PERFORMANCE OF HERBICIDE COMBINING WITH AQUEOUS EXTRACT OF LENTIL CROP RESIDUES ON WEED MANAGEMENT AND YIELD OF WHEAT

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ABSTRACT

The use of allelopathy is an alternative weed control method in integrated weed management programs. Hence, an experiment was undertaken at Agronomy Field Laboratory, Bangladesh Agricultural University to evaluate how aqueous extract of lentil crop residues affected weed management and wheat crop performance. The experiment included three wheat varieties viz., BARI Gom-30, BARI Gom-31, BARI Gom-32 and six weeding regimes viz., no weeding, recommended dose of herbicide, lentil aqueous extraction and lentil aqueous extraction along with 90%, 80%, 70% and 60% of recommended dose of herbicide, respectively following randomized complete block design with three replications. The aqueous extract of lentil crop residues and varieties significantly influenced weed biomass and weed control efficacy. The recommended herbicide dose provided the most effective weed control for all the weeds. Among the studied varieties, BARI Gom-31 produced the highest grain yield as well as the other yield contributing characters. The highest numbers of tillers hill^{-1} and grain yield observed where recommended dose of herbicide was used followed by the application of 90% recommended dose + aqueous extraction of lentil. According to results, 90% recommended dose + aqueous extract of lentil crop residues showed potential activity to suppress weed growth and significant effect on wheat yield.

Keywords: Wheat varieties, lentil extract, weed population, allelopathy, grain yield

INTRODUCTION

Achieving sustainable weed management approach is a very tedious job and weeds are responsible for significant crop yield reduction globally even more than the total infestation caused by insects, pests and diseases. However, today's agriculture is centered on productivity and mostly relies on synthetic inputs to combat weeds and other pest problems (Sadeghi *et al*., 2010). Weed control with herbicides, although effective, can be costly and is increasingly problematic due to public concerns about health and environmental issues (Razzaq *et al*., 2010). Modern agriculture is now challenged to reduce environmental damage and health hazards from chemical inputs and yet maintain a high level of production. Herbicides have high risk of causing significant environmental contamination and therefore, environmentally safe herbicides that are similar or more effective and selective than recently on hand synthetic herbicides are essential. Hence, an alternative way is needed to control weeds in crop fields which have no adverse effect on the environment. Allelochemicals may play a key role in suppressing weeds in organic crop fields without impairing the environment and yields can be increased to a great extent. Regarding this, natural plant products derived from higher plants/microbes can be ideal allelochemicals (Batish, 2006). In addition, leaves, bark, roots, root exudates, inflorescence and fruits of plants can be the source of allelochemicals (Weir *et al*., 2004). Plant discharges the allelochemicals (viz., phenolics, terpenoids, alkaloids, coumarins, tannins, steroids and quinines) into the environment through exudation from roots, leaching from the leaves and other aerial plant parts, volatile emissions, and the decomposition of plant materials (Xuan *et al*., 2005). Crop or its different parts that are left in the field for decomposition after thrashing or harvesting can be considered as crop residues (Kumar and Goh, 2000). Earlier these were regarded simply as waste, but now because of their usefulness they are considered an important resource that can bring significant physical, chemical, and biological changes in the agricultural soil after amendment. Crop allelopathy suppresses weed growth by

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releasing allelochemicals from living plant roots and/or through decomposition of phytotoxic plant residues (Khanh *et al*., 2005). The occurrence of weed growth inhibition as well as phytotoxic symptoms induction by plants and their residues is well documented for many crops, including all major grain crops viz., rice (*Oryza sativa* L), rye (*Secale cereal* L.), barley, sorghum (*Sorghum bicolor* L.), wheat, mustard, marsh pepper, hairy vetch, buckwheat and other crop residues (Uddin and Pyon, 2010; Won *et al*., 2011; Uddin *et al*., 2014; Ferdousi *et al*., 2017; Hossain *et al*., 2017; Ahmed *et al*., 2018; Pramanik *et al*., 2019; Sarker *et al*., 2020). Crop residues can significantly affect weed growth and development by altering the soil physical, chemical as well as biological properties. Thus, the phenomenon of allelopathy, which is expressed through the release of chemicals by plant or crop residues, has been suggested to be one of the possible alternatives for achieving sustainable weed management. Nowadays, experts are putting more attention on utilizing various crop residues for weed management. Alteration of crop allelopathy can be a viable approach for achieving sustainable weed management strategy. Generally, allelopathic interactions suppress weeds to a lesser extent than standard weed control limits. Moreover, combining allelopathic crop water extracts with reduced herbicides rates may lead to lower desirable weed control levels, resulting in decreased herbicide usage. Considering all these points of views, the current research project will be conducted to evaluate the synergistic or additive phytotoxic effects of aqueous extracts of lentil either tank mixed or mixed with reduced rates of herbicides for effective weed management and crop performance in upland wheat crops.

MATERIALS AND METHODS

The experimental site was selected at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh during the period from November 2020 to March 2021, situated at 2425 N latitude and 9050 E longitude at an elevation of 18 m above the sea level. The soil of the experimental area was close to neutral in reaction with pH value 6.8, low in organic matter and fertility level. The experimental treatment consisted of two factors, Factor A- Variety (3): i) BARI Gom-30 (V_1), ii) BARI Gom-31 (V_2) and iii) BARI Gom-32 (V_3) and Factor B-Aqueous extract of lentil crop residue and herbicide (7): i) no weeding (T_1), ii) recommended dose of herbicide (Ronstar 40% Oxadiazon, 3 ml L^{-1} water) (T_2), iii) aqueous extraction of lentil crop residue (T_3), iv) 90% recommended dose of herbicide + aqueous extraction of lentil crop residue (T_4), v) 80% recommended of dose herbicide + aqueous extraction of lentil crop residue (T_5), vi) 70% recommended dose of herbicide + aqueous extraction of lentil crop residue (T_6), vii) 60% recommended dose of herbicide + aqueous extraction of lentil crop residue (T_7). The experiment was designed according to randomized complete block design (RCBD) with three replications. The seeds were sown on 21 November 2018 as per treatment specifications. The depth of sowing was 5 cm in each treatment and the seeds were covered with soil. At the time of preparing aqueous extract, the small pieces of lentil crop residues were dipped into water maintaining the ratio of 1:20 (w/v) for 24 hours and then collected the aqueous extract from residues. The prepared lentil aqueous extract as well as herbicides was sprayed according to the prescribed treatments, and their combined effect was evaluated against numerous weed species. Weeds were collected at 30 days after treatment and kept separately in brown paper bags and then placed in an electric oven at 72 °C for three days. The samples were weighed separately. Dry matter of weed species is used to assess the efficacy of different rotation crop residues. Besides, five randomly selected sample plants were used from each plot to obtain data on yield and yield contributing characters. The data on grain and straw yields were collected from an area of 1 m^2 in the middle of each plot. After sun drying the grains were properly cleaned. Then the final grain weight was adjusted to the 14% moisture content. After sun drying, the data of grain yield as well as straw yield was measured and adjusted to t ha^{-1}. Then data taken on various parameters were properly compiled, tabulated, and statistically analyzed. The analysis of variance (ANOVA) was performed by using MSTAT-c computer program. Least significance difference Test (LSD) was used to determine the mean differences among the treatments (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

Infested weed species in the experimental field

Six weed species belonging to 5 families infested the experimental field namely *Polygonum hydropiper, Chenopodium album, Echinochloa colonum, Paspalum scorbiculatum, Cyperus rotundus and Hedyotis corymbosa.* The details of these weeds have been presented in Table 1 along with their local name, scientific name, family, morphological type and life cycle.

Table 1. Infested weed species found growing in the experimental plots of Wheat

Sl. No.	Local name	Scientific name	Family	Morphological type	Life cycle
1.	Biskatali	*Polygonum hydropiper*	Polygonaceae	Broad leaved	Annual
2.	Bathua	*Chenopodium album*	Chenopodiaceae	Broad leaved	Annual
3.	Khudashama	*Echinochloa colonum*	Poaceae	Grass	Annual
4.	Angta	*Paspalum scrobiculatum*	Poaceae	Grass	Annual
5.	Mutha	*Cyperus rotundus*	Cyperaceae	Sedge	Perennial
6.	Khetpara	*Hedyotis corymbosa*	Rubiaceae	Broad leaved	Annual

Effect of variety on number, dry weight and control efficacy of different weeds

Weed population of bathua, bishkatali and khetpara was not significantly affected by variety, whereas Khudashama, angta and mutha were significantly affected by variety. BARI Gom-32 produced the maximum weed population (6.23) and minimum (1.90) for khudashama and angta, respectively (Table 2). Variety exerted significant effect on total weed dry weight and weed control efficiency. The lowest weed dry weight (9.09) was obtained from BARI Gom-30 where the highest weed dry weight (9.77) was observed in BARI Gom-32. Weed control efficiency was the highest (67.41%) in BARI Gom-32 and the lowest one (64.94%) was observed in BARI Gom-30. This finding is similar with that reported by Ahmed *et al.* (2018) where significant deviation was recorded in weed population and dry weight.

Table 2. Effect of variety on number, dry weight and control efficacy of different weeds

Variety	Number of weeds						Total Weed dry weight (g)	Weed control efficacy (%)
	Bishkatali	Bathua	Khudashama	Angta	Mutha	Khetpara		
V_1	1.95	2.28	5.19b	2.04	2.38a	2.00	9.09b	64.94c
V_2	2.23	2.28	5.71ab	2.09	2.00b	2.28	9.64a	66.38b
V_3	2.14	2.42	6.23a	1.90	2.28ab	2.09	9.77a	67.41a
$LSD_{(0.05)}$	0.11	0.09	0.62	0.14	0.36	0.19	0.23	0.75
Level of sig.	NS	NS	**	NS	*	NS	**	**
CV (%)	5.81	8.29	7.48	6.92	6.04	5.92	3.93	1.83

In a column, figures with the same letter do not differ significantly as per DMRT; **=Significant at 1% level of probability, *=Significant at 5% level of probability, NS=Non significant; V_1=BARIGom-30, V_2=BARI Gom-31, V_3=BARI Gom-32

Effect of aqueous extract of lentil crop residue and herbicide on number, dry weight and control efficacy of different weeds

Weed population of all weeds were significantly affected by aqueous extract of lentil crop residue (Table 3). The highest weed population (11.88) was found in T_1 treatment for khudeshama and the lowest was found in T_6 treatment (0.33) for angta, mutha, khetpara and bishkatali. Weed dry weight and efficacy were significantly affected by aqueous extract of lentil crop residue (Table 3). The highest weed dry weight (28.21) was found in T_1 treatment and the lowest was found in T_2 treatment (1.92). Weed control efficacy of weed was the highest (93.13) in T_2 and the lowest one was observed in T_3 treatment. These findings were found to be same as observed by Sarkar *et al.* (2020).

Table 3. Effect of aqueous extract of lentil crop residue and herbicide on number, dry weight and control efficacy of different weeds

Treatment	Number of weeds						Total Weed dry weight (g)	Weed control efficacy (%)
	Bishkatali	Bathua	Khudashama	Angta	Mutha	Khetpara		
T_1	4.77a	6.22a	11.88a	5.55a	5.88a	5.55a	28.21a	0.000f
T_2	0.33e	0.44e	2.11e	0.33f	0.33f	0.33e	1.92f	93.13a
T_3	2.33c	2.44c	7.55b	2.22c	2.44c	2.22c	9.92b	64.65e
T_4	0.66e	0.66de	1.88e	0.66ef	0.55f	0.66e	2.08f	92.55a
T_5	1.22d	1.22d	4.55d	1.00e	1.22e	1.33d	6.60e	76.57b
T_6	1.88c	1.88c	5.44d	1.55d	1.77d	1.77cd	8.23d	70.78c
T_7	3.55b	3.44b	6.55c	2.77b	3.33b	3.00b	9.55c	66.03d
$LSD_{(0.05)}$	0.52	0.63	0.95	0.52	0.55	0.52	0.35	1.15
Level of sig.	**	**	**	**	**	**	**	**
CV (%)	5.81	8.29	7.48	6.92	6.04	5.92	3.93	1.83

In a column, figures with the same letter do not differ significantly as per DMRT; **=Significant at 1% level of probability; T_1=No weeding (Control), T_2=Recommended dose of herbicide, T_3=Aqueous extraction of lentil crop residue, T_4=90% Recommended dose of herbicide + Aqueous extraction of lentil crop residue, T_5=80% Recommended dose of herbicide + Aqueous extraction of lentil crop residue, T_6=70% Recommended dose of herbicide + Aqueous extraction of lentil crop residue, T_7=60% Recommended dose of herbicide + Aqueous extraction of lentil crop residue

Interaction effect of variety and aqueous extract of lentil crop residue along with herbicide on number, dry weight and control efficacy of different weeds

The interaction between variety and aqueous extract of lentil crop residues and herbicides were found as significant on weed population. The highest khudeshama weed population was (14.00) found in V_3T_1 and the lowest (0.33) was found in V_1T_2 (Table 4). The interaction between variety and crop residues was found to be significant on weed dry weight and efficacy. The highest weed dry weight (30.00 g) found in V_3T_1 (Table 4). The highest weed control efficiency of weed was found in V_3T_4.

Effect of variety on yield and yield contributing characters of wheat

The different varieties that were studied significantly affected the grain yield (Table 5). The highest grain yield (3.90 t ha^{-1}) was obtained in BARI Gom-31 while the lowest grain yield (3.77 t ha^{-1}) was obtained in BARI Gom-32. This difference was observed due to different varietal characteristics of wheat plant. Straw yield was significantly influenced by three varieties (Table 5). The highest straw yield (5.74 t ha^{-1}) was found in BARI Gom-31 and the lowest straw yield (5.38 t ha^{-1}) was found in BARI Gom-32. Similar variations in different varieties were also found (Uddin *et al*., 2013). In another study, significant differences were observed due to varietal effect (Pramanik *et al*., 2019).

Table 4. Interaction effect of variety and aqueous extract of lentil crop residue and herbicide on number, dry weight and control efficacy of different weed of different weeds

Interaction	Number of weeds						Total Weed dry weight (g)	Weed control efficacy (%)
	Bishkatali	Bathua	Khudas hama	Angta	Mutha	Khetpara		
V_1T_1	4.33bc	6.00ab	10.00c	5.33a	6.00ab	5.33a	25.93c	0.000i
V_1T_2	0.33i	0.66hi	2.00k	0.33h	0.33i	0.33h	2.10k	91.90b
V_1T_3	2.33e	2.33def	6.33fg	2.33bcd	2.66d	2.00def	10.03de	61.30h
V_1T_4	0.66hi	0.66hi	2.00k	0.66gh	0.66hi	0.66gh	2.10k	91.90b
V_1T_5	1.00ghi	1.00ghi	4.00ij	1.00fgh	1.33fgh	1.33fg	6.23j	75.97c
V_1T_6	1.66efg	2.00efg	5.33f-i	1.66def	2.00def	1.66ef	7.73i	70.17de
V_1T_7	3.33d	3.33cd	6.66ef	3.00b	3.66c	2.66bcd	9.50ef	63.36g
V_2T_1	5.33a	5.66b	11.66b	6.00a	5.33b	6.00a	28.70b	0.000i
V_2T_2	0.33i	0.33i	1.66k	0.33h	0.33i	0.33h	1.86k	93.49ab
V_2T_3	2.33e	2.66cde	8.33d	2.33bcd	2.33de	2.33cde	10.30d	64.10g
V_2T_4	0.66hi	0.66hi	1.33k	0.66gh	0.66hi	0.66gh	2.30k	91.99b
V_2T_5	1.33fgh	1.33 f-i	5.00ghi	1.00fgh	1.00ghi	1.33fg	6.80j	76.29c
V_2T_6	2.00ef	1.66 e-h	5.66fgh	1.66def	1.66efg	2.00def	8.26hi	71.19d
V_2T_7	3.66cd	3.66c	6.33fg	2.66bc	2.66d	3.33b	9.29fg	67.61f
V_3T_1	4.66ab	7.00a	14.00a	5.33a	6.33a	5.33a	30.00a	0.000i
V_3T_2	0.33i	0.33i	2.66jk	0.33h	0.33i	0.33h	1.80k	93.99a
V_3T_3	2.33e	2.33def	8.00de	2.00cde	2.33de	2.33cde	9.43ef	68.56ef
V_3T_4	0.66hi	0.66hi	2.33k	0.66gh	0.33i	0.66gh	1.86k	93.77ab
V_3T_5	1.33fgh	1.33 f-i	4.66hi	1.00fgh	1.33fgh	1.33fg	6.76j	77.44c
V_3T_6	2.00ef	2.00efg	5.33f-i	1.33efg	1.66efg	1.66ef	8.70gh	70.98d
V_3T_7	3.66cd	3.33cd	6.66ef	2.66bc	3.66c	3.00bc	9.86def	67.12f
$LSD_{(0.05)}$	0.89	1.08	1.64	0.89	0.95	0.91	0.61	2.00
Level of sig.	**	**	**	**	**	**	**	**
CV (%)	5.81	8.29	7.48	6.92	6.04	5.92	3.93	1.83

In a column, figures with the same letter do not differ significantly as per DMRT; **=Significant at 1% level of probability; V_1=BARI Gom-30, V_2=BARI Gom-31, V_3=BARI Gom-32; T_1=No weeding (Control), T_2=Recommended dose of herbicide, T_3=Aqueous extraction of lentil crop residue, T_4=90% Recommended dose of herbicide + Aqueous extraction of lentil crop residue, T_5=80% Recommended dose of herbicide + Aqueous extraction of lentil crop residue, T_6=70% Recommended dose of herbicide + Aqueous extraction of lentil crop residue, T_7=60% Recommended dose of herbicide + Aqueous extraction of lentil crop residue

Effect of aqueous extract of lentil crop residue and herbicide on yield and yield contributing characters of wheat

Grain yield was significantly influenced by aqueous extract of lentil crop residue (Table 6). The highest grain yield (4.78 t ha^{-1}) was produced by T_4 treatment and lowest one (2.90 t ha^{-1}) was produced by T_1 (no weeding) treatment. Crop-weed competition mostly takes place due to several growth enhancing resources *i.e.*, nutrients, water, air, sunlight and space. The increased yield was contributed in weed free condition by higher number of effective tiller $hill^{-1}$ over no weeding treatment. Straw yield was significantly influenced by

aqueous extract of lentil crop residue (Table 6). The highest straw yield (6.00 t ha^{-1}) was observed in T_2 and T_4 treatment and the lowest straw yield (5.08) was observed in T_1 (no weeding) treatment. Similar results were also reported where aqueous extract of crop residues influenced in crop performance (Uddin and Pyon, 2010). Additionally, extracts derived from the crop residues were also reported to be effective (Uddin *et al*., 2013).

Table 5. Effect of variety on yield and yield contributing characters of wheat

Variety	Plant height (cm)	Total tillers hill^{-1} (no.)	Effective tillers hill^{-1} (no.)	Spike length (cm)	No. of grains spike^{-1}	Filled grains spike^{-1}	1000 grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Harvest index (%)
V_1	82.21b	4.20a	3.15a	9.65b	33.53	16.47	49.76b	3.86a	5.52b	40.94a
V_2	89.37a	4.17a	2.68c	9.89a	33.50	16.49	50.11b	3.90a	5.74a	40.15c
V_3	89.76a	3.94b	3.07b	9.82ab	33.96	17.1	50.65a	3.77b	5.38c	40.89b
$LSD_{(0.05)}$	0.48	0.12	0.08	0.22	…	…	0.35	0.07	0.10	0.01
Level of significance	**	**	**	*	NS	NS	**	**	**	**
CV (%)	2.89	4.80	4.38	3.52	3.88	2.72	3.14	2.96	3.01	2.03

In a column, figures with the same letter do not differ significantly as per DMRT; **=Significant at 1% level of probability, *=Significant at 5% level of probability, NS=Non significant, V1=BARI Gom-30, V2=BARI Gom-31, V3=BARI Gom-32

Table 6. Effect of aqueous extract of lentil crop residue and herbicide on yield and yield contributing characters of wheat

Treatment	Plant height (cm)	Total tillers hill^{-1} (no.)	Effective tillers hill^{-1} (no.)	Spike length (cm)	No. of grains spike^{-1}	Filled grains spike^{-1}	1000 grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Harvest index (%)
T_1	85.35d	3.75c	1.95f	9.14c	30.52e	15.67e	47.68e	2.90e	5.08d	36.32g
T_2	88.94a	4.45a	3.53a	10.74a	35.71a	17.58a	52.15a	4.77a	6.00a	44.31b
T_3	87.13bc	4.03b	2.86d	9.70b	33.75bc	17.05b	50.60c	3.47c	5.67b	38.01f
T_4	88.94a	4.45a	3.57a	10.61a	35.36a	17.67a	51.21b	4.78a	6.00a	44.37a
T_5	87.38b	4.16b	3.30b	9.70b	34.01b	16.67c	50.59c	4.13b	5.86a	41.32c
T_6	86.41c	4.03b	3.00c	9.30c	33.03d	16.19d	49.66d	3.57c	5.27c	40.42d
T_7	85.63d	3.84c	2.56e	9.31c	33.27cd	15.99d	49.35d	3.28d	4.96d	39.83e
$LSD_{(0.05)}$	0.73	0.18	0.12	0.32	0.60	0.27	0.54	0.11	0.15	0.01
Level of sig.	**	**	**	**	**	**	**	**	**	**
CV (%)	2.89	4.80	4.38	3.52	3.88	2.72	3.14	2.96	3.01	2.03

In a column, figures with the same letter do not differ significantly as per DMRT; **=Significant at 1% level of probability, NS=Non significant; T_1=No weeding (Control), T_2=Recommended dose of herbicide, T_3=Aqueous extraction of lentil crop residue, T_4=90% Recommended dose of herbicide + Aqueous extraction of lentil crop residue, T_5=80% Recommended dose of herbicide + Aqueous extraction of lentil crop residue, T_6=70% Recommended dose of herbicide + Aqueous extraction of lentil crop residue, T_7=60% Recommended dose of herbicide + Aqueous extraction of lentil crop residue

Interaction effect of variety and aqueous extract of lentil crop residue along with herbicide on yield and yield contributing characters of wheat

Grain yield was significantly influenced by the interaction between varieties and aqueous extract of lentil crop residues (Table 7). The highest number of grain yield was produced by V_2T_2 treatment and the lowest number of grain yield was produced by V_1T_1 treatment. The lowest grain yield ha^{-1} in the no weeding condition might be due to the poor performance of yield contributing characters like number of tillers hill^{-1}

and grain spike^{-1}. Acute weed infestation between weed and wheat plants occurred because of competition for moisture and nutrients. Straw yield was significantly influenced by the interaction between variety and aqueous extract of lentil crop residue (Table 7). The highest straw yield was produced by V_2T_2 treatment and the lowest straw yield was produced by V_3T_1 treatment.

Table 7. Interaction effect of variety and aqueous extract of lentil crop residue and herbicide on yield and yield contributing characters of wheat

Interaction	Plant height (cm)	Total tillers hill^{-1} (no.)	Effective tillers hill^{-1} (no.)	Spike length (cm)	No. of grains spike^{-1}	Filled grains spike^{-1}	1000 grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Harvest index (%)
V_1T_1	80.23i	3.43i	1.93m	9.06h	29.94i	15.70hi	47.04l	3.00hi	5.25fgh	36.34p
V_1T_2	84.33f	4.66ab	3.83ab	10.66ab	36.26a	17.40bc	51.95abc	4.60b	5.75b-e	44.42c
V_1T_3	81.53gh	3.93fgh	2.83hij	9.40 e-h	33.97def	16.83de	49.83hi	3.50fg	5.67de	38.17m
V_1T_4	84.36f	4.80a	3.90a	10.39bcd	35.09bc	17.43b	51.07c-f	4.66b	5.74cde	44.84b
V_1T_5	82.73g	4.40bc	3.60cd	9.68efg	33.82ef	16.01gh	50.43e-h	4.30c	6.02b	41.67f
V_1T_6	81.40hi	4.20c-f	3.30ef	9.20gh	32.41gh	15.99gh	48.96ij	3.63ef	5.27fg	40.81h
V_1T_7	80.90hi	4.00efg	2.70ijk	9.19gh	33.22fg	15.91ghi	49.04i	3.36g	4.98hi	40.31j
V_2T_1	88.40de	3.92fgh	1.89m	9.32fgh	30.26i	15.46i	48.10jk	2.90ij	5.16gh	35.98q
V_2T_2	91.33a	4.40bc	3.16fg	10.96a	34.95bcd	16.98b-e	52.37a	5.00a	6.50a	43.48e
V_2T_3	88.40de	4.26cde	2.73ijk	9.76efg	32.99fg	17.11bcd	50.03gh	3.53efg	5.83bcd	37.72n
V_2T_4	91.00ab	4.30cde	3.16fg	10.96a	35.16bc	17.23bcd	50.93d-g	4.96a	6.35a	43.86d
V_2T_5	89.66cd	4.33cd	2.90hi	9.60e-h	34.32cde	16.94cde	50.12gh	4.10d	5.94bc	40.81h
V_2T_6	88.40de	4.06d-g	2.56kl	9.27fgh	33.30efg	15.97gh	50.26fgh	3.70e	5.55e	40.00k
V_2T_7	88.40de	3.90fgh	2.36l	9.36fgh	33.51ef	15.78hi	49.00ij	3.13h	4.86i	39.20l
V_3T_1	87.43e	3.90fgh	2.03m	9.04h	31.36h	15.86ghi	47.90kl	2.80j	4.84i	36.63o
V_3T_2	91.16a	4.30cde	3.60cd	10.60ab	35.91ab	18.36a	52.13ab	4.73b	5.77b-e	45.05a
V_3T_3	91.46a	3.90fgh	3.03gh	9.95cde	34.30cde	17.20bcd	51.94abc	3.40g	5.51ef	38.16m
V_3T_4	91.46a	4.26cde	3.66bc	10.49abc	35.82ab	18.36a	51.62a-d	4.72b	5.90bcd	44.43c
V_3T_5	89.76bc	3.76gh	3.40de	9.84def	33.88ef	17.06b-e	51.23b-e	4.00d	5.64de	41.49g
V_3T_6	89.43cd	3.83gh	3.13fg	9.45e-h	33.38efg	16.61ef	49.77hi	3.40g	5.00ghi	40.47i
V_3T_7	87.60e	3.63hi	2.63jk	9.37fgh	33.09fg	16.26fg	50.01gh	3.36g	5.05ghi	40.00k
$LSD_{(0.05)}$	1.27	0.32	0.21	0.56	1.04	0.47	0.94	0.18	0.27	0.02
Level of significance	**	**	**	**	**	**	**	**	**	**
CV (%)	2.89	4.80	4.38	3.52	3.88	2.72	3.14	2.96	3.01	2.03

In a column, figures with the same letter do not differ significantly as per DMRT. **=Significant at 1% level of probability, V_1=BARI Gom-30, V_2=BARI Gom-31, V_3=BARI Gom-32. T_1=No weeding (Control), T_2=Recommended dose of herbicide, T_3=Aqueous extraction of lentil crop residue, T_4=90% Recommended dose of herbicide + Aqueous extraction of lentil crop residue, T_5=80% Recommended dose of herbicide + Aqueous extraction of lentil crop residue, T_6= 70% Recommended dose of herbicide + Aqueous extraction of lentil crop residue, T_7=60% Recommended dose of herbicide + Aqueous extraction of lentil crop residue

CONCLUSION

The application of herbicide at 90 percent of its recommendation along with aqueous extract of lentil crop residue may be used to inhibit weed growth and to optimize the yield and yield contributing traits of BARI Gom-31 in field conation.

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