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Research Article

Impact of different herbicides on morphological and biochemical parameters of wheat and weeds control

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Abstract

The present study was conducted to evaluate the effect of different herbicides on morphological and biochemical characters of wheat (*Triticum aestivum* L., varity: Sahar-2006) and control of weeds. The variety Sahar is a local developed variety and as per the Institute of Biotechnology and Genetic Engineering, this variety is very much suited for Peshawar valley in terms of its productivity. The experiment was laid out in Randomized Compete Block Design (RBCD) with three replicas, each with seven plots. Five different herbicides at the rate Clodinafop 100 gm/6-liter, Affinity 100 gm/liter, Isoprotron 50% w/w 100 gm/6 liter, Bromoxynil 62.5 ml/6 liter, MCPA 62.5 ml/6 liter of water, Hand weeding and Weedy check were used. Weed density was calculated before and after of treatment of different herbicides. Maximum weed (97 %) was controlled in plots treated with Bromoxynil. Number of tillers/plants, spike length, number of spikelet's/ spikes, plant height, number of nodes/plant and stem width were non-significantly affected by herbicides. Maximum spike length (9.53 cm), number spiklets/spike (18.97), plant height (89.10 cm), number of nodes/plant (5.57), leaf width (1.53 cm), stem width (1.49 cm) and grain yields (kg/m^2) were noted in weedy check. Maximum number of tillers/plant (11.33), number spiklets/spike (18.97) and grains/spike (51.87) were noted in hand weeding plots. Clodinafop showed positive correlation with weedy check and hand weeding plots for the number of tillers (6.67), spike length (9.07 cm), plant height (87.60 cm), leaf length (42. 37 cm), leaf width (1.53 cm), 1000-grains weight (51.37 gm) and total grains yields (2.42 kg/ha). Maximum moisture (8.90 %) and fats (2.6 %) for Clodinafop, maximum fibers (6.8 %) for MCPA and maximum protein (15.28 %) for Isoprotron treated plots were recorded. Isoprotron, Affinity and Bromoxynil showed similar results (1.8 %) for Ash contents. Highest value 71.81 % and 71.52 % of carbohydrates were recorded in hand weeding and weedy check plots respectively.

Keywords: Biochemical; Herbicides; Morphological; Parameters; Wheat; Weed Control

Introduction

Wheat (*Triticum aestivum* L.) is one of the most important staple foods of mankind. It is also known as "The king of cereal". About 37% of the world population depends on it as their main cereal crop. Wheat whether

cultivated or wild belongs to the genus *Triticum*. Wheat is an annual self pollinated long day crop. Plant body consisting of rolled or rounded shoots, fibrous adventitious roots and leaf with sheet ligules and leaf blade lamina. The plant as a whole is glabrous. Depend on fertility of soil, wheat produces tillers like other grasses [1]. It is the indispensable and regarded as the world leading food crop because of its antiquity. It has been suggested that the demand for wheat crop in the year 2020 will be ratio from 840 million tons to 1050 million tons [2]. It occupies a central position in the crop and plays a very important role to meet the need of food requirement. Wheat ranks first in all cereal crops and annually it occupies 66% of crop area in Pakistan [3]. Wheat kernel contains 10-15% Proteins, 63-71% Carbohydrates, 1.5-2% Fats, 1.5-2% Minerals, and 20-25% Vitamins. Of the average diet, wheat supplies (73%) calories and proteins [4, 5]. On the basis of area and production of wheat, Pakistan ranks 8th, out of the 121 countries of the world. On the basis of yield per unit area, Pakistan ranks 9th, throughout the world. Pakistan occupies 6th position and a populous country, where wheat is used as a primary source of food [6]. Wheat ranks 1st in all cereal crops and annually it occupies 66% area in Pakistan. Through the world, Pakistan has a position among the top ten wheat producing country [3]. Sowing time, education, fertilizers application, seed rate, irrigation and herbicides cost are the factors that affecting wheat production [7]. The major causes for the low production of wheat in Pakistan are the ignoring of recommended use of technology shortage of water, infestation of weeds, disease etc. [8]. Weed infestation is one of the main reasons for the low production [9]. It was reported that (18-30%) lose in wheat crop occur due to weed infestation [10]. The competition of weeds with wheat crop result in yield reduction [11]. Methods for controlling weeds at different growth stages of wheat and weeds are very important [9]. To decrease weeds and increase grain yield, most effective is the use of herbicides 30 days after sowing seed [12]. Wheat yield reduced (25-30%) due to the presence of weeds in Pakistan [13]. Due to weed infestation losses in wheat yield (1.25-2.5 million tons) occurred at national level per year [14]. Annually (28 billion) losses occurred in wheat in Pakistan (2 billion) in Khyber Pukhtunkhwa [3]. About two hundred and eighty varieties of weeds have been identified in Khyber Pukhtunkhwa that infests the crop field in varying status [15]. If weed remained undisturbed, eighty percent loss in yield occurred. To control weeds, Chemical weed control is the best method because it was easily reliable, independent and cheaper one [16, 17]. Some common weeds which are competitive with wheat crops in Khyber Pukhtunkhwa are *Avena fatua, Phalaris minor, Poa anna, cirsium arvense, Convolvulus arvensis, Ammi visnaga, Chenopudium album, Fumaria indica, Carthamus oxaycantha, Gallium aparine, Euphorbia helioscopia, Euphorbia peplus, Euphorbia prostrata, Euphorbia trigona, Euphorbia pulcherrima, Melilotus inidcus, Sinapis arvinsis, Cynodon dactylon, Anagallis arvensis, Medicago dentculata, Coronopus didymus, Ranunculus muricantus, Melilotus parviflora, Rumex dentatus, Silybum marianum, Sisymbrium iro, Linum sp, Sorghum halepense, Vicia sativa, Fumaria polymorpha.*

Materials and Methods

Study area

To study the impact of different herbicides on morphology and proximate components of wheat and weed control. A field experiment was conducted at Botanical Garden, Islamia College University, Peshawar during Rabi season 2011-12. Location of the experimental site was at 34^{0}

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N and 71.3^0 E and an altitude of 347 m ASML. Coordinates of the area from which plants were collected: 34.0000° N, 71.4760° E.

Experimental procedure

Procedure of the experiment was carried out in two main steps.

1. Field experiment
2. Biochemical analysis

Experimental design

The experiment was laid out in Randomized Complete Block design (RCBD) with three replicas. In each replication there were seven sub plots having five for herbicides application, one hand weeding and weedy check plots. Each plot had eight rows. The size of each plot was (3 x 1.5) m^2. A distance of 30 cm was kept among the rows.

Preparation of the soil

The soil of the experimental site was well prepared by ploughing. A basal dose of nitrogen fertilizers in the form of nitrate was used at the time of seed sowing. In well prepared seedbed of soil, wheat (variety: Sahar- 2006) was sown by hand at the rate of 120 $Kgha^{-1}$ on November 26th 2011. There was sufficient amount of moisture in the soil while sowing the seed. Seeds were sown in rows and depth of the seed in the soil was kept 5 cm.

Seed germination

Germination of the seed started on December 7th 2012, just before first irrigation urea fertilizer was applied to the field. Canal water was used for irrigation purpose. On the basis of water need second, third and fourth irrigation were providing to the field during the entire experimental period.

Weeds in the experimental site

During the course of study of the experimental site, different types of weeds were observed. These weeds were as follows. *Allium cernuum, Oxalis corniculata, Fumaria Parviflora, Taraxacum officinales, Anagallis arvensis, Brassica juncea, Rumex hastatus, Euphorbia helioscopia, Medicago denticulata, Convolvulus arvensis, Poa anum, Silybum marianum, Ranunculus muricantus, Coronopus didymus, Mazus japonicus and Cyanodon dactylon.*

The following data of weeds was recorded before and after the application of herbicides:

1. Weed density and relative weed density
2. Frequency and relative frequency
3. Canopy cover and relative canopy cover

Weed density

Weed density was calculated when wheat was at 4-6 leafy stage. Weed density was calculated by quadrat method. Quadrate used during this experiment having size of 20 cm length and 10 cm width ($0.02m^{-2}$). All treatments of three replications were taking into account while calculating weed density. In each treatment quadrat was placed five times randomly and then weeds inside the quadrat were counted. Density for each individual species and that for different species inside the quadrat was calculated as a whole.

Herbicides and other methods used in the experiment

Following five different types of herbicides were used for the controlling weeds in the study area (Table 1).

Formula for calculating weed density, frequency and canopy cover

For calculating weed density the following formula was used.

$$1.\ \textbf{Density} = \frac{\text{Total number of individual of a species}}{\text{Area sampled}}$$

$$2.\ \textbf{Frequency} = \frac{\text{Number of quadrat in which a species present}}{\text{Total number of quadrat sampled}}$$

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3. **Canopy Cover** $= \frac{\text{X value of a species}}{\text{Area sampled}}$

X value: Sum of mid-point of coverage classes of species/Total no. of quadrates
Relative values were calculated according to the following formulas.

1. $\text{Relative density (R.D)} = \frac{\text{Dentisty for a species}}{\text{Total denisties for all the species}} \times 100$
2. $\text{Relative Frequency (R.F)} = \frac{\text{Frequency for a species}}{\text{Total frequency value for all the species}} \times 100$
3. $\text{Relative C.Cover (R.C)} = \frac{\text{Cover area of a psecies}}{\text{Total covered area by all the species}} \times 100$
4. $\text{Important Value} = \text{R.D} + \text{R.F} + \text{R.C}$

Table 1. Herbicides and other methods used in the experiment

S. #	Herbicides		Rate	Method
	Trade name	Chemical name		
1.	Clodinafop	Clodinafop- proargyle	15.5gm /6 liters	Spray in moist condition
2	Isoproturon	Isoproturon 50% w/w	100gm/6 liters	Spray in moist condition
3	Affinity	Carfentrazone-ethyle-A1+isoproturon	100gm/6 liters	Spray in moist condition
4	Bromoxynil	Bromxynil+MCPA	62.51 ml/6 liters	Spray in moist condition
5	MCPA	MCPA	62.5l ml/6 liters	Spray in moist condition
6	H. Weeding	_	_	_
7	W. check	_	_	_

Application of herbicides

Five different types of herbicides viz: Clodinafop, Isoproturon, Affinity, MCPA and Bromoxynil were sprayed on wheat on February 14th 2012. The herbicides were sprayed in moist condition with knapsack sprayer. All the precautionary measures were taken into account during the application of the herbicides spray. Parameters like spike initiation, number of tillers/ plant, plant height, number of leaves/ plant, leaf length, leaf width, stem width, spike length, number of spikelet's/ spike, number of grains/ spike, 1000 grains weight (gm) and grains yield ($Kgha^{-1}$) were recorded.

Statistical analysis

Data recorded for each parameter, was then subjected to the analysis of variance technique (ANOVA) by using M-state C computer software and means were separated by using fisher protected LSD test at 5% level of probability [18].

Biochemical analysis of wheat

To study the effect of different herbicides on the biochemistry of wheat, a laboratory experiment was carried out at NIFA, Research institute, Tarnab, Peshawar.

Experimental procedure

Different samples were collected from selective treatments of wheat. These samples were subjected to grinding and grind with the help of grinding machine. Fine powders of the sample were subjected to investigate the biochemistry of wheat under the influence of different herbicides. Biochemistry of wheat included moisture, ash, fats, fibers, protein and carbohydrate.

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$$\text{Moistue (\%)} = \frac{\text{weight. of fresh sample - weight. of sample after drying}}{\text{weight. of sampel}} \times 100$$

$$\text{Ash (\%)} = \frac{\text{weight. of samples after ashing}}{\text{weight of sampels}} \times 100$$

$$\text{Crude fat (\%)} = \frac{\text{wt of beaker with fat - wt of empty beaker}}{\text{wt of sampel}} \times 100$$

$$\text{Fiber (\%)} = \frac{W_1 - W_2}{\text{wt of sample}} \times 100$$

$$\text{Protein= \%N} = \frac{\text{Nx14x100xT itre}}{\text{sample wt x 1000}}$$

N=Normality of HCl=0.1% Factor for protein=5.57
Protein = % N x Factor
Carbohydrates % = 100 – sum of known values (moisture + ash + fiber + fats + protein)

Soil analysis

To study the nature of the soil of the experimental site, soil samples from different treated plots were taken to the depth of 15 cm. Collected samples of soil were air dried, cleaned off from stones and plant residues were grounded in a stainless steel grinder and passed through 2 mm sieve. The sieved soils were collected, sampled and stored in plastic bottles. Soil was analyzed for soil texture, pH, organic matter, soil nitrogen and electrical conductivity,

Soil texture =

$$\%[\text{silt} + \text{caly}](w/w) = \frac{R_1 \times 100}{\text{sample wt}}$$

$$\%\ \text{caly}\ (w/w) = \frac{R_2 \times 100}{\text{sample wt}}$$

$$\%\ \text{sand (w/w)} = 100 - (\text{silt} + \text{clay})$$

$$\%\ \text{Silt} = (\%\text{silt} + \text{Caly}) - (\%\text{clay})$$

$$\%\ \text{Organic mattar} = 10\left(1 - \frac{\text{Samples reading}}{\text{Blank sample reading}}\right) \times 1.34$$

$$\%\ \text{N} = \frac{\text{N} \times .14 \times 100 \times \text{Titre}}{\text{weight of sample} \times 1000}$$

$$\%\ \text{EC} = \frac{\text{sample x 100}}{1000}$$

Results and Discussion

Field experiments were conducted to investigate "the effect of different herbicides on the morphology and biochemistry of wheat and controlling weeds" at Botanical garden, Islamia College University, Peshawar. Data was recorded on weed density and some morphological and biochemical characteristics of wheat.

Weed density (m^{-2})

Analysis of the data showed that all the herbicides significantly controlled weeds as

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compared to weedy check (Table 2). In Bromoxynil treated plot 97.01% weeds were controlled followed by Isoproturon (96.65%), Affinity (95.65%) and MCPA (94.86%). Minimum weeds (71.40%) were controlled in Clodinafop treated plot. Highest weed density (101.45%) was recorded in weedy check. Bromoxynil, Isoproturon, Affinity and MCPA showed a prominent result by decreasing weed density/m² when applied at post emergence stage of wheat crop. Shakoor [19], Salarzai [20], Nati [21], Marwat [4], Shah [22], Abbas [23], Mahmood [24] and Sangi [10] concluded that herbicides significantly affected the weed population per unit area.

Table 2. Weed density unit area^{-1} (3x1.5 m^2) before and after application of herbicides

S. No.	Treatments	Weed density (m^{-2})		
		Before application of herbicides	After application of herbicides	% difference (+/-)
1	Clodinafop	11830 a	3383 b	-71.40
2	Isoproturon	10300 a	350 c	-96.60
3	Affinity	12250 a	533 bc	-95.65
4	MCPA	10700 a	550 bc	-94.86
5	Bromoxynil	8933 a	267 c	-97.01
6	Hand weeding	00 b	00 c	00
7	Weedy check	8017 a	8133 a	+1.45
LSD value at 5%		7036	2919	

Means followed by different letters in the respective column are significantly different at 5% probability level according to LSD test % (+/-) = % increase (+)/% decrease (-)

Number of tillers/plant

Analysis of the data showed that the numbers of tillers/plant were significantly affected by different herbicides treatments (Table 3). Maximum tillers/plant (11.33) and (9.33) were recorded in hand weeding and weedy check plots respectively. Clodinafop with (6.67) tillers/plant followed by Isoproturon (6.00), Bromoxynil and Affinity (2.33) each and MCPA (3.00) tillers/plant were recorded. Shah [9], Marwat [16] also reported similar results. Tiller per unit area increased with herbicides application [25].

Spike length (cm)

Maximum spike length (9.53cm) was observed in weedy cheek plot. Hand weeding and plot treated with Clodinafop have spike length (9.07cm), Isoproturon (8.73cm). MCPA and Bromoxynil treated plots with spike length (8.67cm). Minimum spike length (8.07cm) was recorded in Affinity treated plot. Similar results were also reported by Mahmood [24].

Number of spikelets/spike

Highest number of spikelets/spike (18.97) was recorded in hand weeding plots followed by weedy check plot with spikelests/spike of (18.73), Isoproturon with spikelets/spike of (18.60), Clodinafop plot treated with spikelets/spike (18.13), Affinity (17.47) and MCPA (17.7) spikelets/spike. Minimum number of spikelets/spike (16.53) recorded in Bromoxynil treated plot. Khan [25] reported that spikelets/spike was significantly affected by herbicides application.

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Table 3. Number of tillers/plant, spike length and number of spikelets/spike, Plant height (cm), number of nodes and leaf length (cm) as affected by weed management methods at maturation of wheat

S. No.	Treatments	Parameters					
		1	2	3	4	5	6
1	Clodinafop	6.67 bc	9.07 ab	18.13 ab	87.60 a	5.07 bc	42.37 a
2	Isoproturon	6.00 c	8.73 b	18.60 a	78.13 b	5.17 ab	37.00 bc
3	Affinity	2.33 d	8.07 c	17.47 b	75.07 b	4.63 c	35.23 c
4	MCPA	3.00 d	8.67 bc	17.73 b	86.63 a	5.27 ab	36.13 bc
5	Bromoxynil	2.33 d	8.67 bc	16.53 c	75.87 b	5.23 ab	38.23 b
6	Hand weeding	11.33 a	9.07 ab	18.97 a	89.10 a	5.50 ab	41.37 a
7	Weedy check	9.33 ab	9.53 a	18.73 a	91.17 a	5.67 a	41.60 a
LSD value at 5%		2.21	0.65	0.84	7.19	0.51	2.19

Keys: 1. Tillers/plant, 2. Spike length, 3. Spikelets/spike, 4. Plant height, 5. Nodes/plant, 6. Leaf length. Means followed by different letters in the respective column are significantly different at 5% probability level according to LSD test

Plant height (cm)

Analysis of the data revealed that maximum plant height (91.17cm) was recorded in weedy check plot followed by hand weeding (89.10cm). Among the herbicides treated plots, maximum plant height (87.60cm) was recorded in Clodinafop treated plots and minimum plant height (75.7cm) in Affinity treated plot. All the other herbicides have a comparable effect on plant height (Fig. 1). Shah [9, 22], Ahmad [26] and Khalil [27] investigated that plant height is strongly under the genetic control and not affected by herbicides application.

Number of Nodes/plant

Data regarding nodes/plant was analyzed. The results showed non significant (Fig. 1) differences among the means (Table 4). Maximum number of nodes/plant (5.67) was recorded in weedy check followed by hand weeding (5.50) nodes/plant. The lowest number of nodes/plant (4.637) was found in Affinity treated plot. Plots treated with other herbicides have comparable results with each other. It was concluded that herbicides have least effect on the number of nodes/plant.

Leaf length (cm)

Maximum leaf length (42.37cm) was found in plot treated with Clodinafop followed by weedy check (41.60cm), and hand weeding (41.37cm) plots. Bromoxynil (38.23cm), Isoproturon (37.00cm) and MCPA (36.13cm) were intermediate for the length of leaves. Lowest value (35.23cm) was found in plot treated with Affinity. Thus it was concluded that herbicides have controlled leaf length as compared to weedy check and hand weeding.

Leaf width (cm)

Statistical analysis showed that herbicides have significant affect on leaf width in different plots (Table 4). Highest value of leaf width in different treated plots were; weedy check and Clodinafop (1.53cm) each, Bromoxynil (1.20cm), Affinity and MCPA (1.33cm) each and hand weeding and Isoproturon (1.47cm) and (1.43cm) respectively (Table 3).

Stem width (cm)

Statistical analysis of the data showed that stem width was significantly affected by different herbicides treatments (Table 4). Maximum stem width (1.49cm) was found in weedy check as compared with hand weeding plot with stem width (1.46cm). Among the herbicides treated plots, stem width (1.37cm) for Bromoxynil, (1.30cm) for Clodinafop, (1.12cm) for Isoproturon and (1.13cm) for Affinity were recorded. It was concluded that herbicides have

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significantly effect and suppressed stem width as compared to control.

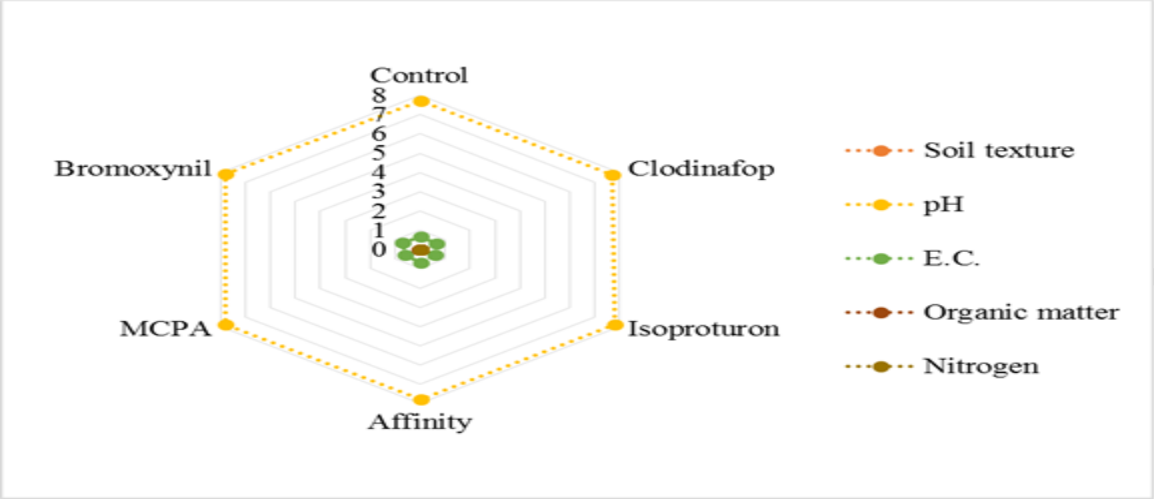

Figure 1. Effect of different herbicides on different parameters of soil

Table 4. Leaf width (cm), stem width (cm), grains/spike, 1000-grain weight (g) and grain yield (kg m^{-2}) as affected by weed management methods at maturation of wheat

S. No.	Treatments	Parameters				
		7	8	9	10	11
1	Clodinafop	1.53 a	1.30 cd	44.33 b	51.37 a	2.42 a
2	Isoproturon	1.43 ab	1.12 f	43.63 bc	50.93 a	1.97 ab
3	Affinity	1.33 bc	1.13 ef	38.00 c	44.70 b	1.06 c
4	MCPA	1.33 bc	1.23 de	41.87 bc	48.93 ab	1.97 ab
5	Bromoxynil	1.20 c	1.37 bc	46.33 ab	51.10 a	1.56 bc
6	H. weeding	1.47 ab	1.46 ab	51.87 a	51.47 a	2.54 a
7	Weedy check	1.53 a	1.49 a	50.47 a	50.57 a	2.56 a
LSD value at 5%		0.15	0.11	5.64	4.53	0.60

Keys: 7. Leaf width, 8. Stem width, 9. Grains/spike, 10. 1000-grain weight, 11. Grain yield. Means followed by different letters in the respective column are significantly different at 5% probability level according to LSD test

Number of grains/spike

Number of grains/spike is another important factor of yield. Maximum number of grain/spike (51.87) was recorded in hand weeding plot. All the herbicides have significantly effected the number of grains/spike. Maximum number of grains/spike (46.33) was observed in Bromoxynil while minimum number of grains/spike (38.00) was recorded in Affinity treated plots. Number of grains/spike was reported to be maximum in hand weeding plot [4]. Khalil [27], Qureshi [28] and Mahmood [24] reported that herbicides treatments significantly increased the number of grains/spike. When weeds were controlled at 2-5 leaf stage of wheat, highest number of grain/spike was produced [9].

Thousand Grains weight

Analysis of variance of the data showed that herbicides have no significant effect on 100-grains weight. Highest 1000 grains weight (51.47g) was recorded in hand weeding and (50.57g) was found in weedy check plots. Lowest 1000 grain weight (44.70g) was found in Affinity treated plot. Data recorded for other treatments were comparable with

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each other and no significant differences were found. Qureshi [28], Hassan [29] and Marwat [19] stated that herbicides application increased 1000 grain weight significantly when compared with weedy check.

Grain yield (kg/m²)

Results showed that herbicides have significant effect on the grain yield (Fig. 2). Maximum grain yield (2.6kg/m²) was obtained in weedy check plot closely followed by hand weeding (Table 5). In herbicides treated plots, maximum grain yield (2.42kg/m²) was obtained in Clodinafop treated plot and minimum grain yield (1.06kg/m²) in Affinity treated plot. All the other treatments have comparable effect for grain yield. Hassan [29], Khan [30], Abbas [23] and Sangi [10] stated that herbicides treatments significantly increased grain yield in wheat. Controlling of weed at 2-5 leaf stage of wheat, produced maximum grain yield [9].

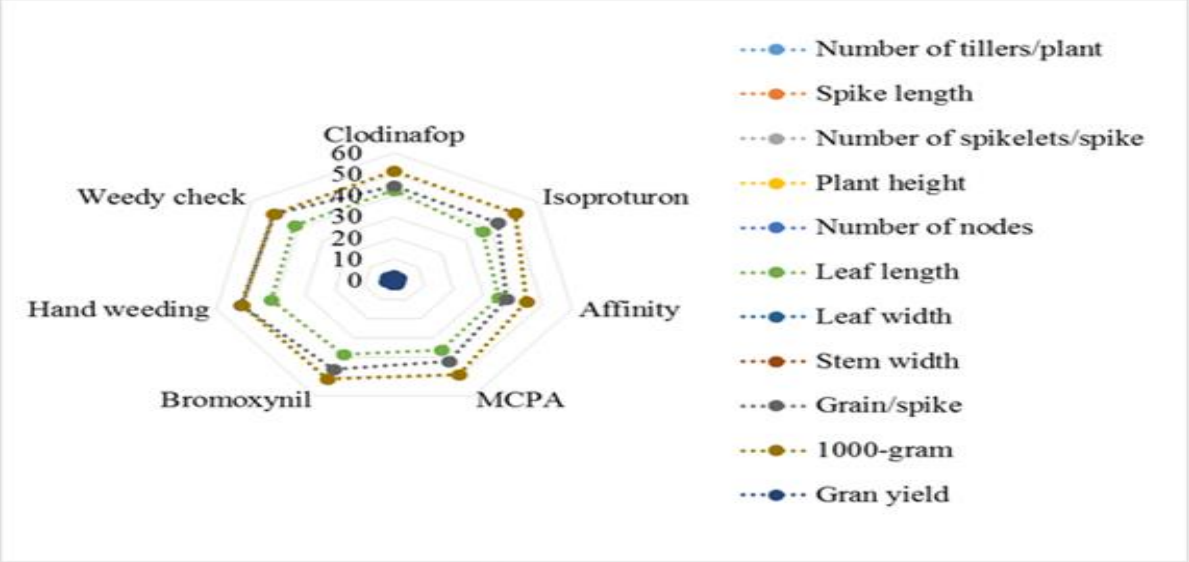

Figure 2. Effect of different herbicides on different parameters of wheat

Table 5. Determination of soil texture, soil pH, soil electrical conductivity, Soil organic matter and soil nitrogen

S. No	Treatments	Parameters				
		1	2	3	4	5
1	Control	Silt-Clay-loam	7.7	0.65	0.73%	0.04%
2	Clodinafop	Clay-Loam	7.7	0.65	0.60%	0.03%
3	Isoproturon	Loam	7.8	0.60	0.67%	0.03%
4	Affinity	Clay-Loam	7.8	0.69	0.54%	0.02%
5	MCPA	Clay-Loam	7.8	0.60	0.54%	0.03%
6	Bromoxynil	Clay-Loam	7.8	0.70	0.60%	0.03%

Key: 1. Soil texture, 2. pH, 3. Electrical conductivity, 4. Organic matter, 5. Nitrogen

Proximate analysis of wheat flour

Moisture

Moisture contents of different wheat samples were non-significantly affected by different herbicides treatments (Table 6). Maximum moisture contents (8.90%) were found in Clodinafop treated plots followed by Isoproturon and MCPA each with moisture of (8.70%) and (8.48%) in Bromoxynil treated plots. Affinity, hand

weeding and weedy check having moisture 8.60%, 8.54% and 8.50% respectively. It was concluded that herbicides application have increased the moisture contents of different wheat samples as compared with control plot (Fig. 3).

Ash contents

Ash obtained from different herbicides treated plots showed that application of herbicides has a significant effect on ash contents. Results revealed that maximum ash (1.8%) were found in Isoproturon, Affinity and Bromoxynil treated plots followed by (1.6%) in Clodinafop and MCPA treated plot. Minimum ash contents (1.3%) were found in hand weeding plot and weedy check (1.4%) (Fig. 3). It was concluded that ash contents have increased in herbicides treated plots as compared to control.

Fats contents

Analysis revealed that herbicides application has non-significant effect on fats. Maximum fats contents (2.6%) were found in Clodinafop while minimum fats contents (1.2%) were noted in Bromoxynil treated plots. Same value was recorded for fats contents (2.4%) in herbicides treatment plots. It was probably due to the effective control of weed by herbicides as a result of which the crop may have absorbed and utilized the available resources for fats content.

Fibers contents

Data regarding the fibers contents of wheat flour showed that different herbicides treatments significantly affected the fibers, protein and carbohydrates contents of wheat (Table 6). Maximum fibers contents (6.8%) were recorded in MCPA treated plots followed by Isoproturon and Affinity having 5.9% and 5.7% fibers contents respectively. Minimum fibers contents of 2.7% and 3.1% were found in weedy check and hand weeding plots. This increase in the fibers contents of wheat is attributed due to the effective weed control by herbicides and availability of recourses to wheat crop as compared to control plots.

Proteins contents

Data revealed that maximum proteins contents (15.28%) were recorded in Isoproturon treated plots. All other herbicides like MCPA, Bromoxynil, Affinity and Clodinafop have a comparable effect on wheat crop for proteins contents. i.e. (14.81%), (14.34%), (14.19%), (14.03%) and (2.42%) respectively. Minimum protein contents (13.25%) were recorded in hand weeding plot followed by weedy check with protein contents (13.88%). The high proteins in herbicides treatments may attribute to plots to the effective weed control and the availability of resources in order to increases proteins contents in wheat crop.

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Table 6. Percentage determination of moisture, ash, fats, fibers, proteins and carbohydrates contents of wheat

S. No.	Treatments	Parameters					
		1	2	3	4	5	6
1	Clodinafop	8.90	1.6	2.6	14.03	5.5	67.37
2	Isoproturon	8.70	1.8	2.4	15.28	5.9	65.92
3	Affinity	8.60	1.8	2.4	14.19	5.7	65.59
4	MCPA	8.70	1.6	2.4	14.81	6.8	65.69
5	Bromoxynil	8.748	1.8	1.2	14.34	4.5	69.42
6	H. weeding	8.54	1.8	2.0	13.25	3.1	71.31
7	Weedy check	8.50	1.4	2.0	13.88	2.7	71.52

Key: 1. Moisture, 2. Ash, 3. Fats, 4. Fibers, 5. proteins 6. Carbohydrates

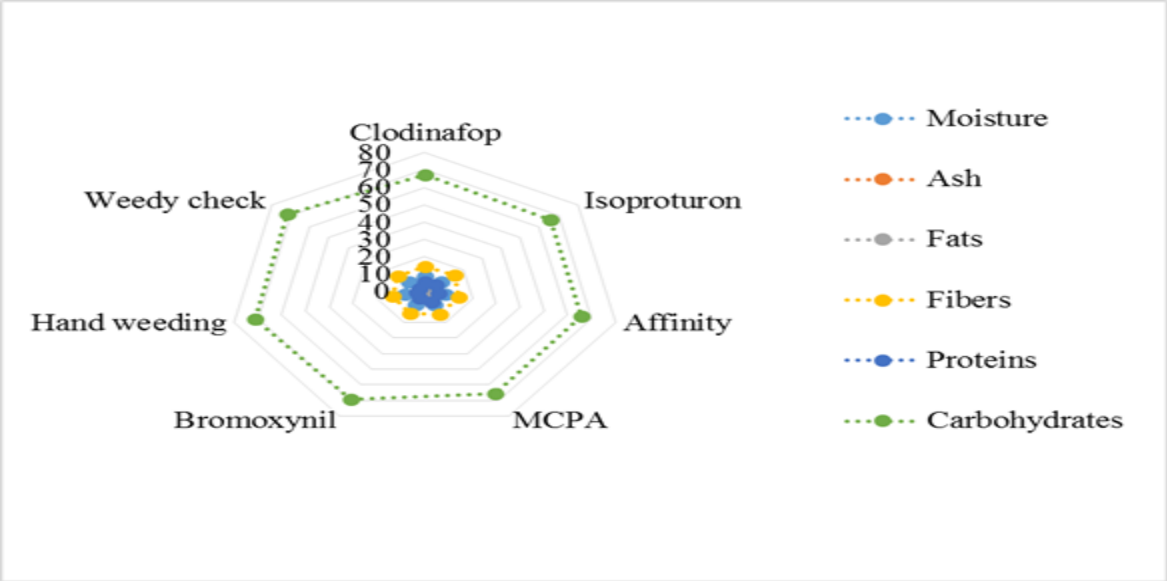

Figure 3. Effect of different herbicides on proximate components of wheat

Carbohydrates contents

Maximum carbohydrates contents (71.81%) were recorded in hand weeding followed by weedy check with carbohydrates contents (71.52%). Among the herbicides treated plots, maximum carbohydrates contents (69.78%) were found in Bromoxynil treated plots while minimum carbohydrates contents (69.68 %) were recorded in MCPA treated plots. Other treatments like Affinity, Clodinafop and Isoproturon have comparable effect for carbohydrates values i.e. 67.31%, 67.10% and 65.92% respectively. The reason for the low carbohydrate content in herbicides treated plots may be attributed to the controlling weeds in these plots, Herbicides also influence the amount of carbohydrate in wheat crop.

Soil analysis

After harvesting the crop, soil from different herbicides treated plots were collected and analyzed for soil texture, soil pH, soil electrical conductivity, soil organic matter and soil nitrogen contents.

1. Soil texture

Analysis of the data (Table 5) showed that the texture of the soil in all treatments is clay-loam.

2. Soil pH

Analysis of the data revealed that there is no difference in the pH value in different soil sample (Table 5). The value of pH for different soil samples ranged from 7.7 to 7.8 which are slightly alkaline in nature.

3. Soil electrical conductivity (E.C.)

Analysis showed that E.C value for different soil samples is variable. Maximum E.C value 0.70 was found in Bromoxynil treated plots closely followed by Affinity with E.C value 0.69. E.C value for control plots was 0.65 (Table 5). It was concluded that these values of E.C favoured the growth of the crops when E.C value is in between 0-2 ds/m^2.

4. Soil organic matter

Soil organic matter is also an important factor for the growth of crops. Analysis of the data showed that in different treatments values for the organic matter ranges from 0.54% to 0.73%. Maximum values 0.73% were recorded for control plot and minimum values (0.54%) were recorded for Affinity

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and MCPA. Bromoxynil, Clodinafop and Isoproturon treated plots have 0.60 %, 0.60 % and 0.67 % respectively (Table 5).

5. Soil Nitrogen

Nitrogen is also another important constituent for plant growth. Analysis showed that Nitrogen content in the soil ranges from 0.02% to 0.04% in different treatments. Maximum value 0.04% for Nitrogen was recorded in control plot followed by MCPA, Clodinafop, Isoproturon and Bromoxynil with Nitrogen contents 0.03%. Lowest value for Nitrogen 0.02% was found in Affinity treated plots (Table 6).

Authors' contributions

Conceived and designed the experiments: WM Khan & Mursaleen, Performed the experiments: WM Khan, Mursaleen, M Zahir, I Ahmad & KS Ahmad, Analyzed the data: WM Khan, S Khalid & SIU Haq, Contributed materials/ analysis/ tools: S Khalid, I Ahmad, Mursaleen, M Zahir & KS Ahmad, Wrote the paper: S Khalid, I Ahmad & SIU Haq.

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