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Effect of Tillage and Mulch in Mustard Crop under Rainfed Conditions

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ABSTRACT: *An experiment was conducted in* rabi *season of 2012-13 to study the effect of tillage and mulch in mustard crop under rainfed conditions. The treatments compared were two levels of tillage (Reduced Tillage and Conventional Tillage) in main plots and four levels of mulch (No mulch, Water hyacinth mulch, Paddy straw mulch, and Legume straw mulch) in sub-plots in a Split Plot Design. The growth and yield attributes* viz. *plant height, number of leaf per plant, number of primary and secondary branch per plant, total dry matter accumulation per plant, siliqua length, number of siliqua per plant, number of siliqua per seed, 1000 grain weight, seed yield, stover yield and harvest index found higher under reduced tillage and water hyacinth mulch in comparison to remaining treatments.*

Keywords: *Tillage, Mulch, Moisture conservation, Mustard, Rainfed Agriculture*

INTRODUCTION

World population is increasing day by day, which is likely serious threat to food security. This can be overcome by enhancing production of major crops. On the oilseed map of the world, India occupies a prominent position, both with regard to acreage and production and among the top few vegetable oil economies of the world. Here, oilseeds are an important component of the agricultural economy, next to food grains, in terms of area, production and value. Rapeseed-mustard (*Brassica spp*.) is a major group of oilseed crop of the world being grown in 53 countries across the six continents, with India being the second largest cultivator after China (Hedge, 2005).

Tillage has been an important aspect of technological development in the evolution of agriculture, particularly in food production. Tillage plays a vital role in conservation of soil moisture at different depths in rainfed cultivation. It also improves soil condition by altering the mechanical impedance to root penetration, hydraulic conductivity and holding capacity, which in turn affects plant growth (Dexter, 1989).

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.

MATERIAL AND METHODS

The experiment was carried out at the Agricultural Research Farm of Rajiv Gandhi South Campus, Brakachha (BHU), Mirzapur which is situated in *Vindhyan* region of district Mirzapur (25° 10′ latitude, 82° 37′ longitude and altitude of 147 meters above mean sea level). *Vindhyan* soil comes under rainfed and invariably poor fertility status. This region comes under agro-climatic zone III A (semi-arid eastern plain zone). The climate of Barkachha is sub-humid, characterized by extremes of temperature both in summer and winter with medium rainfall. Maximum

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temperature in summer (May) as high as 39.85 °C and minimum temperature in winter (January) falls below 8.12 °C. The average annual rainfall of locality is 1100 mm, of which nearly 90 per cent is contributed by South West monsoon between July to September and 10 percent rain fall in other months. The rainfall during the experimental period was recorded from the meteorological observatory of the (KVK) Agronomy farm. The total rainfall and evaporation during the crop season 2012-13 was 53.55 mm and 43.9 mm; maximum and minimum temperature was 37.48 ^{o}C and 4.75 ^{o}C, and relative humidity was 96.28 and 83.96 per cent respectively.

The soil of the experimental field was sandy loam in texture with poor fertility clearly reveals that soil was acidic in reaction, poor in nitrogen and phosphorus and moderate in potash. Observations were taken at an interval of 20 days i.e. sowing time, 20th, 40th, 60th, 80th, 100th days after sowing and at harvest. Hybrid variety Parasmani-8 was sown with the spacing of 30x10 m. The crop was sown at 21/11/2012 and harvested at 22/03/2013. Relatively higher seed rate (5 kg ha^{-1}) was applied at 4 cm depth in open furrows made with a manual single row drill and immediately covered with soil. Recommended package of practices were applied.

Split plot design was selected for experimentation having eight treatments with three replications. In main plots two treatments (Conventional tillage and Reduce tillage) and in sub-plots four treatments (No mulch, Water hyacinth mulch, Paddy straw mulch and Legume straw mulch) were applied. The gross plot size was 3 m x 4 m (12 m^2) and net plot size was 2.10 m x 3.0 m (6.3 m^2). In the control no mulch were applied while water hyacinth was applied @ 2 ton/ha and paddy and legume straw mulch were applied as 2.5 ton/ha at the next day of sowing.

RESULT AND DISCUSSION

Effect of Moisture Conservation Measures on Growth Attributes

Plant Height (cm)

Plant height was significantly highest in reduced tillage as compared to conventional tillage might be due to proper soil moisture availability and more nutrient uptake by the plant which make favorable environment for better growth and development. Similar results were also reported by Cepeda and Gomez (2010). Among the different mulches, the water hyacinth mulch was found significantly higher compare to other treatments minimum was recorded with no mulch. This could be assigned due to favorable condition for better growth through sufficient soil moisture, less weed infestation and higher nutrient uptake. Corroborative results are also studied by Wang Min *et al.*(2011).

Number of Leaf/plant

Number of leaf/plant found non significant due to tillage and significant due to mulch at maturity. The water hyacinth mulch was found significantly higher in terms of number of leaf plant^{-1} over other treatments and minimum under no mulch. This increase was attributed to healthy plant condition under this treatment. The findings were similar to Sarangi *et al.* (2010) and Yadav *et al.* (2011).

Number of Primary Branch/plant

Non significant results were obtained due to tillage and mulch both for number of primary branch/plant at maturity.

Number of Secondary Branch/plant

The reduce tillage system resulted significantly higher secondary branch plant^{-1} over conventional tillage. Water hyacinth mulch recorded significantly higher number of secondary branches over no mulch. This increase might be attributed due to better moisture content and also more number of secondary branches. The similar finding was also reported by Verma *et al.* (2010).

Total Dry Matter/plant

Significantly higher dry matter plant^{-1} was recorded under reduce tillage than conventional tillage might be due to significant increase in plant height, secondary branches, which contributes to the dry weight of plant and ultimately resulted as dry matter accumulation. This result was in conformity with Saha *et al*. (2010). The water hyacinth mulch produced significantly higher dry matter accumulation compare to no mulch. This increase in dry matter could be assigned due to better environment for growth and development which attributed to more plant height, number of secondary branches and ultimately increase in total dry matter/plant.

Effect of Moisture Conservation Measures on Yield and Yield Attributes

Siliqua Length

Siliqua length of mustard plant increased significantly with reduce tillage (5.67 cm) system over conventional tillage (5.41 cm). Significantly higher (5.75cm) siliqua

Table 1
Effect of Moisture Conservation Measures on Growth Attributes of Rapeseed and Mustard

Treatment	*Plant height (cm)*	*Number of leaf/plant*	*Number of primary branch/ plant*	*Number of secondary branch/plant*	*Total dry matter (g)*
Tillage					
Conventional tillage	180.71	54.54	7.40	11.48	33.82
Reduce tillage	182.57	56.40	7.95	11.85	35.73
SEm±	0.19	0.32	1.58	0.04	0.22
CD (0.05)	1.15	NS	NS	0.25	1.33
Mulch					
No mulch	179.08	49.28	6.76	11.02	32.73
Water hyacinth mulch	183.32	58.28	8.18	11.97	36.57
Paddy straw mulch	182.28	57.50	7.97	11.92	34.95
Legume straw mulch	181.87	56.82	7.78	11.77	34.85
SEm±	0.17	0.33	0.59	0.08	0.33
CD (0.05)	0.52	1.02	NS	0.26	1.02

length compare to rest of mulching treatments and minimum siliqua length was recorded in no mulch (5.30 cm).

Number of Siliqua Plant^{-1}

Significantly more numbers of siliqua plant^{-1} (186.52) was recorded with reduce tillage over conventional tillage (154.60). This might be attributed due to better growth of plant. Among the different mulches, the water hyacinth mulch produced significantly higher (207.27) number of siliqua plant^{-1} compare to no mulch (107.5) and legume straw mulch (179.33). The water hyacinth mulch was also observed statistically at par to paddy straw mulch. The increase in number of siliqua could be assigned due to higher growth attributes.

Number of Seed Siliqua^{-1}

Maximum seeds siliqua^{-1} (13.68) was recorded in reduce tillage over conventional tillage (13.40). The increase in number of seed per siliqua might be attributed due to more length of siliqua in this treatment. The similar findings were also reported by Katiyar *et al.* (2001). Among the different mulches, the water hyacinth mulch produced significantly higher number of seeds siliqua^{-1} (13.78) compare to other mulching treatments and minimum in no mulch (13.24). This increase is also might be due to increase in siliqua length.

1000-grain Weight

Significantly more 1000 grain weight (7.53 g) were produced when crop sown with reduce tillage than conventional tillage (6.15 g). This increase in 1000 grain weight might be due to healthy seed in this treatment. Corroborative findings were also reported by Cepeda and Gomez (2010). Water hyacinth mulch resulted in significantly higher (7.81 g) 1000 grain weight compared to other mulching treatments and minimum under no mulch (5.53 g) treatment, due to poor growth as well as yield attributes. The results are similar to Verma *et al.* (2010) and Sarangi *et al.* (2010).

Table 2
Effect of Moisture Conservation Measures on Yield Attributes of Rapeseed and Mustard

Treatment	*Siliqua length (cm.)*	*Number of siliqua plant^{-1}*	*Number of seed siliqua^{-1}*	*1000-grain weight (g)*
Tillage				
Conventional tillage	5.41	154.60	13.40	6.15
Reduce tillage	5.67	186.52	13.68	7.53
SEm±	0.03	5.03	0.04	0.06
CD (0.05)	0.18	30.59	0.25	0.36
Mulch				
No mulch	5.30	107.50	13.24	5.53
Water hyacinth mulch	5.75	207.27	13.78	7.81
Paddy straw mulch	5.59	188.13	13.65	7.17
Legume straw mulch	5.53	179.33	13.49	6.85
SEm±	0.04	6.95	0.06	0.17
CD (0.05)	0.13	21.42	0.20	0.53

Grain Yield (kg ha^{-1})

The reduce tillage (1371 kg ha^{-1}) recorded with maximum grain yield followed by conventional tillage (1242 kg ha^{-1}). This significant increase in grain yield could be assigned due to better yield attributing characters. The corroborative findings were also reported by and Toth *et al.* (2011). Among different mulching practices, the water hyacinth mulch produced significantly higher (1419 kg ha^{-1}) grain yield over no mulch (1154 kg ha^{-1}) and legume straw mulch (1297 kg ha^{-1}) treatments, however, it was also

found at par to paddy straw mulch (1357 kg ha^{-1}). The increase in grain yield of mustard was due to more dry matter production and increased in most of the yield attributing characters of the crop. Similar findings were also reported by Verma *et al.* (2011).

Stover Yield (kg ha^{-1})

Significantly highest stover yield (4845 kg ha^{-1}) was recorded in reduce tillage over conventional tillage (4636 kg ha^{-1}). Significantly higher stover yield (4975kg ha^{-1}) recorded in water hyacinth mulch compared to other mulching treatments and minimum in no mulch (4364 kg ha^{-1}) treatment. This also might be due higher dry matter production under this treatment. This might be due to higher dry matter accumulation. Similar finding was also reported by Verma *et al.* (2010) and Toth *et al.* (2011).

Harvest Index (%)

The tillage practices had no significant response on harvest index of crop. The water hyacinth mulch was recorded significantly superior (22.16 per cent) over no mulch, but was statistically at par to paddy straw and legume straw mulch.

Table 3
Effect of Moisture Conservation Measures on Grain Yield, Stover Yield and Harvest Index

Treatment	*Grain Yield (kg ha^{-1})*	*Stover Yield (kg ha^{-1})*	*Harvest index (%)*
Tillage			
Conventional tillage	1242	4636	21.13
Reduce tillage	1371	4845	22.02
SEm±	12	18	0.15
CD (0.05)	78	113	NS
Mulch			
No mulch	1154	4364	20.91
Water hyacinth mulch	1419	4975	22.16
Paddy straw mulch	1357	4861	21.81
Legume straw mulch	1297	4762	21.40
SEm±	21	26	0.29
CD (0.05)	67	82	0.90

CONCLUSION

So, on the basis of above experimentation it can be inferred that for obtaining the higher yield of rapeseed and mustard reduced till practice should be applied along with application of water hyacinth mulch @ 2 t/ha.

REFERENCES

Cepeda, M. A. Gomez, B. L. (2010), Response of canola (Brassica napus) al different conservation tillage in rainfed Purhepecha Plateau, Michoacan, Mexico. *ITEA*; **106**(4): 282-293.

Dexter, A. R. (1989), Soil mechanics relation to tillage implements and root peretration in lowland soils. In Soil Physics and Rice. *Int. Rice Res. Inst*., **105** : 261-281.

Hedge, D. M. (2005), Oilseed scenario in India past, present and future with special reference to rapeseed-mustard. *In winter School on Advances in Rapeseed- Mustard Research Technology for Sustainable Production of Oilseeds, National Centre on Rapeseed- Mustard, Sewar, Bhagalpur.* **15** (04): 1–15.

Katiyar, S. C. (2001), Water use and yield of rainfed mustard as influenced by moisture conservation practices. *Indian Journal of Soil Conservation*; **29**(2): 182-183.

Sarangi, S. K. Saikia, U. S. Lama, T. D. (2010), Effect of rice (Oryza sativa) straw mulching on the performance of rapeseed (Brassica campestris) varieties in rice-rapeseed cropping system. *Indian Journal of Agricultural Sciences;* **80**(7): 603-605.

Toth, Z. Dunai, A. Toth, I. M. (2011), Effect of soil tillage on moisture content and temperature of the soil in oilseed rape. *Novenytermeles*; **60**: 199-202.

Verma, C. K. Bharti, S. S. Yadav, R. B. (2010), Effect of fertilizer and moisture conservation practices on performance of mustard (Brassica juncea L.) under rain fed condition. *Journal of Plant Development Sciences*; **2**(1/2): 19-23.

Verma, C. K. Yadav, D. D. Kushwaha, K. P. (2011), Effect of fertilizers and moisture conservation practices in mustard (Brassica juncea L.) under rainfed condition. *Crop Research;* **42**(on productivity, economics and water use efficiency of rainfed Indian mustard (Brassica juncea). *Current Advances in Agricultural Sciences;* **3** (2): 108-111.

Wang Min Wang HaiXia Han QingFang Li Rong Zhang Rui Jia ZhiKuan Yang BaoPing (2011), Effects of different mulching materials on soil water, temperature, and corn growth. *Acta Agronomica Sinica*; **37**(7): 1249-1258.

Yadav, P. N. Uttam, S. K. Singh, R. P. Kaushal Kumar (2011), Effect of fertilizer and moisture conservation Yadav, B. L. Yadav, C. P. 2007 Effect of soil water conservation practices on mustard for efficient water and nitrogen use in coarse textured soil. *Agropedology*; **17**(2) :131-134.