (5.58 %) was observed from T7 followed by T2 > T6 > T4 > T3 > T5 whereas the lowest soil moisture content (2.16 %) was recorded in the T1 which was significantly lower than other treatments. Therefore, mulching enables the soil moisture levels to maintain for longer periods and acts as a vapor barrier to reduce evaporation. Mulch protects soil surface serving as a block which is meant to prevent moisture loss from the soil, and as a result, water would remain longer under the soil and which can be converted into soil moisture available for plant growth (Sinukaban, 2007; Shaver, Peterson, Ahuja & Westfall, 2013).

The different mulching materials affected on soil moisture content at 45 DAS (first time of irrigation), 78 DAS (second time of irrigation) and 93 DAS (third time of irrigation) at Yamethin (Table 2). The soil moisture content was recorded until 35 DAI (days after irrigation). Whereas, the soil moisture contents were significantly different among different mulching materials at 35 DAI and the highest soil moisture contents (12.15 %) were observed from T2 followed by T7, T4, T6, T5 and T3 meanwhile the lowest soil moisture content (7.32 %) was resulted from T1. At 78 DAS (second time of irrigation), the soil moisture content was significantly different among different mulching materials at 14 DAI. The maximum soil moisture content (23.53 %) was detected from T7 followed by T4, T2, T5, T3 and T6 while T1 was noted the minimum soil moisture content (23.53 %). At 93 DAS (third time of irrigation), the soil moisture contents were significantly different on different mulching materials. At 14 DAI, the soil moisture content was significantly different on different mulching materials and the maximum moisture content (16.43 %) was resulted from T7 followed by T4, T2, T6, T5 and T3 although the minimum soil moisture content (12.58 %) was recorded from T1. In the present study, it may be assumed that different mulches can improve soil moisture by decreasing moisture losses from soil because they completely covered around the root environment and may favorable for plant growth due to effective use of water. The greater capacity of straw mulch to maintain moisture content in the topsoil is attributed to lower soil evaporation owing to the mulch cover, as opposed to soil with no mulch covering (Li, Li, Lin, Feng & Dyck, 2018).

Leaf area index (LAI) and crop growth rate (CGR)

In the present study, LAI was measured at MGS, TS and GFS at Yezin (Figure 3A). At MGS and TS, LAI value was significantly different among different mulching treatments. At GFS, LAI value was not significantly differences among mulching materials. However, the highest LAI value (1.33) was obtained from T2 followed by T6 > T4 > T5 > T3 whereas the minimum LAI (1.05) was observed in T1. Mean effect of different mulching materials was observed on leaf area index at Yamethin (Figure 3B). The LAI values of all mulching treatments were not significantly different at all sampling times. At MGS, the maximum LAI value (2.19) was obtained from T2 while the minimum LAI value (1.47) was recorded in T1. At TS, the maximum LAI (2.71) was obtained in T2 whereas the minimum LAI (1.57) was resulted in T1. At GFS, the highest LAI value (2.00) was observed from T7 which was followed by T2 with value of (1.91) while the minimum LAI value (1.54) was recorded from T1. In both experiments, no mulching plot obtained the lowest LAI in all growth stages. A larger leaf area contributes to a higher yield in maize as it helps capture of more solar energy, which enhances photosynthesis. These findings could imply that no mulching increases water evaporation, which has a negative impact on plant development and leaf number due to a reduction in photosynthetic rate and, as a result, a decrease in LAI. It shows a substantial rise in maize LAI when mulching is used (Tolk, Hawell & Evett, 1999).

Crop growth rate (CGR) measured at MGS and TS stages were also affected by different mulching in growth stages. Significantly differences in crop growth rate (CGR) were observed at Yezin (Figure 4A). CGR was significantly different among different mulching materials and the highest CGR (13.31 $gm^{-2}day^{-1}$) was observed in T2 followed by T3, T7, T4, T5 and T6 whereas the lowest CGR (5.06 $gm^{-2}day^{-1}$) produced in T1. At Yamethin, CGR was significantly different among different mulching materials (Figure 4B). The highest CGR value (14.19 $gm^{-2}day^{-1}$) was obtained from T2 followed by T7 with mean value of (11.21 $gm^{-2}day^{-1}$), T4, T6, T5 and T3 whereas the least CGR value (3.72 $gm^{-2}day^{-1}$) was recorded in T1. In mulching treatments, the higher CGR was resulted from rice straw mulching treatments in both experiments. It could be assumed that rice straw mulching has contributed to increasing vegetative growth and has had a positive effect on the growth of the maize crop. These results are in arrangement with the investigations of Sharma and Sharma (2003); Singh, Vidya Chaudhari and Basu (2007) who also suggested that mulching advances result in plant growth, yield and yield quality.

Weed infestation

Weed infestation of grasses, sedges and broadleaf weeds was measured two times at 45 and 90 DAS. The weed infestation was significantly different between mulching and no mulching plots at Yezin (Table 3). At 45 DAS, the maximum grasses dry weight (43.74 g), sedges dry weight (20.41 g) and total weed dry weight (64.15 g) were observed from T1 and the minimum grasses dry weight (4.76 g), sedges dry weight (2.25 g) and total weed dry weight (7.0 g) were obtained from T7. In the experimental site, broadleaf weeds were not found during the growing season. At 90 DAS, the weed infestation was significantly different among different mulching treatments. The lowest grasses dry weight (38.66 g) was observed in T2, sedges dry weight (1.00 g) from T6 and total weed dry weight (40.86 g) was observed in T2 while the highest grasses dry weight (93.80 g), sedges dry weight (14.33 g) and total weed dry weight (108.13 g) were resulted from T1. It can be assumed that the plants with no mulching showed the most weed infestation due to favorable conditions for weed germination and weed growth. Evans, Knezevic, Lindquist, Moll and Kamprath (1997) reported that the wide species of weed families interfere with the standing maize crop for a prolonged period and are able to decrease ear number per plant and thousand seed weight linearly.

Similar to Yezin, weed infestation was measured two times at 45 DAS and 90 DAS at Yamethin. Weed infestation was significantly suppressed by the different mulching treatments (Table 4). At 45 DAS, the minimum grasses weight (0.18 g) was observed from T2 which was not significantly different with T7 with the mean value of (0.24 g) and the maximum grasses weight (0.70 g) was recorded from T1. Furthermore, T1 was recorded the highest sedges weight (0.87 g) and the lowest sedges weight (0.33 g) resulted in T7. T2 resulted the minimum broadleaves weed weight (0.36 g) which was the same with T7 whereas

T1 gave the maximum broadleaves weed weight (0.78 g). The maximum total weed weight (2.34 g) was recorded from T1 and the minimum total weed weight (0.93 g) was obtained from T7 < T2 < T6 < T3 < T4 < T5. At 90 DAS, the grasses weights were significantly differences among different mulching materials and the maximum grasses weight (0.09 g) was observed from T1 and T5 whereas the minimum grasses weight (0.03 g) was obtained from T7 and T3. The sedges weights were not significantly different among different mulching materials. The maximum sedges weight (0.09 g) was achieved from T1 and the minimum sedges weight (0.04 g) was from T4. The highest broadleaves weed weight (0.17 g) was recorded from T1 whereas the lowest broadleaves weed weight (0.03 g) was achieved from T6. The maximum total weed weight (0.35 g) was found from T1 and the minimum total weed weight (0.25 g) was recorded from T6 < T7 < T2 < T3 < T4 < T5. Weeds not only compete for moisture, nutrients, light and air but also produce toxic allelochemicals in the plant rhizosphere through root exudation (Hussain, Khaliq, Matloob, Fahad & Tanveer, 2015). Sarma and Gautam, (2010) reported that yield loss due to weed infestation in maize crops is substantially greater than that of other agricultural diseases and pests, and depending upon nature, intensity and duration yield losses varying from 28-100%.

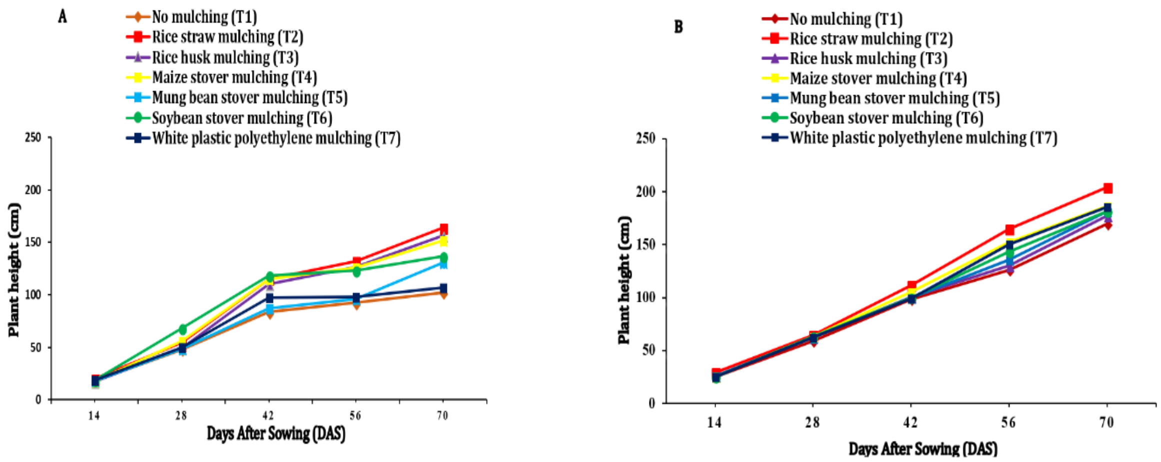


Figure 1. Plant height of maize as affected by different mulching materials at Yezin (A) and Yamethin (B) during dry season, 2019 – 2020

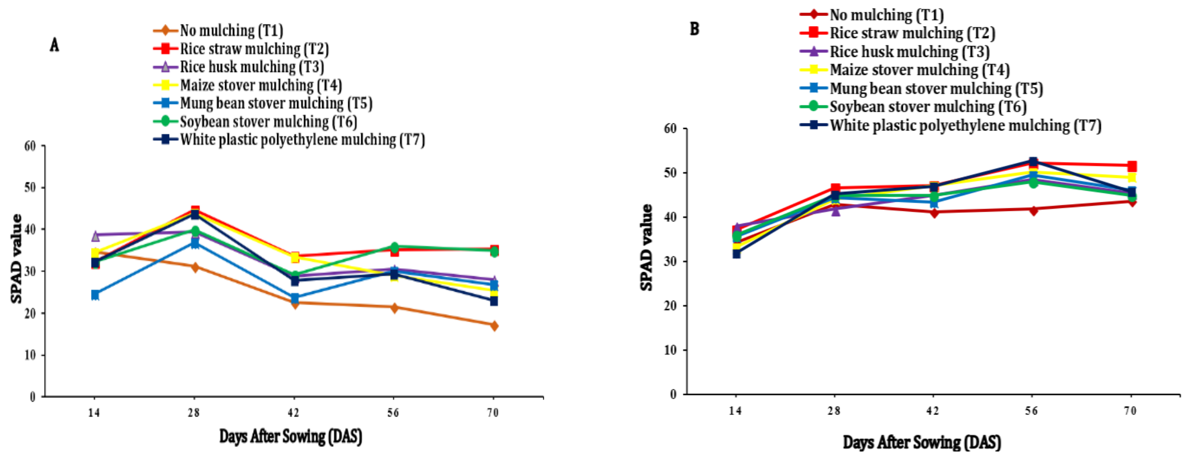


Figure 2. SPAD value of maize as affected by different mulching materials at Yezin (A) and Yamethin (B) during dry season, 2019 - 2020

Table 1. Soil moisture content as affected by different mulching materials at Yezin during the dry season, 2019 – 2020

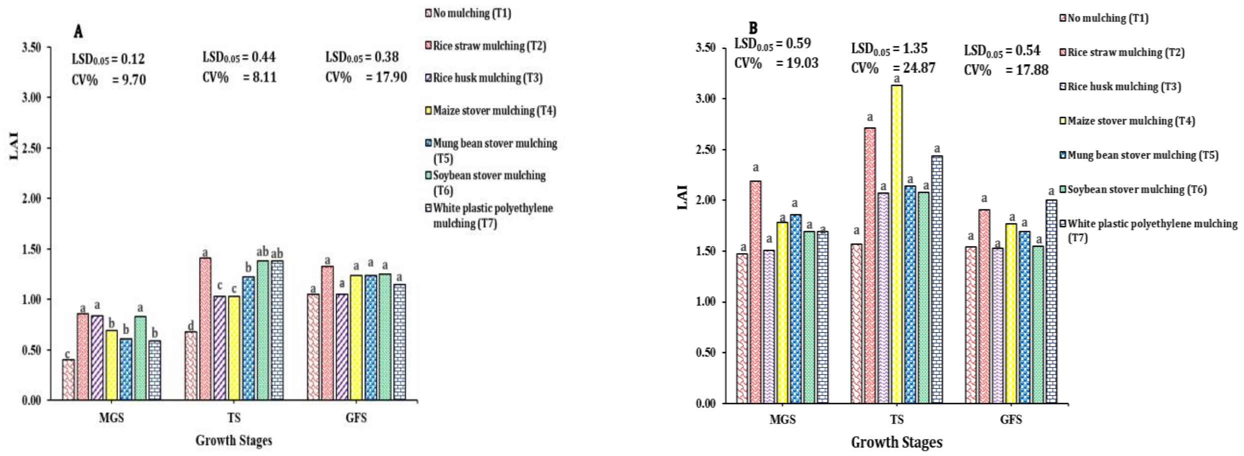
Treat-ments	1st Irrigation (45 DAS)				2nd Irrigation (68 DAS)				3rd Irrigation (84 DAS)			
	1 DAI	3 DAI	7 DAI	14 DAI	1 DAI	3 DAI	7 DAI	14 DAI	1 DAI	3 DAI	7 DAI	14 DAI
T1	19.72	16.34	9.31 d	4.47 d	34.52	22.67	5.38 e	3.81 c	13.51	10.30	4.02 d	2.16 d
T2	26.30	23.78	26.12 a	13.81 a	35.46	29.03	19.94 a	7.51 a	14.74	11.90	6.62 ab	4.59 ab
T3	24.23	22.53	18.20 ab	9.25 c	34.05	26.26	13.82 b	5.81 b	14.30	9.83	5.29 cd	3.16 cd
T4	22.92	21.27	18.33 bc	11.73 b	30.46	28.57	13.07 b	7.05 ab	14.02	11.33	5.05 cd	3.21 cd
T5	26.41	23.13	19.34 b	11.06 b	34.20	25.55	10.90 c	6.48 ab	13.91	11.10	5.88 bc	2.77 d
T6	21.81	20.44	15.69 c	9.22 c	37.29	27.37	8.43 d	6.61 ab	13.90	10.58	5.21 cd	4.09 bc
T7	24.02	20.16	18.15 bc	12.16 b	27.77	26.04	19.68 a	6.42 ab	13.90	11.79	7.35 a	5.58 a
$LSD_{0.05}$	6.90	6.36	2.93	1.26	6.61	8.27	1.63	1.43	2.70	3.19	1.28	1.20
Pr>F	0.3941	0.2706	0.00001	0.00001	0.1094	0.7035	0.00001	0.0028	0.9719	0.7757	0.0022	0.0007
CV%	16.41	16.95	9.23	6.93	11.13	17.54	7.04	12.92	10.80	16.22	12.76	18.45

DAS= Days After Sowing, DAI = Days After Irrigation, T1- No mulching, T2- Rice straw mulching, T3- Rice husk mulching, T4- Maize stover mulching, T5- Mung bean stover mulching, T6- Soybean stover mulching, T7- White plastic polyethylene mulching

Table 2. Soil moisture content as affected by different mulching materials at Yamethin during the dry season, 2019 – 2020

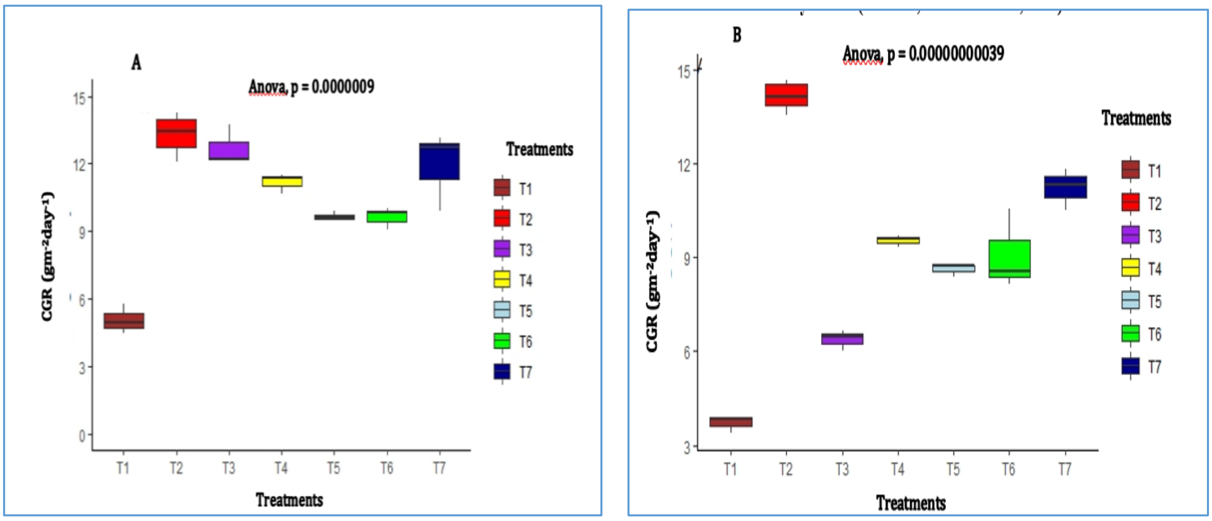
Treat-ments	1st Irrigation (45 DAS)			2nd Irrigation (78 DAS)						3rd Irrigation (93 DAS)		
	1 DAI	7 DAI	14 DAI	1 DAI	7 DAI	14 DAI	1 DAI	7 DAI	14 DAI	1 DAI	7 DAI	14 DAI
T1	69.55	33.29 b	13.81	69.55	33.29 b	13.81	69.55	33.29 b	13.81	69.55	33.29 b	13.81
T2	64.96	51.01 a	26.31	64.96	51.01 a	26.31	64.96	51.01 a	26.31	64.96	51.01 a	26.31
T3	62.72	42.11 ab	16.50	62.72	42.11 ab	16.50	62.72	42.11 ab	16.50	62.72	42.11 ab	16.50
T4	65.81	51.09 a	20.30	65.81	51.09 a	20.30	65.81	51.09 a	20.30	65.81	51.09 a	20.30
T5	62.57	42.95 ab	20.38	62.57	42.95 ab	20.38	62.57	42.95 ab	20.38	62.57	42.95 ab	20.38
T6	60.24	44.64 a	16.80	60.24	44.64 a	16.80	60.24	44.64 a	16.80	60.24	44.64 a	16.80
T7	66.65	51.37 a	21.01	66.65	51.37 a	21.01	66.65	51.37 a	21.01	66.65	51.37 a	21.01
$LSD_{0.05}$	15.69	11.30	7.551	15.69	11.30	7.551	15.69	11.30	7.551	15.69	11.30	7.551
Pr>F	0.8866	0.0385	0.0653	0.8866	0.0385	0.0653	0.8866	0.0385	0.0653	0.8866	0.0385	0.0653
CV%	13.64	14.05	21.99	13.64	14.05	21.99	13.64	14.05	21.99	13.64	14.05	21.99

DAS = Days After Sowing, DAI = Days After Irrigation, T1- No mulching, T2- Rice straw mulching, T3- Rice husk mulching, T4- Maize stover mulching, T5- Mung bean stover mulching, T6- Soybean stover mulching, T7- White plastic polyethylene mulching



MGS= Maximum growth stage, TS= Tasseling stage, GFS= Grain filling stage

Figure 3. Leaf area index of maize as affected by different mulching materials at Yezin (A) and Yamethin (B) during dry season, 2019 – 2020



T1- No mulching, T2- Rice straw mulching, T3- Rice husk mulching, T4- Maize stover mulching, T5- Mung bean stover mulching, T6- Soybean stover mulching, T7- White plastic polyethylene mulching

Figure 4. Crop growth rate of maize as affected by different mulching materials at Yezin (A) and Yamethin (B) during dry season, 2019 – 2020

Table 3. Weed infestation of maize as affected by different mulching materials at Yezin during the dry season, 2019 - 2020

Treatments	45 DAS Weed Dry Weight (1 m²)			90 DAS Weed Dry Weight (1 m²)		
	Grasses (g)	Sedges (g)	Total (g)	Grasses (g)	Sedges (g)	Total (g)
T1	43.74 a	20.41 a	64.15 a	93.80 a	14.33 a	108.13 a
T2	11.71 cd	12.26 b	23.97 c	38.66 e	2.20 de	40.86 d
T3	26.35 b	6.53 cd	32.88 b	70.67 b	3.80 cd	74.47 b
T4	12.75 c	6.75 cd	19.50 c	61.21 bcd	6.33 b	67.55 bc
T5	10.86 cd	8.85 c	19.71 c	56.85 cd	4.87 bc	61.72 c
T6	13.00 c	4.67 de	17.66 c	69.21 bc	1.00 e	70.21 bc
T7	4.76 d	2.25 e	7.01 d	54.75 d	6.80 b	61.55 c
$LSD_{0.05}$	7.19	3.00	6.67	13.00	2.40	12.61
Pr>F	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001
CV%	22.98	19.14	14.19	11.49	24.00	10.24

T1- No mulching, T2- Rice straw mulching, T3- Rice husk mulching, T4- Maize stover mulching, T5- Mung bean stover mulching, T6- Soybean stover mulching, T7- White plastic polyethylene mulching

Table 4. Weed infestation of maize as affected by different mulching materials at Yamethin during the dry season (2019 - 2020)

Treat-ments	45 DAS Weed Dry Weight (1 m²)				90 DAS Weed Dry Weight (1 m²)			
	Grasses (g)	Sedges (g)	Broadleaves Weed (g)	Total (g)	Grasses (g)	Sedges (g)	Broadleaves Weed (g)	Total (g)
T1	0.70 a	0.87 a	0.78 a	2.34 a	0.09 a	0.09	0.17 a	0.35 a
T2	0.18 e	0.41 de	0.36 d	0.95 e	0.04 bc	0.06	0.06 cd	0.15 c
T3	0.38 d	0.60 bc	0.53 b	1.52 c	0.03 c	0.05	0.07 bc	0.15 c
T4	0.46 c	0.76 a	0.59 b	1.81 b	0.07 ab	0.04	0.05 cd	0.16 c
T5	0.58 b	0.62 b	0.61 b	1.81 b	0.09 a	0.06	0.10 b	0.25 b
T6	0.42 cd	0.48 cd	0.45 c	1.36 d	0.04 bc	0.05	0.03 d	0.12 c
T7	0.24 e	0.33 e	0.37 d	0.93 e	0.03 c	0.05	0.05 cd	0.13 c
$LSD_{0.05}$	0.24	0.14	0.08	0.12	0.04	0.03	0.04	0.07
Pr>F	0.00001	0.00001	0.00001	0.00001	0.0112	0.1193	0.0001	0.0001
CV%	8.61	13.09	8.05	4.22	40.13	33.48	29.15	21.04

T1- No mulching, T2- Rice straw mulching, T3- Rice husk mulching, T4- Maize stover mulching, T5- Mung bean stover mulching, T6- Soybean stover mulching, T7- White plastic polyethylene mulching

Conclusion

In the present study, all mulching methods were found to have the best performance in soil moisture, leaf area index, crop growth rate, and weed infestation. Rice straw mulching resulted in the highest plant height and SPAD values. At three sampling times, the maximum LAI was achieved from rice straw mulching at Yezin. At Yamethin, the maximum LAI was recorded from rice straw mulching at MGS, maize stover mulching at TS and white plastic polyethylene mulching at GFS. The maximum CGR was achieved from rice straw mulching. White plastic polyethylene mulching and rice straw mulching can be considered as the best for conservation of soil moisture and minimal weed infestation. Moreover, all of the mulching materials not only maintained the maximum soil moisture content but also suppressed weed infestation better than no mulching. Therefore, mulching practices are efficient for maize production, and rice straw mulching is the best in all parameters among the treatments for Yezin and Yamethin areas. Based on the results obtained in the future, different mulching rates should be tested, and soil nutrient recovery should be studied by type.

Author's declaration

Authors declare that there is no conflict of interest. ZMA conducted field experiments, recorded and analyzed field data, and prepared the manuscript. TZ, AZH, LTN and HHO supervised the experiment and conducted manuscript proof-reading before submission. All authors read and approved the final version of the manuscript.

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