Effect of Mulching and Sulphur on Growth and Yield of Yellow mustard (*Sinapis alba)*

ABSTRACT

A field experiment was carried out at Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, SHUATS, Prayagraj (U.P) in *Rabi,* 2021 to study the Effect of Biofertilizers and Sulphur on Growth and Yield of Yellow Mustard (*Sinapis alba*). It was consisting of combination of three types of Mulching No mulch, Paddy straw and Poly sheet mulch and three Sulphur levels (20kg S/ha, 40 kg S/ha and 60 kg S/ha). The experiment was laid out in Randomized Block Design with nine treatments each replicated thrice. The experiment results revealed that the growth parameters and yield parameters such as plant height (145.94 cm), dry weight (34.30 g), number of branches/plant (11.58), number of seeds/siliquae (37.41) and test weight (3.08 g) at harvest, significantly recorded in treatment T_9 with the application of Poly sheet mulch+60 kg S/ha. Moreover, seed yield (1.82 t/ha), stover yield (3.94 t/ha), gross return (95,762.64 INR/ha), net return (52,487.44 INR/ha) and B:C ratio (2.21) were also recorded significantly higher in the treatment which is Poly sheet mulch + Sulphur 60 kg/ha among all treatments.

Comment [DE1]: What is the relationship between mulching and biofertilizers?! Can you consider the mulching one of biofertilizers? It's wrong.

Keywords: *Mulching, Sulphur, yellow mustard, Growth and Yield.*

INTRODUCTION

In present era oil seed crops form the main source of energy for major portion of Indian population due to less availability of animal fat and its ill effect on heart. Among the rapeseed and mustard group, yellow sarson which belongs to family Brassicaceae is an important crop in terms of its high seed oil and protein content. value. In India, about 27.5 million ha area is occupied by oilseeds which represent 14 per cent of the total cropped area with the production of 24.72 million tonnes accounting for 5 per cent of gross national product and 10 per cent value of all agricultural commodities **(Anonymous, 2015)**.

India mustard is predominantly cultivated in the states of Rajasthan, Uttar Pradesh, Haryana, Madhya Pradesh and Gujarat. Rajasthan ranks first in area and production of rapeseed and mustard with 2.50 million ha area and 3.71 million tonnes production. Mustard oil is used as condiment in pickles, flavoring curries and vegetables, preparation of hair oils, medicines, soap making and in the tanning industry for softening of leather. The mustard cake is used mostly for cattle feed and manure **(Potdar *et al.,* 2019).**

One of the common practices to reduce evaporation loss from the soil and prolonging the availability of moisture to the crop is the use of mulches. Mulching increases soil moisture, regulates soil temperature, suppresses weed growth, minimized leaching loss of nutrients, checks excessive evaporation, reduces soil erosion, improves production and quality. Thus, mulching economises the use of irrigation or rainwater and boosts nutrient use efficiency by conserving more water in the crop rhizosphere. The effects of mulch on soil temperature, moisture regime and root growth as well as yield depend on the micro-environment, made of mulch application and quality and quantity of mulch materials (**Manoj *et al.,* 2014**). Mulch increased soil organic matter and soil moisture contents but decreased bulk density and soil strength compared to control. The effects of mulch on soil temperature, moisture regime and root growth as well as yield depend on the micro-environment, made of mulch application and quality and quantity of mulch materials. Keeping in view these circumstances, it was contemplated to work out the suitable tillage and mulching practices for taking the higher yield of mustard in rainfed condition.

The poly sheet can be used in moisture deficit areas. The polythene mulch is easily available in the market and its use in agriculture is eco-friendly as after use, poly sheets may be collected from the crop field and can be well mixed with coltar during construction of pucca roads. If black polyethylene is used for the purpose, it prevents entry of light to the soil surface thus restricting any possible growth of weed, which is a menace in rainfed agriculture.

Comment [DE2]: What about the other mulching materials are? Some information related their, please.

Sulphur is the nutrient which plays a multitudinous role in providing nutrition to oilseed crops, particularly those belonging to ~~cruciferae~~Cruciferae family. The importance of sulphur is obvious in oilseed production as it is required for the synthesis of sulphur containing amino acids methionine (21%), cysteine (26%) and cystine (27%), which are essential components of protein and oil as well as for vegetative growth of the plant, it is involved in the formation of chlorophyll~~.~~, glucosides and glucosinolates (mustard oils), activation of enzymes and sulphydryl (-SH) linkages that are the source of pungency in oils and increases the root growth and stimulate seed formation. Sulphur is a secondary plant nutrient which plays a significant role in increasing production specially in oil seed crops. Rapeseed-mustard crops are particularly sensitive to sulphur deficiency mainly due to the fact that S plays an important role in the chemical composition of seed and increases the percentage of oil content of seed. Sulphur increases the oil content and gives pungency to oil as it forms certain disulphide linkages~~.~~ **(Khan *et al.,* 2002).** Oilseed crops require more Sulphur than cereals as their oil storage organs are mostly proteins, rich in S. Deficiency of Sulphur is known to hamper N metabolism in plants as well as synthesis of S-containing amino acids and thus exerts adverse effects on both seed and oil yield.

Comment [DE3]: Reinforce the introduction with some studies, please.

Comment [DE4]: What is the aim of your study? Inform a reader.

MATERIALS AND METHODS

The present examination was carried out during *Rabi* 2021-2022 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj, UP, which is located at 25.28^{o}N latitude, 81.54^{o}E longitude and 98 m altitude above the mean sea level. The experiment laid out in Randomized Block Design which consisting of nine treatments with No Mulch + Sulphur 20 kg/ha, Paddy straw mulch + Sulphur 40 kg/ha, Poly sheet mulch + Sulphur 60 kg/ha, No Mulch + Sulphur 20 kg/ha, Paddy straw mulch +Sulphur 40 kg/ha, Poly sheet mulch + Sulphur 60 kg/ha, No mulch + Sulphur 20 kg/ha, Paddy straw mulch + Sulphur 40 kg/ha, and Poly sheet mulch + Sulphur 60 kg/ha. The observations recorded on different growth parameters at harvest viz, plant height (cm), number of branches per plant, Plant dry weight, number of siliques per plant, number of grains per silique, test weight, grain yield and stover yield and harvest index were recorded and statistically analyzed using analysis of variance (ANOVA) as applicable to Randomized Block Design (Gomez and Gomez 1984).

Comment [DE5]: please, explain the answer for the following questions:
when and how the seeds sowed were?
what were the soil characteristics, fertility and texture?
what is the irrigation method was used or the plant on rainfed?
if the plants grew under rainfed condition, how much rain was in the region?

RESULT AND DISCUSSION

Growth Attributes

Effect on the growth of yellow mustard.

As can be seen in Table.1, growth parameters are summarized statistically. At 100 DAS, significantly taller plant height (145.94 cm) was recorded with Poly sheet mulch + Sulphur 60 kg /ha. However, *Paddy straw mulch + Sulphur 60 kg/ ha, Poly sheet mulch + Sulphur 40 kg/ ha* was statistically at par with *Paddy straw mulch + Sulphur 60 kg/ ha*. The minimum plant height was recorded in the treatment combination of No mulch + Sulphur 20 kg/ha which is 128.52 cm. Significantly maximum Number of branches (11.69) was recorded with application of *Paddy straw mulch + Sulphur 60 kg/ ha*. However, *Poly sheet mulch + Sulphur 60 kg/ ha* was statistically at par with *Poly sheet mulch + Sulphur 60 kg/ ha*. The minimum number of branches was recorded in the treatment combination of No mulch + Sulphur 20 kg/ha which is 9.01 g. Significantly maximum plant dry weight (34.30 g) was recorded in the treatment combination *Poly sheet mulch + Sulphur 60 kg/ ha*. However, *Paddy straw mulch + Sulphur 60 kg/ ha, Poly sheet mulch + Sulphur 40 kg/ ha* was statistically at par with *Paddy straw mulch + Sulphur 60 kg/ ha*. Pachauri et al., (2012) reported that various levels of sulphur significantly influenced the growth parameters viz., plant height and dry weight of plant. The plant height increased significantly with each increment in the dose up to 60 kg /ha. However, the difference in plant height due to further increase in the dose of sulphur was not significant. Application of 60 kg S /ha produced more dry weight of plant at 90 DAS as compared to control and 30 kg S/ ha. Better nutrition to plant resulted in more height and number of branches and other growth parameters, which resulted in higher dry weight of plant. These results are in conformity with those reported by Kumar and Yadav (2007) in mustard. The overall improvement in growth character of plant owing of sulphur application were known sulphur enhance cell multiplication, elongation and expansion, imparts a deep colour to leaves due to better chlorophyll synthesis resulting in greater amount of dry matter in comparis~~i~~on to sulphur deficient plant. This argument was also supported by Singh and Meena (2004) ~~[14]~~, Mishra (2001) ~~[8]~~, Nepalia and Jain (2000) ~~[9]~~.

Yield Attributes:

As can be seen in Table.2, yield parameters are summarized statistically. At the time of harvest, significantly length of silique (8.02 cm) was recorded with Paddy straw mulch + Sulphur 60 kg /ha. However, *Poly sheet mulch + Sulphur 40 kg/ ha, Poly sheet mulch + Sulphur 60 kg/ ha* was statistically at par with *Paddy straw mulch + Sulphur 60 kg/ ha*. The minimum length of silique was recorded in the treatment combination of No mulch + Sulphur 20 kg/ha which is (6.10 cm). Significantly maximum Number of seeds per silique (37.41) was recorded with application of *Poly sheet mulch + Sulphur 60 kg/ ha*. However, *Paddy straw mulch + Sulphur 60 kg/ ha* was statistically at par with *Poly sheet mulch + Sulphur 60 kg/ ha*. The minimum number of seeds per silique was recorded in the treatment combination of No mulch + Sulphur 20 kg/ha which is (27.07). Significantly maximum test weight (3.08 g) was recorded in the treatment combination *Poly sheet mulch + Sulphur 60 kg/ ha*. However, *Paddy straw mulch + Sulphur 60 kg/ ha, Poly sheet mulch + Sulphur 40 kg/ ha* was statistically at par with *Paddy straw mulch + Sulphur 60 kg/ ha*. The minimum test weight was recorded in the treatment combination of No mulch + Sulphur 20 kg/ha which is (2.13 g). Significantly maximum grain yield (1.82 t)) was recorded in the treatment combination *Poly sheet mulch + Sulphur 60 kg/ ha*. However, *Paddy straw mulch + Sulphur 60 kg/ ha, Poly sheet mulch + Sulphur 40 kg/ ha* was statistically at par with *Paddy straw mulch + Sulphur 60 kg/ ha*. The minimum grain yield was recorded in the treatment combination of No mulch + Sulphur 20 kg/ha which is (1.13 t). Significantly maximum stover yield (3.94 t) was recorded in the treatment combination *Poly sheet mulch + Sulphur 60 kg/ ha*. However, *Paddy straw mulch + Sulphur 60 kg/ ha, Poly sheet mulch + Sulphur 40 kg/ ha* was statistically at par with *Paddy straw mulch + Sulphur 60 kg/ ha*. The minimum stover yield was recorded in the treatment combination of No mulch + Sulphur 20 kg/ha which is (1.71 t). Significantly maximum harvest index % (37.68) was recorded in the treatment combination *Poly sheet mulch + Sulphur 60 kg/ ha*. However, *Paddy straw mulch + Sulphur 60 kg/ ha, Poly sheet mulch + Sulphur 40 kg/ ha* was statistically at par with *Paddy straw mulch + Sulphur 60 kg/ ha*. The minimum harvest index was recorded in the treatment combination of No mulch + Sulphur 20 kg/ha which is (32.22 %). Makeen et al., (2008) reported that number of siliqua plant, number of grains siliqua weight of 1000 seeds, seed yield and harvest index were significantly influenced by application of sulphur. Application of sulphur @ 60 kg/ha recorded the highest values with respect to these parameters. The seed yield increased to 25.5 q/ha at 60 kg S ha-1 as compared to 11.1 q /ha at control. These results are in agreement with the findings of Raut et al., (2000), Sharma (1994) and Sarma and Dehnath (1999). Harvest index increased significantly and harvest index at 60 kg S/ ha was higher than other treatments.

Table 1. Effect of Mulching and Sulphur on growth attributes of Yellow Mustard

Treatment combination	At 100DAS		
	Plant Height (cm)	Number of Branches per plant	Plant dry weight (g/plant)
1-No mulch + sulphur 20 kg / ha	128.52	9.01	22.74
2-Paddy straw mulch+ sulphur 20kg ha	135.23	9.21	26.25
3-Polysheet mulch + sulphur 20 kg / ha	132.79	9.17	24.39
4- No mulch + sulphur 40 kg / ha	138.04	9.70	28.43
5-Paddy straw mulch +sulphur 40 kg/ ha	143.18	10.75	32.11
6-Poly sheet mulch + sulphur 40 kg/ ha	143.62	10.93	30.18
7- No mulch + sulphur 60 kg/ ha	141.50	9.88	31.56
8 Paddy straw mulch + sulphur 60kg/ha	144.38	11.69	33.12
9-Polysheet mulch + sulphur 60 kg/ ha	145.94	11.58	34.30
F-Test	**S**	**S**	**S**
Sem (±)	2.29	0.63	1.13
CD (5%)	6.88	1.89	3.40

Table 2. Effect of Mulching and sulphur on yield attributes of Yellow Mustard

Treatment combination	At Harvest					
	Length of silique	No. of Seeds/silique	Test weight(g)	Grain yield (t/ha)	Stover yield (t/ha)	Harvest Index (%)
1	6.10	27.07	2.13	1.13	2.71	32.22
2	7.46	29.19	2.31	1.32	2.95	41.19
3	7.56	28.45	2.26	1.21	2.86	33.15
4	6.51	30.14	2.49	1.40	3.17	35.99
5	7.63	34.22	2.84	1.68	3.72	40.78
6	7.78	33.73	2.72	1.54	3.61	35.48
7	6.98	32.68	2.56	1.49	3.32	33.41
8	8.02	35.16	2.97	1.71	3.83	35.85
9	7.78	37.41	3.08	1.82	3.94	37.68
F-Test	**S**	**S**	**NS**	**S**	**S**	**S**
Sem (±)	0.35	1.32	0.27	0.06	0.04	1.94
CD (5%)	1.04	3.95	0.80	0.17	0.12	5.80

CONCLUSION

It is concluded that, treatment 9 with Polysheet mulch and sulphur 60 kg/had performed better in growth and yield parameters. As it is was more productive it can be recommended to farmers after further trails.

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Comment [DE6]: There is a need to modern references.

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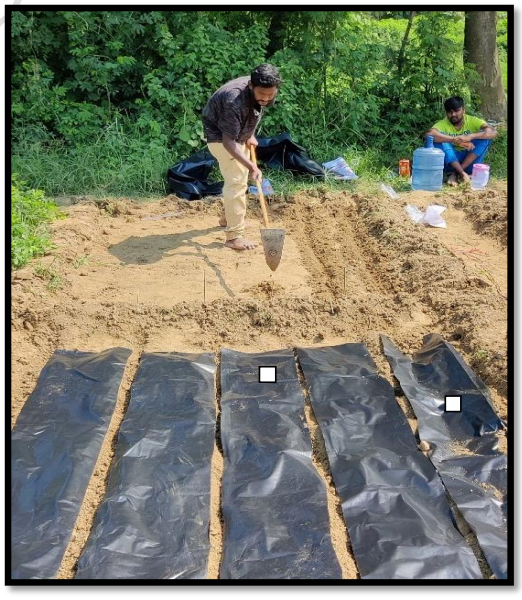

Image 1 : Arrangement of Poly sheet mulch in experimental field at Crop Research Farm.

Image 2 : Arrangement of Paddy straw mulch in experimental field at Crop Research Farm.

Image 3 : Different types of Mulches which I have took for my Research during Rabi season, 2021-22

Image 4 : The Recommended Dose of Fertilizer (80:40:40 NPK kg/ha) will be applied, as Half dose of Nitrogen along with full dose of Phosphorus, Potassium and Sulphur as basal and remaining half dose of Nitrogen after 30 Days of Sowing (DAS).

Image 5 : Harvesting in Experimental field at Crop Research Farm during Rabi season, 2021-22