International Journal of Research in Agronomy 2024; 7(3): 231-234

E-ISSN: 2618-0618
P-ISSN: 2618-060X

www.agronomyjournals.com
2024; 7(3): 231-234
Received: 23-12-2023
Accepted: 28-01-2024

Sharandeep Kaur
Postgraduate Department of Agriculture, Khalsa College, Amritsar, Punjab, India

Sumesh Chopra
Former Senior Extension Scientist, Farm Advisory Service Scheme, Punjab Agricultural University Regional Research Station, Gurdaspur, Punjab, India

Corresponding Author:
Sharandeep Kaur
Postgraduate Department of Agriculture, Khalsa College, Amritsar, Punjab, India

Evaluation of non-chemical weed control methods in wheat (*Triticum aestivum* L.)

Sharandeep Kaur and Sumesh Chopra

DOI: https://doi.org/10.33545/2618060X.2024.v7.i3d.425

Abstract
A field experiment was conducted to evaluate the non-chemical weed control methods in wheat (*Triticum aestivum* L.). Field experiment was designed in randomized block design with three replications. The observations were recorded count and dry matter accumulation of grassy weeds and broad leaf weeds in wheat, weed control efficiency, weed index and grain yield of wheat. Highest weed control efficiency was recorded in weed free (100%), stale seedbed technique and wheat straw mulch (76.23%) and stale seedbed technique and two hoeings (77.73%) and two hand hoeing (74.50%). Weed index recorded in weedy check (54.27%) and weed free (0%). Lowest narrow and broad leaf weed dry matter was recorded in weed free. Maximum grain yield was recorded under weed free (47.9 q ha^{-1}) which remain at par with stale seedbed technique and straw mulching (46.8 q ha^{-1}), stale seedbed technique and two hoeings (47.2 q ha^{-1}), and two hand hoeing (46.5 q ha^{-1}).

Keywords: Non-chemical, grassy weeds, broad leaf weeds, weed control efficiency, weed index

Introduction

Since weeds can drastically lower crop output and quality, weed management is an essential part of growing wheat. Weeds are nasty and get in the way of human activities. Yield losses mainly dependent on weed species. Maximum yield loss in wheat caused by *Phalaris minor* (Hadayat *et al.* 2024) [4]. The potential of wheat to adapt to changing environmental conditions and the use of efficient agronomic techniques are essential for its development. Non-chemical weed management methods are becoming more popular as worries about the effects of chemical herbicides on the environment and human health grow. Crop rotation, intercropping, and tillage techniques are examples of cultural activities that can reduce the growth of weeds by changing the competitive landscape (Verma *et al.* 2021) [10]. Herbicide-free targeted weed management is possible with mechanical techniques like manual weeding, hoeing, and mechanical cultivating. Furthermore, the use of biological control techniques such as allelopathy, microbiological agents, and bioherbicides has encouraging promise for the sustainable management of weeds. The combination of several non-chemical methods adapted to particular agroecological circumstances can improve weed control effectiveness while reducing negative environmental effects. Comprehending the interplay and balance between various weed control approaches is essential in creating integrated weed management programmes that support long-term wheat production.

Materials and Methods

The field experiment was conducted at Student's Research Farm, Khalsa College, Amritsar (latitude 31.63 degree N and longitude 74.87 degree E, at an average elevation of 229 meters above the mean sea level) during *rabi* season 2019-20, on sandy loam soil, low in organic carbon (0.48) and available nitrogen (N 179 kg ha^{-1}), available phosphorus (P 24 kg ha^{-1}) was medium and potassium (K 360 kg ha^{-1}) very high. The values of pH (8.4) and electrical conductivity (0.21 EC dS m^{-1}) were within the normal range. There were ten treatments of weed control (Weedy check, Weed free, Furrow Irrigated Raised Beds System, Live mulching of Coriander (12.5 Kg ha^{-1}), Eucalyptus leaves mulching (6.0 t ha^{-1}), Stale seedbed technique, Stale seedbed technique and wheat straw mulching (4.0 t ha^{-1}), Stale seedbed technique and two hoeings (wheel hand hoe), Hand hoeings, System of wheat intensification were laid out in randomized block design, replicated thrice. Square root transformation (√x+0.5) was used in weed data. Original data presented in the parenthesis.

Weed control efficiency

$$WCE = \frac{DMC - DMT}{DMC} X\ 100$$

Where, WCE: Weed control efficiency; DMC: Dry matter of weeds from controlled (no weed control); DMT: Dry matter of weeds from treated plots. It was calculated by using formula given by Kondap and Upadhayay (1985) [5].

Weed index (percent)

$$WI = \frac{YWF - YPT}{YWF} X\ 100$$

(Where, WI: Weed index; YWF: Yield from weed free plot; YPT: Yield from particular treatment. It was calculated by using the formula given by Gill and Kumar (1969) [3].

Harvest index (percent)

Harvest index was defined by Donald (1962) [2] as the ratio between weight of grains and the weight of total dry matter.

$$\text{Harvest index (percent)} = \frac{\text{Economic yield}}{\text{Biological yield}} x\ 100$$

Results and Discussion

Table 1: Effect of grassy weeds and broad leaf weeds count on wheat.

Treatment	Grassy weeds count (no. m^{-2})				Broad leaf weeds count (no. m^{-2})			
	30 DAS	60 DAS	90 DAS	At harvest	30 DAS	60 DAS	90 DAS	At Harvest
Weedy check	15.0 (224.1)	18.99 (360.06)	17.02 (289.1)	13.87 (191.5)	9.24 (84.6)	9.62 (91.71)	9.07 (81.55)	8.69 (74.6)
Weed free	1(0)	1(0)	1(0)	1(0)	1(0)	1(0)	1(0)	1(0)
Furrow irrigated raised beds (FIRBs)	8.35 (69.1)	8.88 (78.2)	8.60 (73.4)	8.23 (67.1)	4.61 (20.43)	4.92 (23.65)	4.58 (20.71)	4.33 (17.85)
Live mulching of coriander	9.76 (94.5)	10.10 (101.23)	9.82 (95.73)	9.37 (87.17)	5.57 (30.2)	6.26 (38.60)	6.11 (36.65)	5.83 (33.1)
Eucalyptus leaves mulching	10.72 (114.3)	11.62 (134.2)	11.31 (127.23)	10.56 (110.8)	6.33 (39.26)	6.99 (48.18)	6.91 (47.15)	6.68 (43.81)
Stale seedbed technique	9.48 (89.2)	10.04 (100.1)	9.65 (92.3)	9.22 (84.2)	5.49 (29.25)	5.93 (34.53)	5.91 (34.2)	5.75 (32.21)
Stale seedbed technique and wheat straw mulching	6.62 (43.2)	7.36 (53.4)	7.11 (50.1)	6.86 (46.5)	3.79 (13.55)	4.24 (17.47)	4.19 (16.7)	3.19 (9.57)
Stale seedbed technique and two hoeings (wheel hand hoe)	6.41 (40.5)	7.30 (52.6)	6.99 (48.2)	6.69 (44.1)	3.67 (12.65)	4.23 (17.1)	3.95 (15.05)	3.10 (8.9)
Two hand hoeing	6.93 (47.4)	7.47 (55.2)	7.35 (53.5)	6.99 (48.3)	3.87 (14.25)	4.43 (19.1)	4.22 (17.3)	3.34 (10.6)
System of wheat intensification (SWI)	8.49 (71.3)	9.01 (80.5)	8.65 (74.1)	8.38 (69.6)	4.75 (21.8)	5.06 (25.37)	4.81 (22.65)	4.46 (19.05)
CD (0.05)	0.89	0.92	0.40	0.76	0.57	0.48	0.48	0.84

Grassy weeds count (m^{-2}): The data pertaining to population of grassy weeds presented in the Table 1 revealed that population was significantly influenced by different weed control treatments. Effect of all weed control treatments was significant on grassy weed count at 30, 60, 90 days after sowing and at harvest. At all stages of crop growth, weed count was highest in weedy check. The treatment weed free where hand pulling and hoeing were given to the crop has least weed count than all the other treatments. Treatment stale seedbed technique and straw mulching which received less weed count due to straw mulching which provided smothering effect to weeds. Stale seedbed technique and two hoeings with wheel hand hoe gave remarkable effect on the crop by reducing weed competition during weed critical period of 30-45 days after sowing. In treatment live mulching of coriander also acted as an intercrop and economically beneficial. It provided cover to the weeds and suppressed their growth and allowed the crop to grow and furnish well. Treatment eucalyptus leaves mulching also provided allelopathic effect to the weeds. Weed free treatment was very effective throughout the crop period which suppressed weed growth and helped to attain the maximum height, more leaf area index, higher effective tillers count, more dry matter accumulation and maximum yield. These results were also quoted by Amare *et al.* (2014) [1] which concluded that less weed-crop competition for light, nutrients, space and moisture in hoeing treatment produced higher yield and effective weed control than weedy check treatment.

Broad leaf weeds count (m^{-2}): The data embodied in Table 1 revealed that population of broad leaf weeds differed significantly at 30, 60, 90, and at harvest stage. Broad leaf weeds decreased with the increase in duration of wheat crop and being minimum at the harvest. At 30 days after sowing, weed count was highest in weedy check treatment and where hoeing, hand weeding, stale bed technique, mulching, and other weed control treatment applied received lower weed count. At 60, 90, and 120 days after sowing treatment weed free with exclusive weed removal attained significantly low broad leaf weeds than weedy check, furrow irrigated raised beds, live mulching of coriander, eucalyptus leaves mulching, stale seedbed technique and system of wheat intensification. The furrow irrigated raised beds suppressed the growth of broad leaves by limiting the soil moisture. In live mulching of coriander increased the productivity and profitability and reduced the crop-weed competition by reducing space and other available resources (Tripathi *et al.* 2017) [8]. Stale bed technique was successful weed management practice where herbicides became resistant to weed species (Senthilkumar *et al.* 2019) [6].

Table 2: Effect of grassy weeds dry matter accumulation and broad leaf weeds dry matter accumulation on wheat.

Treatment	Grassy weeds dry matter accumulation (g m^{-2})				Broad leaf weeds dry matter accumulation (g m^{-2})			
	30 DAS	60 DAS	90 DAS	At harvest	30 DAS	60 DAS	90 DAS	At Harvest
Weedy check	6.29 (38.5)	11.11 (122.4)	16.94 (286.0)	24.20 (584.7)	8.06 (64.0)	11.09 (122.0)	13.60 (184.0)	16.82 (282.0)
Weed free	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)
Furrow irrigated raised beds (FIRBs)	3.58 (11.8)	5.67 (31.0)	27.62 (762.0)	15.49 (239.0)	4.12 (16.0)	6.93 (47.0)	9.27 (85.0)	10.82 (116.0)
Live mulching of coriander	4.47 (19.0)	7.36 (53.1)	10.58 (111.0)	18.89 (356.0)	5.66 (31.0)	8.90 (78.0)	10.95 (119.0)	13.27 (175.0)
Eucalyptus leaves mulching	5.50 (29.4)	8.66 (74.0)	12.58 (157.2)	20.90 (436.0)	6.56 (42.0)	9.95 (98.0)	12.25 (149.0)	14.99 (224.0)
Stale seedbed technique	4.39 (18.3)	7.33 (52.7)	10.22 (103.5)	17.83 (317.0)	5.39 (28.0)	8.60 (73.0)	10.72 (114.0)	12.99 (168.0)
Stale seedbed technique and wheat straw mulching	2.57 (5.6)	3.99 (14.2)	7.38 (53.4)	11.62 (134.0)	2.82 (7.0)	5.48 (29.0)	7.14 (50)	8.54 (72.0)
Stale seedbed technique and two hoeings (wheel hand hoe)	2.49 (5.2)	3.75 (13.1)	7.30 (52.3)	11.35 (128.0)	2.45 (5.0)	4.67 (20.8)	6.48 (41.0)	8.12 (65.0)
Two hand hoeing	2.62 (5.9)	3.94 (14.5)	7.40 (53.8)	11.74 (137.0)	2.99 (8.0)	5.74 (32.0)	8 (63.0)	9.22 (84.0)
System of wheat intensification (SWI)	3.62 (12.1)	5.69 (31.3)	8.90 (78.3)	15.72 (246.0)	4.47 (19.0)	7.28 (52.0)	9.49 (89.0)	11.18 (124.0)
CD (0.05)	0.24	0.11	0.14	0.06	0.16	0.12	0.18	0.12

Dry matter accumulation of grassy weeds (g m^{-2})

Dry matter accumulation by weeds reflects the competing ability of weeds. Accumulation of biomass by weeds increased progressively with the advancement of crop age. The maximum dry matter was recorded at harvest. The weeds dry weight at all stages of observations was significantly influenced by various weed control measures. The data in the Table 2 showed that throughout the crop period, grassy weeds dry matter accumulation was higher under weedy check and the lowest under weed free. Treatments weed free, stale seedbed technique and two hoeings, stale seedbed technique and straw mulching and two hand hoeings were very effective in weed management. The maximum dry matter accumulation of grassy weeds was recorded at harvest. The dry matter accumulation of grassy weeds was recorded under all the treatments significantly lower than weedy check (58.47 q ha^{-1}). Treatment furrow irrigated raised beds and system of wheat intensification as well as live mulching of coriander and stale seedbed technique were non-significant to each other. Treatment eucalyptus leaves mulching also control the weeds but did not yield any remarkable effect on the grain yield. Senthilkumar *et al.* (2019) [6] reported that stale seedbed technique was an effective approach to control weeds.

Dry matter accumulation of broad leaf weeds (g m^{-2})

Dry matter accumulation of weeds indicates the magnitude of crop-weed competition and reflects the comparative efficacy of different weed control treatments. Dry matter accumulation by broad leaf weeds increased progressively with the advancement of crop age. The data in the Table 2 showed that the maximum dry matter was recorded at harvest. The weeds dry weight at all stages of observation were significantly influenced by various weed control measures. At 30, 60, 90 days after sowing and at harvest, dry weight was highest in weedy check treatment than other treatments. Treatments weed free throughout the crop period received lowest weed count due to three weedings at different stages of the crop and complete eradication of weeds. In furrow irrigated raised beds the weed count was also low due to adequate soil moisture. Treatments live mulching of coriander and eucalyptus leaves mulching were non-significant to each other. In stale bed technique was very effective in controlling weeds. Treatments stale bed technique and straw mulching provided smothering effect to the weeds throughout the crop growth period. In stale seedbed technique and two hoeings with wheel hand hoe before and after first irrigation very effective in weed control. Treatment two hand hoeings application of weeding at 4 and 6 weeks after sowing effect the weeds population. Treatment system of wheat intensification with spacing (15 cm) reduced the dry matter accumulation of weeds and done interculture for controlling weeds. These results were in close agreements with the findings of Amare *et al.* (2014) [1].

Table 3: Effect of different weed control treatments on weed control efficiency, weed index and grain yield

Treatment	Weed control efficiency (%)	Weed index (%)	Grain yield (q ha^{-1})
Weedy check	0	54.27	21.9
Weed free	100	0	47.9
Furrow irrigated raised beds (FIRBs)	59.04	15.44	40.5
Live mulching of coriander	39.42	29.23	33.9
Eucalyptus leaves mulching	23.84	41.96	27.8
Stale seedbed technique	44.04	28.79	34.1
Stale seedbed technique and wheat straw mulching	76.23	2.29	46.8
Stale seedbed technique and two hoeings (wheel hand hoe)	77.73	1.46	47.2
Two hand hoeing	74.50	2.92	46.5
System of wheat intensification (SWI)	57.30	16.48	40.0
CD			5.34

Weed control efficiency (percent)

The data in the Table 3 presented the highest weed control efficiency under treatment weed free, stale seedbed technique and straw mulching, stale seedbed technique and two howings, and two hand hoeings followed by furrow irrigated raised beds, system of wheat intensification, stale seedbed technique, live mulching of coriander, and eucalyptus leaves mulching. The highest weed control efficiency (100 percent) recorded under weed free treatment with hoeing. Tyagi *et al.* (2015) [9] also concluded the same results of higher weed control efficiency higher under weed free treatment.

Weed index (percent)

The data in the Table 3 represented that, among the different treatments for weed control, it is expressed as percentage of yield potential under weed free treatment. Higher weed index was recorded in weedy check (54.27 percent). Higher the weed index means greater loss due to weeds and the lowest value was observed weed free followed by stale seedbed technique and two hoeings (1.46 percent), stale seedbed technique and wheat straw mulching (2.29 percent) and two hand hoengs (2.92 percent), furrow irrigated raised beds (15.44 percent), system of wheat intensification (16.48 percent), stale seedbed technique (28.79 percent), live mulching of coriander (29.23 percent), and eucalyptus leaves mulching (41.96 percent). Singh *et al.* (2021) [7] reported that highest weed index recorded in weedy check and lowest among hand weeding.

Conclusion

From the experiment, it was concluded that the treatment 'stale bed technique, pre-germinated seeds and two hoeings (T_8)', 'stale bed technique, pre-germinated seed with straw mulching (T_7)' and 'hand hoeings (T_9)' due to effective weed control produced higher yield as produced by 'weed free plot (T_2)'. Furrow irrigated raised beds (T_3) and system of wheat intensification (T_{10}) were medium in weed control and they produced significant higher grain yield than other treatments but were inferior to the T_2, T_7, T_8 and T_9. Quality parameters did not significantly differed. Live mulching with coriander (T_4) produced maximum net return and significantly high wheat grain yield than control plot. Weed control efficiency of the weed free treatment was 100 percent but the weedy check has 0 percent weed control efficiency due to unrestricted weed growth. Highest yield losses received under weedy check due to higher weed index (54.27) followed by T_5, T_4, T_6, T_{10}, T_3, T_9, T_7, T_8 and T_2.

References

1. Amare T, Sharma JJ, Zewdie K. Effect of weed control methods on weeds and wheat (Triticum aestivum L.) yield. World journal of agricultural research. 2014;2(3):124-8.
2. Donald CM. In search of yield. Journal of the Austalian Institute of Agricultural Sciences. 1962;28:171-178.
3. Gill GS, Vijaya Kumar K. Weed Index- A new method of reporting weed control trials. Indian Journal of Agronomy. 1969;14:96-98.
4. Hadayat A, Zahir ZA, Cai P, Gao CH. Integrated application of synthetic community reduces consumption of herbicide in field Phalaris minor control. Soil Ecology Letters. 2024;6(2):230207.
5. Kondap SM, Upadhyay UC. A Practical Manual of Weed Control. Oxford and IBH Publishing Co Pvt Ltd, New Delhi; c1985.
6. Senthilkumar D, Murali AP, Chinnusamy C, Bharathi C, Yalabela L. Stale seed bed techniques as successful weed management practice. Journal of Pharmacognosy and Phytochemistry. 2015;SP2:120-123.
7. Singh MK, Singh S, Prasad SK. Weed suppression and crop yield in wheat after mustard seed meal aqueous extract application with reduced rate of isoproturon. Journal of Agriculture and Food Research. 2021;6:100235.
8. Tripathi SC, Chander S, Meena RP. FIRB intercropping of vegetables and seed spices with wheat for higher productivity and profitibilty of small and marginal farmers. Journal of Wheat Research. 2017;9(2):128-131.
9. Tyagi S, Nanher AH, Singh RS. Effect of weed control treatments on wheat crop and associated weeds. Trends in Biosciences. 2015;8(2):421-428.
10. Verma SK, Bhatnagar GS, Shukla AK, Singh RK, Meena RK. Integrated weed management in wheat (*Triticum aestivum* L.): A review. Current research in agriculture and farming. 2021;2(2):1-4.