Plant Archives Vol. 25, Supplement 2, 2025 pp. 1359-1363 e-ISSN:2581-6063 (online), ISSN:0972-5210

Plant Archives

Journal homepage: http://www.plantarchives.org
DOI Url : https://doi.org/10.51470/PLANTARCHIVES.2025.v25.supplement-2.168

EFFECT OF DIFFERENT TILLAGE AND WEED MANAGEMENT PRACTICES ON WEED DYNAMICS AND YIELD OF TORIA IN RICE FALLOW

Anshu Kumar[1]*, Nawab Tayab Rafique[1], Kalyan Pathak[1], Gaurav Kumar[1], Khagen Kurmi[1], Samiron Dutta[2], Manas Jyoti Barooah[3], Hemanta Saikia[4] and Anjan Krishna Sarmah[1]
[1]Department of Agronomy Assam Agricultural University, Jorhat, Assam -785 013, India
[2]Department of Soil Science Assam Agricultural University, Jorhat, Assam -785 013, India
[3]Department of Agricultural Engineering Assam Agricultural University, Jorhat, Assam 785 301, India
[4]Department of Basic Sciences & Humanities Assam Agricultural University, Jorhat, Assam -785 013, India
*Corresponding author E-mail: anshu9jun@gmail.com
(Date of Receiving : 23-03-2025; Date of Acceptance : 02-06-2025)

ABSTRACT

A field experiment was conducted during the *rabi* season of 2023–24 at Instructional-cum Research farm of Assam Agricultural University, Jorhat, Assam to study the effect of conservation tillage and weed management practices on rapeseed crop in rice-fallow. The experimental design followed was split-plot with three replications. The main-plot treatments comprised of three tillage practices viz., conventional tillage, minimum tillage and zero tillage while the sub-plot treatments consisted of four weed management practices viz., weedy check, mechanical weeding at 20 DAS followed by hand weeding at 40 DAS, pre-emergence application of oxyfluorfen @ 250g/ha followed by one hand weeding at 40 DAS and early post-emergence application of quizalofop-ethyl @ 50g/ha at 25 DAS. The results revealed that both tillage and weed management practices had significant effects on weed growth. Among the tillage practices lower weed density and dry matter production and higher weed control efficiency, weed control index were observed under conventional tillage. Among the weed management practices, pre-emergence application of oxyfluorfen @ 250g/ha followed by one hand weeding at 40 DAS resulted in significantly the lowest weed population and dry matter as well as higher weed control efficiency (WCE) and weed control index (WCI) but were statistically at par with mechanical weeding at 20 DAS followed by hand weeding at 40 DAS.
***Keywords*:** rice-fallow, weed management, rapeseed, tillage.

Introduction

Rapeseed-mustard (*Brassica spp*.), one of the oldest cultivated crops, is widely grown in Asia and the Mediterranean region. *B. rapa,* known by various local names like *toria*, *rai,* and *sarson*, belongs to the Brassicaceae family (Mahendra *et al*., 2020) and has high oil content (40–45%) with uses in food, industry, and livestock feed. Globally, it's the third most important oilseed crop after soybean and oil palm (Shekhawat *et al*., 2012). India ranks third in production and first in acreage, with a productivity of 1,458 kg/ha (Anonymous, 2022). In Assam, productivity is lower than the national average due to factors like delayed sowing and inadequate soil management. Tillage plays a crucial role in crop performance. While conventional tillage is resource-intensive, reduced and zero tillage methods can enhance timeliness, reduce costs, and maintain yields. However, reduced tillage can increase weed infestation, which may reduce rapeseed-mustard yields by up to 45% (Singh *et al*., 2013), Weeds, especially during the first 15-40 days after sowing, significantly affect mustard yields (Yernaidu *et al*., 2023). Effective weed control is essential for optimizing production. To meet rising food demands, crop intensification, especially in rice fallows, is to be promoted over land expansion which also offers an opportunity for crop diversification. About 22.3 m ha of rice fallows exist in South Asia, including 19.6 m ha in India that offers major opportunities to grow short duration crops. In Assam, 58% of rice-growing areas remain unutilized during the *rabi* season, presenting potential for rapeseed-mustard cultivation using residual soil moisture.

Material and Methods

Experiment was conducted during the *rabi* season of 2023–24 at Instructional-cum Research farm of Assam Agricultural University, Jorhat, Assam, lies at 26°45' N latitude and 94°12' E longitude and at an altitude of 87.0 meters above the mean sea level. The soil was sandy loam in texture, moderately acidic in reaction (5.63 pH), medium in organic carbon (0.56 %) and available K_2O (153.7 kg/ha), low in available N (239.74 kg/ha), and P_2O_5 (19.42 kg/ha).

The total rainfall recorded during crop growth period was 65.4 mm, minimum temperature ranges from 8.1 to 14.6° C and maximum temperature 21.7 to 28.5°C. The field experiment was conducted in split-plot design with three replications, having 12 treatment combinations main plot consist of three tillage practices viz., conventional tillage (T_1), minimum tillage (T_2), zero tillage (T_3) sub plot comprises four different weed management practices viz., weedy check (W_1), mechanical weeding at 20 DAS followed by hand weeding at 40 DAS(W_2), pre-emergence application of oxyfluorfen @ 250g/ha followed by one hand weeding at 40 DAS (W_3) and early post-emergence application of quizalofop-ethyl @ 50g/ha at 25 DAS(W_4). The recommended dose of nutrient 40 kg N through urea, 35 kg P_2O_5 through SSP and 15 kg K_2O through MOP applied at the time of sowing. The rapeseed variety used in the experiment was TS-67 which mature in 90-95 days. Sowing of the crop was carried out on 4th December, 2023 manually in the conventional (ploughing followed by harrowing and cross harrowing) and minimum tillage (single pass of rotovator) while in zero tillage (rice stubble chopper), sowing was done with the help of pneumatic seed drill machine with a spacing of 30 cm row to row and plant to plant spacing of 10 cm was maintained by thinning of crop at 20 DAS of sowing. Harvesting of the crop was done on 6th March, 2024 (93 days). Herbicides were applied with knap-sack sprayer with a flat-fan nozzle, delivering a spray volume of 600 litres/ha. Weed species present in the experimental plots were recorded at 20, 40, 60 and 80 days after sowing (DAS) to assess weed population diversity in rapeseed.

Weed parameters such as weed flora, population, dry weight, weed control efficiency (WCE) and weed control index (WCI) were recorded at these intervals. The recorded data were subjected to analysis of variance (ANOVA) for split-plot design (SPD) as per Panse and Sukhatme (1954). The formula proposed by Mani *et al.* (1973) was utilized to calculate weed control efficiency, while the weed control index was determined using the formula developed by Mishra and Tosh (1979).

The formulae used are as follows:

WCI (%)=

$$\frac{\text{(Weed dry matter (g/m}^2\text{) in control plot} - \text{Weed dry matter(g/m}^2\text{) in treated plot)}}{\text{(Weed dry matter (g/m2) in control plot)}} \times 100$$

WCE (%)

$$\frac{\text{(Weed density (no./m}^2\text{) in control plot} - \text{Weed density (no./m}^2\text{) in treated plot)}}{\text{(Weed density (no./m}^2\text{) in treated plot)}} \times 100$$

Results and Discussion

The predominant weed flora observed in the experimental field in association with the rapeseed includes grasses like *Paspalum conjugatum* (Bergius), *Cynodon dactylon* (L.) *Digitaria ciliaris* (Retz.), broad-leaved weeds like *Acmella ciliata* (Kunth), *Ageratum houstonianum* (Mill), *Centella asiatica* (L.), *Persicaria maculosa* (Gray), *Mitracarpus hirtus* (L.), *Polygonum plebeium* (R. Br), and *Ageratum conyzoides* (L.). Similar weed species in rapeseed were also reported by Borah (2020) and Hazarika (2020) while sedge was almost absent.

Conventional tillage registered significant lower monocot and dicot weed density and weed dry matter among the different tillage practices as compared to minimum tillage and zero tillage at all the growth stages of rapeseed i.e., at 20, 40, 60 and at 80 DAS, respectively. This might be due to fact that the tillage practice that involves soil turning might have affected germination and growth of weeds as the weed seeds buried in the sub- soil got exposed to the sunlight which might have affected the germination of weed seed due to low moisture content of weed seed. These results are in accordance with the findings of Duary and Teja (2016). The highest density of monocot, dicot as well as the total weeds and weed dry matter were recorded with zero tillage. This might be due to the fact that in zero tillage the soil remains undisturbed, conserving enough moisture thereby allowing weed seeds to germinate easily. Mishra and Singh (2011) from Jabalpur, Madhya Pradesh also reported that the zero tillage significantly increased the population of common vetch (*Vicia sativa* L.) in various oilseeds and pulses.

Pre-emergence application of oxyfluorfen @ 250 g/ha followed by one hand weeding at 40 DAS (W_3)

resulted in significantly the lowest weed density and weed dry matter among the weed management practices at all the growth stages except at 40 DAS. This might be due to the pre-emergence application of oxyfluorfen could suppressed the weed germination initially and subsequent control of weed was possible by hand weeding, ultimately reducing the weed population/m^2 and weed dry weight (W_3). On the other hand, quizalofop-ethyl applied as post emergence (25 DAS) was able to successfully knock down the grassy weeds. This might be due to the presence of isomer ACCase I in plastid of grassy weed which is highly sensitive to this group of herbicides (Das, 2013), thereby keeping the field free from the monocot weeds. However, the infestation of broadleaf weeds (BLW) was quite high in this treatment as BLWs were not affected by this herbicide, offering higher crop-weed competition. The two important metrices used to assess the efficacy of various weed management practices are WCE and WCI. Variation in these two indices was brought about by the use of different tillage as well as weed management practices. Among the various tillage practices conventional tillage recorded the highest WCE and WCI at all the growth stages compared to minimum and zero tillage. It might be due to decrease in weed population and weed dry weight under conventional tillage. On the other hand, integrated weed management practice of pre-emergence application of oxyfluorfen @ 250 g/ha followed by one hand weeding at 40 DAS (W3) recorded the highest WCE and WCI. This might be due to the lower number of weeds/m^2 recorded in this treatment as application of pre-emergence herbicide suppressed the emergence of weeds and subsequently by hand weeding at 40 DAS could reduce the weed growth. This perhaps enabled the crop to take-up and utilize the minerals, nutrients, moisture, sunlight and space more efficiently. Conversely, the highest weed population and dry weight, coupled with the lowest WCE and WCI, were observed under the weedy check. This result is likely due to the absence of any weed control measures,

Table 1 : Effect of tillage and weed management practices on weed species density in rapeseed

Treatments	Monocot (No./m^2)				Dicot (No./m^2)			
	20 DAS	**40 DAS**	**60 DAS**	**80 DAS**	**20 DAS**	**40 DAS**	**60 DAS**	**80 DAS**
Tillage practices (T)								
T_1	3.69* (10.83)	3.95 (12.67)	4.07 (14.54)	4.98 (22.29)	6.81 (44.47)	7.34 (50.0)	7.81 (62.85)	9.70 (91.60)
T_2	3.83 (11.71)	4.30 (15.15)	4.45 (17.58)	5.54 (27.14)	7.78 (57.07)	8.07 (60.73)	8.74 (75.94)	10.22 (101.54)
T_3	4.24 (14.66)	4.48 (16.72)	4.73 (20.02)	5.83 (30.93)	8.69 (70.34)	9.01 (75.56)	9.86 (96.09)	11.62 (130.64)
S.Em (±)	0.08	0.09	0.09	0.10	0.16	0.15	0.17	0.20
CD (P= 0.05)	0.30	0.33	0.35	0.41	0.63	0.57	0.68	0.77
Weed management practices (W)								
W_1	4.41 (15.37)	5.70 (27.09)	6.50 (36.07)	7.49 (49.06)	8.93 (71.60)	10.28 (96.10)	12.27 (139.32)	13.78 (176.94)
W_2	4.37 (15.04)	3.85 (11.23)	3.24 (7.53)	4.13 (13.30)	8.90 (71.06)	6.23 (33.42)	5.89 (29.65)	7.95 (56.09)
W_3	2.52 (4.14)	4.10 (12.96)	3.04 (6.50)	4.01 (12.45)	4.31 (15.56)	6.47 (36.04)	5.89 (30.09)	7.85 (54.75)
W_4	4.37 (15.05)	3.34 (8.10)	4.89 (19.41)	6.17 (32.32)	8.89 (70.95)	9.58 (82.82)	11.16 (114.12)	12.47 (143.93)
S.Em (±)	0.10	0.11	0.13	0.15	0.21	0.23	0.26	0.30
CD (P= 0.05)	0.31	0.33	0.37	0.46	0.62	0.68	0.77	0.89
Interaction (T x W)	NS	NS	NS	NS	NS	NS	NS	NS

*Square root transformed [$\sqrt{(x + 0.5)}$] value, where x = observed value. The original values are presented in the parentheses

Table 2 : Effect of tillage and weed management practices on total weed density and dry matter in rapeseed

Treatments	Total weed density (No./m^2)				Weed dry matter (g/m^2)			
	20 DAS	**40 DAS**	**60 DAS**	**80 DAS**	**20 DAS**	**40 DAS**	**60 DAS**	**80 DAS**
Tillage practices (T)								
T_1	7.58* (55.30)	8.21 (62.67)	8.65 (77.39)	10.74 (113.89)	4.02 (13.14)	4.59 (17.38)	5.36 (27.27)	6.80 (43.56)
T_2	8.51 (68.78)	9.01 (75.88)	9.64 (93.52)	11.45 (128.68)	4.40 (16.02)	4.98 (20.70)	5.66 (30.34)	7.30 (50.03)

T_3	9.51 (85.00)	9.93 (92.28)	10.77 (116.10)	12.83 (161.57)	4.41 (15.99)	5.32 (23.87)	6.10 (35.03)	7.87 (58.21)
S.Em (±)	0.18	0.16	0.19	0.22	0.08	0.09	0.11	0.14
CD (P= 0.05)	0.69	0.64	0.75	0.86	0.33	0.34	0.45	0.55
Weed management practices (W)								
W_1	9.80 (86.97)	11.57 (123.19)	13.72 (175.38)	15.50 (226.00)	4.80 (18.50)	6.16 (32.12)	8.17 (58.86)	9.91 (88.74)
W_2	9.75 (86.10)	7.14 (44.64)	6.55 (37.18)	8.79 (69.39)	4.76 (18.16)	4.08 (12.87)	3.92 (11.77)	5.48 (25.02)
W_3	4.82 (19.70)	7.47 (49.01)	6.47 (36.57)	8.66 (67.20)	2.79 (5.27)	4.41 (15.37)	3.76 (10.75)	5.33 (23.57)
W_4	9.74 (86.00)	10.01 (90.92)	12.03 (133.54)	13.75 (176.25)	4.77 (18.28)	5.21 (22.24)	6.98 (42.15)	8.55 (65.07)
S.Em (±)	0.23	0.25	0.28	0.33	0.11	0.14	0.17	0.21
CD (P= 0.05)	0.68	0.75	0.84	0.98	0.34	0.40	0.49	0.62
Interaction (T x W)	NS	NS	NS	NS	NS	NS	NS	NS

*Square root transformed [√(x + 0.5)] value, where x = observed value. The original values are presented in the parentheses

which allowed weeds to proliferate unchecked, ultimately reducing the crop's competitiveness. These outcomes are consistent with the findings of Hadke *et al*. (2021).

Table 3 : Effect of tillage and weed management practices on weed control index and weed control efficiency in rapeseed

Treatments	Weed control index (%)				Weed control efficiency (%)			
	20 DAS	40 DAS	60 DAS	80 DAS	20 DAS	40 DAS	60 DAS	80 DAS
Tillage practices (T)								
T_1	19.28	37.65	49.11	45.14	22.44	39.4	48.34	42.13
T_2	19.25	35.91	47.89	43.04	20.12	38.14	45.43	40.63
T_3	17.46	34.03	45.90	41.18	17.87	35.67	43.37	38.91
Weed management practices (W)								
W_1	-	-	-	-	-	-	-	-
W_2	-	60.117	80.119	72.014	-	64.17	79.15	69.59
W_3	71.688	52.363	81.932	73.657	78.371	60.45	79.67	70.55
W_4	-	30.978	28.491	26.822	-	26.34	24.03	22.08

Table 4 : Effect of tillage and weed management practices on seed, stover, biological yield and harvest index of rapeseed

Treatments	Seed yield (kg/ha)	Stover yield (kg/ha)	Biological yield (kg/ha)	Harvest index (%)
	Tillage practices (T)			
T_1	555.300	1684.833	2770.125	24.56
T_2	537.000	1658.250	2708.042	24.21
T_3	450.250	1493.833	2340.625	23.07
S.Em (±)	7.027	8.280	38.050	0.239
CD (P= 0.05)	27.590	32.512	149.401	0.940
Weed management practices (W)				
W_1	359.600	1290	2099	21.78
W_2	609.933	1797.8	2938.3	25.23
W_3	619.600	1817	2971.4	25.38
W_4	467.600	1544	2416.3	23.33
S.Em (±)	12.948	11.550	65.991	0.566
CD (P= 0.05)	38.469	34.315	196.069	1.683
Interaction (T x W)	S	S	NS	NS

Among the different tillage systems, zero tillage system recorded the minimum values of the yield attributes as compared to other two tillage systems due to highest crop-weed competition and poor crop growth under zero tillage system (Mondal *et al*., 2008)

The higher values of yield recorded with pre-emergence application of oxyfluorfen @ 250 g/ha followed by one hand weeding at 40 DAS (W_3) was found to be at par with mechanical weeding at 20 DAS followed by hand weeding at 40 DAS (W_2) probably due to the initially checked weed growth over weedy check where maximum crop - weed competition was noticed throughout the crop growth period mainly due to heavy weed pressure and poor initial crop growth of rapeseed. Chauhan *et al*. (2005) have reported similar finding in regard to superiority of hand weeding in lowering dry matter accumulation and population of weeds which might have helped in increasing yield attributes, ultimately leading to higher yield. Similar type of findings was also reported by Tiwari and Kurchania, (1993), Singh *et al*, (1994) and Patil *et al,* (1997).

References

Anonymous (2022). Press release of Ministry of Agricultural Affairs. https,//agriwelfare.gov.in/Documents/ CWWG DATA /Agricultural_Statistics_

Borah, P. (2020). Nutrient and weed management in rainfed *toria* by organic methods. Ph.D. Thesis, Assam Agricultural University, Jorhat.

Chauhan, Y.S. and Bhargava, M.K. (2005). Weed management in Indian mustard (*Brassica juncea*). *Indian J. Agron.*, **50**, 149–151.

Das, T.K. (2013). Mode and mechanism of action of herbicides. In, *Weed Science Basics and Application*, Jain Brothers, New Delhi, pp. 427–429.

Duary, B., Dash, S. and Teja, K.C. (2016). Impact of tillage on seed bank, population dynamics and management of weeds. *SATSA Mukhapatra - Annual Technical*, **20**.

Hadke, R.S., Ghatak, R.D., Gawali, K. and Nagmote, A. (2021). Effect of integrated weed control practices on growth parameters and yield attributes of Indian mustard in clay loam soils of Nagpur in Maharashtra. *Pharma Innov. J.*, **10(9)**, 982–985.

Hazarika, J.R. (2020). Evaluation of weed management practices under organic production in rice (A)–rice (W)–toria cropping sequence. Ph.D. Thesis, Assam Agricultural University, Jorhat.

Mahendra, Salam, J.L., Kar, S., Ravi, R., Saxena, R.B., Bhanwar, R., Chandrakar, T., Rakesh, S. and Rohit (2020). Genetic diversity estimation in Toria [Brassica rapa (L.)] genotypes collected from Bastar Plateau. *Int. J. Curr. Microbiol. App. Sci.*, **9(3)**, 2577–2584.

Mani, V.S., Malla, M.L., Gautam, K.C. and Bhagwandas, B. (1973). *Indian Farming*, **23(8)**, 17–18.

Mishra, A. and Tosh, G.C. (1979). *J. Res. OUAT.*, **10**, 1–6.

Gill, G.S. and Vijayakumar. (1969). *Indian J. Agron.*, **16**, 96–98.

Mishra, J.S. and Singh, V.P. (2011). Effect of tillage and weed control on weed dynamics, crop productivity and energy-use efficiency in rice-based cropping systems in Vertisols. *Indian J. Agric. Sci.*, **81(2)**, 129–133.

Mondal, N., Hossain, S. and Bhuiya, S. (2008). Tillage and mulching effects on conservation of residual soil moisture, yield attributes and yield of mustard (cv. Daulat). *Bangladesh J. Agric. Res.*, **33(4)**, 597–606.

Panse, V.G. and Sukhatme, P.V. (1954). *Statistical Methods for Agricultural Workers*, Indian Council of Agricultural Research, pp. 87–89.

Patil, B.M., Nair, S.C., Sethi, H.N. and Karunkar, A.P. (1997). Nutrient uptake by mustard and associated weeds. *Crop Res. (Hisar).*, **14**, 179–181.

Roy, K.C., Rahman, M.M., Rahman, M. and Hossain, A. (2017). Effects of irrigation and sulphur application on growth, yield and oil content of rapeseed (*Brassica napus*). *Eco-friendly Agric. J.*, **10(3)**, 30–34.

Shekhawat, K., Rathore, S.S., Premi, O., Kandpal, B. and Chauhan, J.S. (2012). Advances in agronomic management of Indian mustard (*Brassica juncea* L. Czernj. Cosson), An overview. *Int. J. Agron.*, **2012**, 1–14.

Singh, D.K., Singh, R.P. and Singh, R.K. (1994). Performance of mustard (*Brassica juncea* L.) in relation to weed growth pattern. *Indian J. Weed Sci.*, **26**, 73–74.

Singh, R.K., Singh, R.P. and Singh, M. (2013). Weed management in rapeseed mustard – A review. *Agric. Rev.*, **34**, 36–49.

Tiwari, J.P. and Kurchania, S.P. (1993). Chemical control of weeds in Indian mustard (Brassica juncea). *Indian J. Agric. Sci.*, **63(5)**, 272–275.

Yernaidu, Y., Parameswari, Y.S., Madhavi, M. and Ramprakash, T. (2023). Effect of weed management practices on nutrient uptake and economics of mustard (*Brassica juncea* L.). *Int. J. Econ. Pl.*, **10(1)**, 016–019.