Original Research Article

Effect of organic mulching on weed ~~supression~~suppression, yield and yield contributing components of sesame (*Sesamum indicum* L.)

Abstract

Sesame is the second in oil crop produced in Ethiopia next to niger seed and it is also 2nd foreign currency generator in the country. Weed is the most significant problem in sesame producing areas. This research was conducted with the aim of reducing weed infestation and boost yield. The experiment was conducted in 2016 cropping season at Humera Agricultural Research Center in RCBD design. Growth performance, yield and yield components and weed data collected. Less abundant and dense *Rahynochosia malacophylla* weeds (33 & (132 m^{-2})) were recorded at ~~sudan~~Sudan grass, whereas the most abundant and dense *Rahynochosia malacophylla* weeds (60.5 & (242 m^{-2})) recorded at no mulch plot. The highest yield (695 kg ha^{-1}) was recorded at ~~sudan~~Sudan grass, while the lowest yield (225 kg ha^{-1}) was recorded at no mulch. Farmer should apply grass mulch to suppress weed growth and boost yield.

Introduction

Sesame (*Sesamum indicum* L.) is an important oil crop of Ethiopia, which belongs to the Pedaliaceae family. It is short day plant that grows mainly for its vital seed that contains about 50% oil and 25% protein [1]. Sesame is the second in oil crop produced in Ethiopia next to niger seed and it is also 2nd foreign currency generator in the country. Sesame is a warm season oil crop which is chiefly adapted to areas with extended growing period and well aerated soils. Sesame performs well in slightly acid to alkaline soils (pH 5-8) with moderate fertility [2].

Weed is the most significant problem in sesame producing areas of Ethiopia particularly in western zone of Tigray which can cause a yield loss up to 86.3% [3] . This could be due to lack of option for weed control except hand weeding method. In sesame growing areas of western Tigray there is a strong interest in developing weed control options that are organic nature and

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can keep its international market quality. So application of organic mulching can reduces weed growth and used as a means of weed control option through the world [4]. Organic mulching is important in crop production as they can suppress weed growth by different scholars [4],; [5], [6,] [7,] and [8] . Moreover, organic mulch can enhance soil fertility after decomposition at the field. Sønsteby et al., [9] also noted wood chips mulch fertile a soil with phosphorus and potassium. Mulch also increases soil moisture by increasing infiltration and reducing evaporation. In this regard, -[10] reported high soil moisture conservation for sudanSudan grass, sesame and sorghum mulches respectively. This in conformity with [11]. Mulch do not only suppress weed growth, they conserve also moisture in the root zone [12] and increase also yield. The objectives of the study were:

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- To quantify the efficacy of organic mulching on weed infestation
- To determine effect of organic mulching on yield and yield components

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Material and ~~m~~Methods

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~~2.1.~~ Area description~~.~~

The field experiment was carried out in 2015 main growing season in Humera Agricultural Research Center Western zone of Tigray Ethiopia. It is positioned between 13°14 to 14°27N and 36°27to 37°32E and about 600 km from Mekelle capital city of Tigray regional state. The dominant soil type of the area is chromic vertisol black in color which is characterized with bulk density of 1.4 g cm^{-3}, organic matter content of 1%, pH =8.5 and EC =0.2 mmohs/cm from analyzed result of pre sowing soil sampled. According to Köppen climate classification Humera has a hot semi-arid climate. The annual rainfall ranges between 400 to 600 mm and most of the rain rains in June up to September. The annual mean temperature is 27.6 °C. It is also characterized by hot temperature, erratic rainfall, vast area of plain low lands suitable for large scale and subsistence agriculture including crops and livestock.

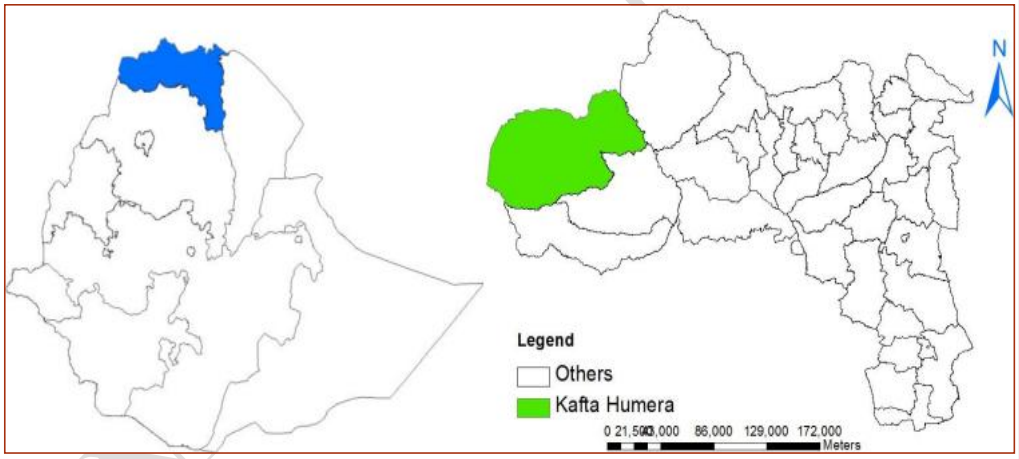

Fig. 1. Map showing study location in Ethiopia

Experimental Design and Treatment

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The experimental design used was Randomized Complete Block Design (RCBD) with three replications and five treatments. The tested treatments were sesame straw, sorghum straw, rice straw, Sudan grass, and no mulch. The gross plot area was 6 m^2 and the net plot area was 3.6 m^2.

The distance between the plot and block was 1 and 1.5 m, correspondingly. Sesame seed variety Setit-1 was sown 40 cm and 10 cm between rows and plants, correspondingly. The field was plowed and provided with 100 kg of NPS (19% N +- 38% P_2O_5 + 7% S) and 50 kg of urea fertilizer. The urea was applied in split form 25 kg at sowing and 25 kg at flower initiation. Webworm pest which cause a potential yield reduction was control with application of diamatet zenawi 2017. In harmony with the methods adopted by [13] the rate of mulches used was 6 kg per plot which is equivalent to 10 t~~on~~/ha and was applied at row whole immediately after germination of sesame and the emerged weed was uprooted using a hoe.

Measurements and Measurements Method

Weed population was determined by counting number of weed plants in 0.5 m x ~~*~~0.5 m quadrant which is dropped randomly three times in a plot. Data was collected in four weeks after sowing. Based on weed count, weed abundance (eq. 1), ~~frequency (eq.1) (eq. 2) and~~ weed dominance (eq. 2~~3~~) and density (eq. 3) were determined.

Weed abundance: it is the population of a species expressed as the number of individuals of weed per unit area. It was calculated as follows:

$$A=\frac{\sum \mathbf{w}}{\mathbf{N}} \quad \text{..... (Equation 1)}$$

Where,

W = number of individuals of a species/sample

N = number of sample

Weed dominance: abundance of individual of species in relation to total abundance. it is calculated as:

$$D=\frac{A*100}{\sum A} \quad \text{..... (Equation 2)}$$

$$\text{Density} =\frac{No.of\ weed\ of\ agiven\ species}{area} \quad \text{..... (Equation 3)}$$

-Agronomic Traits of Sesame

Number of capsules per plant and number of seeds per capsule were counted from five randomly selected plants per plot. Plant height is one of the growth parameter that was measured from five plants per plot. To determine the number of seeds per capsule, the seeds

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of three capsules (lower, medium, and uppermost position on the plant) from each of five plants were counted. Seed yield of each plot was weighed in grams and converted to area basis to determine the yield in kg/ha.

Weed growth

The different grassy and broad leaved weeds observed in association with sesame crop in the study area were ~~s~~Sudan grass (*Topas*), *Rahynochosia malacophylla* (*Teken*), *Ipomoea* spp. (*Dereya*), *Indigofera* spp. (*Demayto*), *Commelina* ~~f~~*Foecunda* (*Wuhankur*) and *Xanthium abyssinicum* (*Begdzemed*). Among the two categories of weeds, broad leaved weeds showed more variation in species composition.

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Result and discussion

Table 1. Effect of organic mulching on weed abundance in sesame fields

	RM		Ip spp		XA		CF		*INS*		Sg	
treatment	Abundance	Density	Abundance	density	Abundance	density	Abundance	Density	Abundance	density	abundance	density
No mulch	60.5	242.0	20.5	82.0	18.0	72.0	26.0	104.0	17.5	70	18.0	72
Rice straw	56.0	224.0	17.5	70.0	11.0	44.0	14.0	56.0	7.5	30	9.0	36
Sesame straw	27.5	110.0	9.0	36.0	3.3	13.2	9.0	36.0	3.5	14	3.0	12
Sorghum straw	33.0	132.0	17.5	70.0	6.5	26.0	10.5	42.0	5.0	20	3.5	14
Sudan grass	33.0	132.0	10.2	40.7	6.8	27.0	11.5	46.0	6.5	26	7.5	30
CV	32.5	32.4	20	20.0	41.8	41.8	37.6	37.0	40.7	40.7	48.6	48.6
LSD	16.3	65.1	3.6	14.24	4.6	18.2	6.4	25.5	3.9	15.6	4.8	19.0

RM=*Rahynochosia malacophylla* XA=*Xanthium abyssinicum* *INS= Indigofera CF= Commelina ~~F~~foecunda IP= Ipomoea* spp. sg= Sudan grass

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Influence of organic mulch on broad leafed weed in abundance and density

~~a~~All broad leafed weeds such as *Rahynochosia malacophylla*, *~~i~~Ipomoea* spp., *Commelina ~~f~~Foecunda*, *Indigofera* spp. and *Xanthium abyssinicum* in sesame field showed highly significant difference at ($p<0.01$) in abundance and density. Abundant and dense weeds of *Rahynochosia malacophylla*, *~~i~~Ipomoea* spp.~~,~~ was noted at no mulch though statistically insignificant with rice straw. In other hand less abundant and dense weeds of *Rahynochosia malacophylla*, *~~i~~Ipomoea* spp.~~,~~ was noted at sorghum, sesame and ~~s~~Sudan grass mulch, respectively (Table1). *Commelina ~~F~~foecunda* and *Indigofera* spp. weeds were easily influenced by all organic mulches in abundance and density (Table 1). *Xanthium abyssinicum* weed was influenced by all mulch material compared to bare plot though there was insignificant difference among organic mulches except for sesame straw. This influence of organic mulch on weeds could be due to the nature of mulch material suppress weed growth through direct sunlight prevention to growing weed seedling and suffocation. This result in line with Stiegler et al.~~,~~ [14], who reported dry grass reduced weed infestation significantly. In addition a layer of mulching material prevents weed growth by inhabiting light penetration [15].

Organic mulching had high significant difference at ($p<0.01$) on ~~s~~Sudan grass weed in terms of abundance and density. The highest ~~s~~Sudan grass weed abundance and density was recorded at bare plot while the lowest at sesame straw mulch (Table 1).

Influence of organic mulching on weed frequency and dominance

The analysis of variance revealed that organic mulch have significant difference ($p<0.05$) on weed frequency in all weeds except *Rahynochosia malacophylla*. All weeds were frequently occurred on the bare and rice mulched plots while less frequent weed occurred on organic mulching except in the case *Rahynochosia malacophylla* which occurred frequently on all treatment (~~f~~Fig.~~ure~~ 2).

The analysis of variance also shown that organic mulching have insignificant difference ($p>0.05$) on weed dominance in the case of all weed except on Ssudan grass (F~~f~~ig.~~ure~~ 3).

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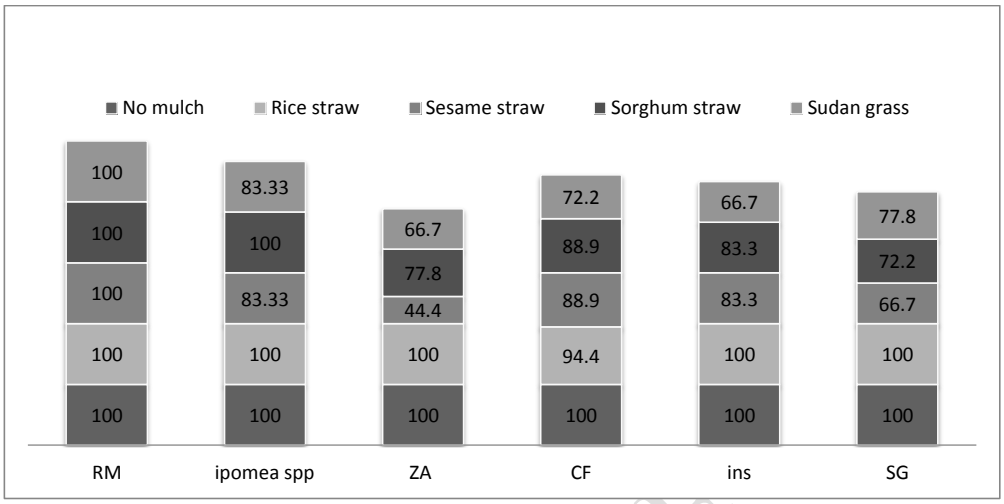

Fig. 2. Effect of organic mulching on weed frequency

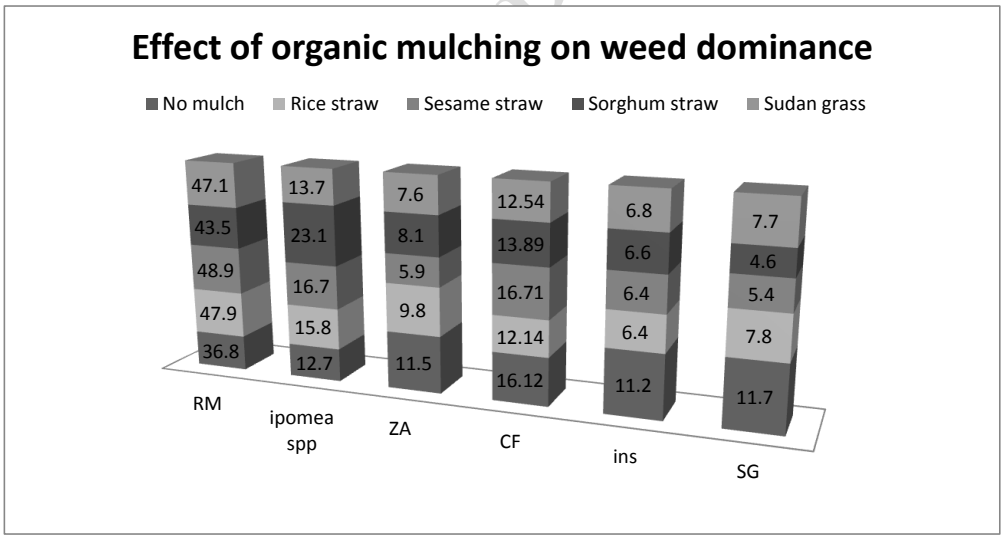

Fig. 3. Effect of organic mulching on weed dominance

Plant height

The analysis of variance showed that organic mulching have highly significant difference (P<0.01) on plant height. The tallest plant height (87.1 cm) was recorded at Sudan grass while the shortest plant height (56 cm) was recorded at bare plots (Table 2). Since the mulch treatment reduced weed infestation as a result the overall performance of the plant superior compared to bare treatment which is weedy. This result in line with Ajibola~~,~~ ~~A.,~~ et al.~~,~~ [16], who reported elephant grass produce highest plant compared to no mulch via weed suppression. This highest plant height in mulch plot could be due to less competition to resource for sesame via controlling undesirable weed.

Number of capsules per plant

The analysis of variance revealed that number of capsules per plant showed highly significant difference ~~on number of capsule per plant~~. The highest numbers of capsules per plant (39.7 & 37.7) were noted at ~~s~~Sudan grass and sesame mulch material, while the lowest was (27.1) recorded at bare plots (Table 2) ~~respectively~~. This could be due to the benefit of mulching material in weed suppression. Sudan grass and sesame straw were effective due to their un decomposed nature. Elephant grass mulching produce comparable result with other weed control option such as hand weeding and herbicide [16]. The lowest number of capsules in no mulch plot could be due to sever competition for resource such as water, nutrient and light and this sever competition prevent from conversion of all produced flower to capsule.

Number of seeds per capsule

The analysis of variance shown that organic mulching has highly significant difference (p<0.01) on number of seeds per capsule compared to bare treatment. All mulching materials didn't show significant difference in between except rice straw. The highest number of seeds per capsule was noted in Sudan grass, sesame and sorghum mulching material while the lowest was noted bare treatment (Table 2). The less weed competition in mulch covered plots favors better number of

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seeds per capsule due to adequate availability of resource for grain filling in the mulch treated plots.

Yield (kg/ha)

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The analysis of variance revealed that organic mulching have highly significant difference ($p<0.001$) on yield compared to bare treatment. All mulching materials have significant difference among them except sorghum and sesame insignificant difference in between. The highest yield (695 kg/ha) was recorded at Sudan grass, while the lowest (225 kg/ha) was recorded at bare plots (Table 2). Mulch treatment as means of weed control increased yield 67.6% yield compared to bare plots. This might be due to the mulching material had significant effect on important agronomic parameter such as plant height, number of capsule and number of seed per capsule.

Table.2 Influence of mulching on yield and yield component of sesame

Treatment	PH	NSPP	NCPP	Yield (kg/ha)
No mulch	56.0^{d}	35.0^{c}	27.1^{c}	225.0^{d}
Rice mulch	77.9^{c}	39.8^{b}	29.7^{c}	496.0^{c}
Sesame mulch	86.0^{ab}	43.5^{a}	37.7^{ab}	587.9^{b}
Sorghum mulch	82.6^{b}	43.0^{a}	31.8^{bc}	550.2^{b}
Sudan grass mulch	87.1^{a}	44.3^{a}	39.7^{a}	695.0^{a}
CV (%)	4.5	3.7	15	7.2
LSD	4.2	1.9	6.1	44.7

Conclusion

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The result of the study show that organic mulching had great influence on weed abundance, frequency, dominance and density and as a result good plant performance and yield compared to control.

Conflict of interest

The author revealed that there is no conflict of interest on publication of this paper.

Data availability

The data used to support this finding will be available up on request.

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