IMPACT OF WEEDS MANAGEMENT PRACTICES ON WHEAT PRODUCTIVITY

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Abstract

Unwise use of herbicides has resulted in environmental and health problems for human beings as well as for animals. Moreover, its frequent application also developed resistance in some weed species against the herbicides. Therefore, a field experiment was planned to assess the effect of multi-approached weed suppression in wheat at Reclamation Research Station, 7/3-L Ahmad Pur Sial District Jhang during winter 2019-20. Experimental treatment was comprised of two wheat cultivars i.e. Ujala 2016 and Faisalabad 2008 and seven weeds control approaches i.e. hand weeding, organic mulching, eucalyptus extract, neem extract, clodinafop, bromoxynil + MCPA and clodinafop + bromoxynil + MCPA including control. Results of the experiment showed that hand weedings, combined application of clodinafop + bromoxynil + MCPA and mulching significantly reduced the weeds density, fresh and dry weight of weeds. However, covering the soil surface with the organic mulch may have a great impact on the growth and yield-contributing attributes, hence produced maximum grain yield.

Keywords: Neem extract, eucalyptus extract, hand weeding, grain yield, wheat.

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Introduction

Agriculture sector has an important role in improving the economic growth. While, the productivity of agricultural crops is far below in most of the developing nations including Pakistan. The contribution of agriculture sector to GDP is 19.3%, although there is a lot of potential in this sector to enhance its share in GDP with the use of modern agricultural techniques and improved crop productivity (GOP, 2020). Among different agricultural crops, wheat is principal staple food and occupies fundamental place in agricultural strategies of Pakistan. Wheat contributes 8.7% to value addition in agriculture and 1.7% to GDP. Its overall productivity improved upto 2.5% and produced 24.946 million tones during 2019-20 (GOP, 2020).

Despite the suitability of agro-climatic conditions, the productivity of wheat in Pakistan is far below as compared to their potential of modern wheat cultivars. Inadequate supply of essential nutrients, moisture stress at critical growth stages, conventional agronomic practices and abundant weeds are the main factors responsible for low yield. Weeds in the wheat crop may be reduced the productivity up to 80% depending upon their density, type and emergence time (Chhokar and Malik, 2002).

Manual or mechanical weeds management has been practiced since centuries, however these operations are laborious, tiresome and expensive due to increasing labour charges (Ashrafi *et al.,* 2009). Under this conditions application of herbicides improve the crops productivity through effective weed control (Marwat *et al*., 2008; Arif *et al*., 2011). But, excessive consumption of herbicides has ensued in ecological and health glitches. As poisonous remains of herbicides enter in the food chain and may prove perilous even to next generations (Judith *et al.,* 2001). Moreover, it was also observed that frequent use of same herbicide might instigate resistance in some weed species (Heap, 2007).

Therefore, allelopathy is considered as a substitute for herbicides in controlling weeds in wheat. As allelochemicals released by different plants in the nearby ecosystem distresses the weeds growth and development (Cheema *et al*., 2009). This is an environment friendly approach and has the competency to alleviate the problems arrived with the application of herbicide (Iqbal and Cheema, 2007). When allelopathic crops grown as cover crops, green manuring, smother crops, surface mulch, crop water extracts, or cultivate in rotational sequence are beneficial in reducing problematic weeds and plant pathogens, increase soil quality and crop productivity (Khanh *et al*., 2005). Although a lot of work has been done to control weeds in wheat crop by using pre and post emergence herbicides. However, only limited studies showing the allelopathic potential of eucalyptus and neem extract and organic mulching to control weeds and their impact on the growth and productivity of wheat are available. Therefore, we hypothesized that the foliar spray of allelopathic chemicals and organic mulching efficiently control the weeds and improve the yield contributing attributes, which ultimately enhance the final wheat productivity. Keeping in view the importance of above-mentioned discussion a field trial was conducted with objective to evaluate the different weeds management techniques in wheat.

Materials and Methods

A field research trial was conducted to assess the effect of multi-approached weed suppression in wheat at Reclamation Research Station, 7/3-L Ahmad Pur Sial (30.7192 °N, 71.7596 °E) District Jhang during Rabi 2019-20. Experimental treatment was comprised of two wheat cultivars i.e. Ujala 2016 and Faisalabad 2008 and seven weeds control approaches i.e. hand weeding, organic mulching, eucalyptus extract, neem extract, clodinafop, bromoxynil + MCPA and clodinafop + bromoxynil + MCPA including control. These treatments were applied after 1st irrigation at wheat tillering stage by "Knapsack" hand sprayer fitted with T-

jet nozzle. Volume of spray was determined by calibration method and water was used at 250 L ha^{-1}. This field study was laid out in a Randomized Complete Block Design (RCBD) with split plot arrangement having 3 replications.

Soil analysis

Prior to sowing, composite soil samples were collected from experimental areas at the depth of 0-30 cm and examined for physico-chemical features. The soil of experimental area was sandy loam in texture with pH 7.28, organic matter 0.87 %, total nitrogen 0.0521%, available phosphorus 3.00 ppm, exchangeable potassium 148 ppm and electrical conductivity 2.20 dS m^{-1}.

Crop husbandry

A fine seedbed was prepared by cultivating the experimental area thrice followed by planking at suitable moisture contents. The sowing of both wheat cultivars (Ujala 2016 and Faisalabad 2008) was done by using hand drill keeping the seed rate 125 Kg ha^{-1} on October 11, 2019 on well prepared seedbed by keeping row to row distance of 20 cm. Nitrogen (N) and phosphorus (P) fertilizers were broadcasted @ 200 and 150 kg ha^{-1}, respectively. Whole of P and half of N were applied at the time of sowing. While remaining N was applied with 1st irrigation. Soil moisture was kept at satisfactory levels to put off water deficit and wilting. Weeds were restricted by hand weeding as required. All other agronomic practices were kept similar to keep the crop free from insect, pest and diseases.

Data recording

Weed population was measured by considering the number of weeds in 1-m^2 quadrates in each experimental unit. Then weeds from 1-m^2 were cut at the ground level and weighed then sun dried for 72 hours to record the dry weight. Randomly selected 10 plants from each experimental unit were tagged to record the final plant height, number of spikelets per spike, spike length, number of grains per spike at physiological maturity of wheat crop. Net plot area of each experimental unit was harvested, sun dried and allowed to threshing in respective plots. Wheat biomass, 1000 grains weight and total grains weight was noted for each experimental unit by operating a spring balance. Moreover, harvest index of each experimental unit was computed by adopting the given equation.

$$\text{Harvest index (\%)} = \frac{\text{Grain yield}}{\text{Biological yield}} \times 100$$

At maturity, crop was harvested on April 19, 2020.

Weather condition

Data regarding mean maximum and minimum temperature and humidity and total rainfall was collected from Meteorological Observatory, Land Reclamation Research Station, 7/3-L Ahmad Pur Sial district Jhang Pakistan during the growth period (Figure 1).

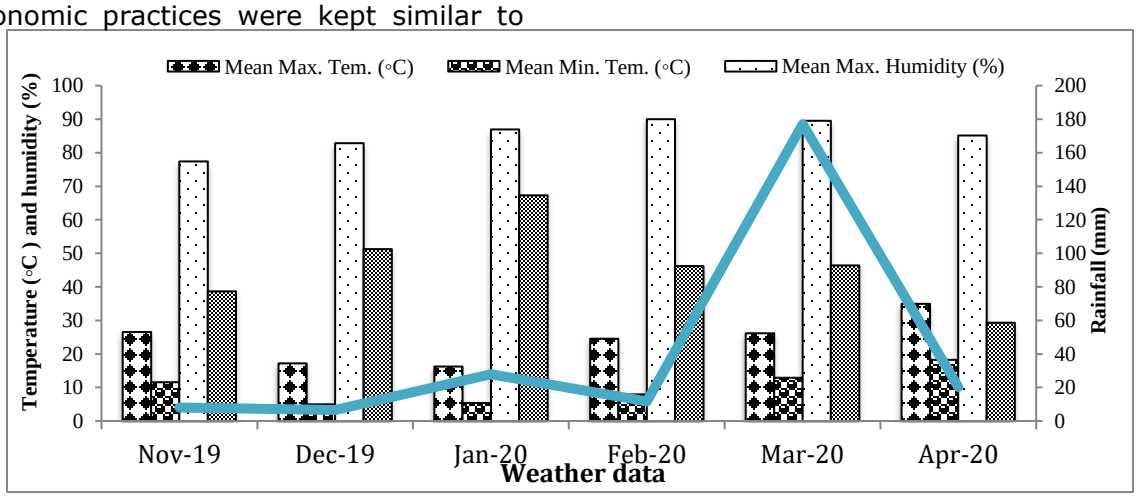

Figure 1: Metrological data for wheat growth period during 2019-20

Statistical analysis

Collected data was statistically analyzed by adopting computer-based software M STAT. LSD test was used to compare the difference among various treatment means at 5% probability level (Steel *et al.,* 1997).

Results

Weeds density per square meter

Comparison of the treatment means showed significant effect of different weeds controlling techniques on weeds density per square meter (Table 1). Results showed that maximum number of weeds per m^2 was recorded from control plots. While minimum number of weeds per m^2 was recorded from hand weeding's plots. Interaction between wheat cultivars and weeds controlling treatments also showed significant effect on weeds density per square meter. Data showed that maximum number of weeds per m^2 was observed from control plots of Faisalabad 2008. While minimum number of weeds per m^2 was observed from hand weedings plots of Ujala 2016.

Weeds fresh weight (g)

Statistically analyzed data showed significant influence of different weeds controlling techniques on weeds fresh weight (Table 2). Results showed that maximum weeds fresh weight was observed from control plots. While minimum fresh weight was observed from hand weedings plots. Interaction between wheat cultivars and weeds controlling treatments also showed significant effect on weeds fresh weight. Data showed that maximum weeds fresh weight was observed from control plots of Faisalabad 2008. While minimum weeds fresh weight was observed from hand weedings plots of Ujala 2016.

Weeds dry weight (g)

Statistically analyzed data showed significant influence of different weeds controlling techniques on weeds dry weight. Results showed that maximum weeds dry weight were observed from control plots (Table 3). While minimum dry weight was observed from hand weedings plots. Interaction between wheat cultivars and weeds controlling treatments also showed significant effect on weeds dry weight. Data showed that maximum dry weight of weeds was observed from control plots of Faisalabad 2008. While minimum dry weight of weeds was recorded from hand weedings plots of Ujala 2016.

Plant height (cm)

Final height of wheat plants showed the striking feature that reveals the growth performance of particular cultivar. Results indicated that plant height was significantly affected with different weeds controlling treatments. Different weeds control treatments significantly affected the final plant height (Table 4). However, use of organic mulch produced considerably taller plants against the minimum height was observed from weedy check plots. Interaction between wheat cultivars and weeds control treatments also indicated substantial effect on final plant height. Application of organic mulch in wheat cultivar Ujala-2016 cultivated experimental units produced significantly taller plants. While minimum plant height was recorded from wheat cultivar Faisalabad 2008 cultivated in weedy check experimental units.

Fertile tillers per m^2

Tillering capability is one of the essential yield controlling character in wheat. Statistically analyzed data showed significant influence of different weeds controlling techniques on number of fertile tillers per m^2. Application of organic mulch produced significantly higher number of spike bearing tillers per m^2 against the minimum was observed from weedy check plots (Table 5). Interaction between wheat cultivars and weeds controlling treatments also showed significant effect on fertile tillers per m^2. Application of organic mulch in wheat cultivar Ujala-2016 cultivated experimental units produced maximum number of fertile tillers per m^2. While minimum fertile tillers per m^2 was recorded from wheat cultivar Faisalabad

2008 cultivated in weedy check experimental units.

Number of spikelets per spike

Spikelets per spike play substantial part in the final productivity. Genetic features, availability of optimum moisture and essential nutrients and agronomic practices are critical in the setting of spikelets. Comparison of the treatment means showed significant effect of different weeds controlling techniques on number of spikelets per spike. Application of organic mulch produced significantly higher spikelets per spike, which was statistically similar to the handweedings. Whereas minimum spikelets per spike was observed from weedy check plots. Interaction between wheat cultivars and weeds controlling treatments also showed significant effect on spikelets per spike (Table 6). Application of organic mulch in wheat cultivar Faisalabad 2008 produced maximum spikelets per spike, which was statistically similar to hand weeding and application of organic mulch in Ujala-2016 cultivated experimental units. While minimum spikelets per spike was observed from wheat cultivar Faisalabad 2008 cultivated in weedy check experimental units.

Spike length (cm)

Spike length is an important yield-contributing attribute. Statistically analyzed data showed significant influence of different weeds controlling techniques on spike length (Table 7). Application of organic mulch produced significantly higher spike length against the minimum was observed from weedy check plots. Interaction between wheat cultivars and weeds controlling treatments also showed significant effect on spike length. Application of organic mulch in wheat cultivar Ujala-2016 cultivated experimental units produced significantly higher spike length. While minimum spike length was recorded from wheat cultivar Faisalabad 2008 cultivated in weedy check experimental units.

Number of grains per spike

It is one of the important yield contributing factors. Inherited features, adequate supply of essential nutrients and availability of optimum moisture at reproductive stage is substantially influenced the setting of grains. Statistically analyzed data showed significant influence of different weeds controlling techniques on number of grains per spike (Table 8). Application of organic mulch produced significantly higher number of grains per spike against the minimum was observed from weedy check plots. Interaction between wheat cultivars and weeds controlling treatments also showed significant effect on number of grains per spike. Application of organic mulch in wheat cultivar Ujala-2016 cultivated experimental units produced maximum grains per spike. While minimum grains per spike was recorded from wheat cultivar Faisalabad 2008 cultivated in weedy check experimental units.

Thousand grain weight (g)

Statistical analysis of treatment means exhibited significant influence of different weeds controlling techniques on 1000 grains weight. Application of organic mulch produced significantly higher 1000 grains weight against the minimum was observed from weedy check plots. Interaction between wheat cultivars and weeds controlling treatments also showed significant effect on 1000 grains weight (Table 9). Application of organic mulch in wheat cultivar Faisalabad-2008 cultivated experimental units produced significantly higher 1000 grains weight. While minimum 1000 grains weight was recorded from wheat cultivar Ujala-2016 cultivated in weedy check experimental units.

Grain yield (kg ha^{-1})

Grain yield is the determination of mutual effects of different yield contributing attributes settled under the certain environmental conditions. Statistically analyzed data showed significant influence of different weeds controlling techniques on final grain yield (Table 10). Application of organic mulch produced maximum grain yield, which was statistically similar to hand weeding, and

combined application of narrow and broad leaves weeds herbicide. The minimum grain yield was observed from weedy check plots. Interaction between wheat cultivars and weeds controlling treatments also showed significant effect on economic yield. Application of organic mulch in wheat cultivar Ujala-2016 cultivated experimental units produced significantly higher grain yield as compared to the other treatments. While minimum grain yield was recorded from wheat cultivar Faisalabad 2008 cultivated in weedy check experimental units.

Straw yield (kg ha^{-1})

Statistically analyzed data showed significant influence of different weeds controlling techniques on straw yield (Table 11). Application of organic mulch produced maximum straw yield against the minimum straw yield was observed from weedy check plots. Interaction between wheat cultivars and weeds controlling treatments also showed significant effect on straw yield. Application of organic mulch in wheat cultivar Ujala-2016 cultivated experimental units produced significantly higher straw yield as compared to the other treatments. While minimum straw yield was recorded from wheat cultivar Faisalabad 2008 cultivated in weedy check experimental units.

Biological yield (kg ha^{-1})

It shows an indirect index of photosynthetic works as it indicated the biomass produced by the plant. Statistically analyzed data showed significant influence of different weeds controlling techniques on biological yield (Table 12). Application of organic mulch produced maximum biological yield. While the minimum biological yield was observed from weedy check plots. Interaction between wheat cultivars and weeds controlling treatments also showed significant effect on biological yield. Application of organic mulch in wheat cultivar Ujala-2016 cultivated experimental units produced significantly higher biological yield as compared to the other treatments. The minimum biological yield was recorded from wheat cultivar Faisalabad 2008 cultivated in weedy check experimental units.

Harvest index (%)

Statistically analyzed data showed significant influence of different weeds controlling techniques on harvest index. Weeds eradication with hand weeding produced significantly higher harvest index (Table 13). While the minimum harvest index was observed from weedy check plots. Interaction between wheat cultivars and weeds controlling treatments also showed significant effect on harvest index. Weeds eradication with hand weeding in wheat cultivar Ujala-2016 cultivated experimental units produced significantly higher harvest index as compared to the other treatments. While minimum harvest index was recorded from wheat cultivar Faisalabad 2008 cultivated in weedy check experimental units.

Discussion

Weed species of wheat varies from field to field relying upon ecological situations, moisture and nutrient availability, soil type, weed management techniques and cropping pattern. Weed plants compete with crop plants for sunlight, space, moisture and nutrients, thus depriving the crop plants to fundamental resources (Shehzad *et al*., 2012). Results of the present study showed that all the weed management techniques were efficient in decreasing the weed density and biomass. Significantly higher number of weeds, fresh and dry weight of weeds was observed in the control experimental units. However, the efficiency of hand weedings, combined application of Clodinafop + Bromoxynil + MCPA and organic mulching was higher in controlling weeds and dry biomass as compared to the other treatments. Although hand weedings was more effectively controlled the weeds, but foliar application of herbicides is favored over hand weedings due to its greater effectiveness as well as economical (Yang *et al*., 2010). It was observed that herbicides enter the cell walls of weeds

and suspend distinctive biochemical activities such as inhibition of photosynthesis, degradation of chlorophyll contents that resultant in weeds mortality (El-Hadary and Chung, 2013).

Data regarding growth, yield and yield contributing attributes showed that application of organic mulching was superb as compared to the other treatments. Mulching reduced the weed occurrence in different crops and increase its gradually used as a weeds management technique, which is of particular applicable in an organic farming to produce high quality safe food (Bilalis *et al*., 2003). Dillard *et al*. (2004) assessed mulching as an efficient weed management technique. As mulching managed the weeds by numerous modes: such as physical barrier and by correlated variations in the micro-climate, C:N ratio, adds organic material, pH, releasing allelopatic chemicals and reduced the light availability to the weeds (Lenka *et al*., 2012; Shehzad *et al*., 2012). Organic mulches keeps constant soil temperature and optimum moisture contents that consequences in favorable circumstances for living organism's activities in the soil and improve the crop productivity (Kar and Kumar, 2007; Lenka *et al*., 2012). It was also observed that organic mulch not only improves the physical properties of soil but also enhance accessibility of essential nutrients in the soil (Sønsteby *et al*., 2004; Sinkevičienė *et al*., 2009). Efficient resource utilization perhaps improved the wheat growth and development that resultant in greater 1000 grains weight, biological and grain yield. This improvement in wheat productivity with combined approach could be credited to suppression of weed density, weed growth and biomass that favored rise in yield contributing attributes such as fertile tillers, grains per spike and 1000 grains weight, which ultimately increased the final yield.

Conclusion

Weeds invasion is one of the key limitation to attain maximum production of wheat. Results of present experiment showed that hand weedings, combined application of clodinafop + bromoxynil + MCPA and mulching significantly reduced the weeds density, fresh and dry weight of weeds. However, covering the soil surface with the organic mulch may have a great impact on the growth and yield-contributing attributes, hence produced maximum grain yield.

Table 1: Influence of integrated weeds management on weeds density (m^{-2}) in wheat

Treatments	**Ujala-2016**	**Faisalabad 2008**	**Mean**
Hand weeding	13.583f	15.450ef	14.517D
Organic mulching	16.303ef	15.860ef	16.082D
Eucalyptus extract	22.373c-e	25.030cd	23.702BC
Neem extract	25.160cd	27.020bc	26.090B
Clodinafop	18.237d-f	18.623d-f	18.430CD
Bromoxynil + MCPA	21.743c-e	24.363cd	23.053BC
Clodinafop + Bromoxynil + MCPA	15.813ef	15.720ef	15.767D
Weedy Check	33.297ab	39.100a	36.198A
Mean	20.814	22.646	
LSD 0.05*p*=	Cultivar=NS, Weeds management =5.2789,Interaction 7.4655		

Table 2: Influence of integrated weeds management on weeds fresh weight (g) of wheat

Treatments	**Ujala-2016**	**Faisalabad 2008**	**Mean**
Hand weeding	28.523f	32.443ef	30.483D
Organic mulching	34.237ef	33.307ef	33.772D
Eucalyptus extract	46.983c-e	52.563cd	49.773BC
Neem extract	52.837cd	56.740bc	54.788B
Clodinafop	38.297d-f	39.107d-f	38.702CD
Bromoxynil + MCPA	45.660c-e	51.163cd	48.412BC
Clodinafop + Bromoxynil + MCPA	33.207ef	33.010ef	33.108D
Weedy Check	69.920ab	82.110a	76.015A
Mean	43.708	47.555	
LSD 0.05*p*=	Cultivar=NS, Weeds management =11.086, Interaction=15.678		

Table 3: Influence of integrated weeds management on weeds dry weight (g) of wheat

Treatments	**Ujala-2016**	**Faisalabad 2008**	**Mean**
Hand weeding	9.203f	10.467ef	9.835D
Organic mulching	11.043ef	10.747ef	10.895D
Eucalyptus extract	15.153c-e	16.953cd	16.053BC
Neem extract	17.043cd	18.303bc	17.673B
Clodinafop	12.353d-f	12.617d-f	12.485CD
Bromoxynil + MCPA	14.733c-e	16.503cd	15.618BC
Clodinafop + Bromoxynil + MCPA	10.713ef	10.650ef	10.682D
Weedy Check	22.553ab	26.483a	24.518A
Mean	14.100	15.340	
LSD 0.05*p*=	Cultivar=NS, Weeds management =1.7880, Interaction= 5.0571		

Table 4: Influence of integrated weeds management on final plant height (cm) of wheat

Treatments	**Ujala-2016**	**Faisalabad 2008**	**Mean**
Hand weeding	108.02a-c	104.02a-c	106.02AB
Organic mulching	112.36a	109.11ab	110.73A
Eucalyptus extract	86.60de	83.16e	84.88C
Neem extract	105.15a-c	103.65a-c	104.40AB
Clodinafop	103.19a-c	102.47a-c	102.83AB
Bromoxynil + MCPA	96.53cd	100.37bc	98.45B
Clodinafop + Bromoxynil + MCPA	105.33a-c	103.32a-c	104.32AB
Weedy Check	82.83e	78.51e	80.67C
Mean	100.00	98.08	
LSD 0.05*p*=	Cultivar=NS, Weeds management=8.36, Interaction=11.82		

Table 5: Influence of integrated weeds management on spike bearing tillers of wheat

Treatments	**Ujala-2016**	**Faisalabad 2008**	**Mean**
Hand weeding	278.83ab	269.52a-d	274.17A
Organic mulching	284.94a	274.00a-c	279.47A
Eucalyptus extract	212.35f	201.35f	206.85D
Neem extract	266.42b-e	251.31e	258.87BC
Clodinafop	271.00a-d	264.94b-e	267.97A-C
Bromoxynil + MCPA	260.72c-e	254.48d-e	257.60C
Clodinafop + Bromoxynil + MCPA	275.52a-c	267.04b-e	271.28AB
Weedy Check	204.19f	196.27f	200.23D
Mean	256.75 A	247.36 B	
LSD 0.05*p*=	Cultivar=6.2934, Weeds management =12.587, Interaction=17.800		

Table 6: Influence of integrated weeds management on spikelets per spike of wheat

Treatments	**Ujala-2016**	**Faisalabad 2008**	**Mean**
Hand weeding	11.537a	10.887a-c	11.212A
Organic mulching	11.643a	11.723a	11.683A
Eucalyptus extract	9.423e-g	9.227e-g	9.325DE
Neem extract	9.817c-g	9.837c-g	9.827CD
Clodinafop	10.370b-e	9.970c-f	10.170BC
Bromoxynil + MCPA	9.723d-g	9.483e-g	9.603C-E
Clodinafop + Bromoxynil + MCPA	11.230ab	10.747a-d	10.988AB
Weedy Check	9.153fg	8.713g	8.933E
Mean	10.362	10.073	
LSD 0.05*p*=	Cultivar=NS, Weeds management =0.8212, Interaction=1.1614		

Table 7: Influence of integrated weeds management on spike length (cm) of wheat

Treatments	**Ujala-2016**	**Faisalabad 2008**	**Mean**
Hand weeding	9.17ab	9.00a-c	9.08A
Organic mulching	9.36a	9.13a-c	9.25A
Eucalyptus extract	8.42c-f	8.15d-f	8.28BC
Neem extract	8.98a-c	8.71a-d	8.84A
Clodinafop	9.09a-c	8.92a-c	9.01A
Bromoxynil + MCPA	8.90a-c	8.57b-e	8.74AB
Clodinafop + Bromoxynil + MCPA	9.15ab	8.95a-c	9.05A
Weedy Check	7.94ef	7.79f	7.87C
Mean	8.8758	8.6537	
LSD 0.05*p*=	Cultivar=NS, Weeds management =0.5164, Interaction=0.7303		

Table 8: Influence of integrated weeds management on number of grains per spike of wheat

Treatments	**Ujala-2016**	**Faisalabad 2008**	**Mean**
Hand weeding	47.797ab	44.507a-e	46.15AB
Organic mulching	48.443a	45.157a-d	46.80A
Eucalyptus extract	44.033b-f	39.927fg	41.98CD
Neem extract	46.103a-d	42.963c-g	44.53A-C
Clodinafop	46.967a-c	43.730b-f	45.35AB
Bromoxynil + MCPA	44.607a-e	41.920d-g	43.26BC
Clodinafop + Bromoxynil + MCPA	47.390ab	44.130b-f	45.76AB
Weedy Check	40.703e-g	38.837g	39.77D
Mean	45.75A	42.65B	
LSD 0.05*p*=	Cultivar=1.5064, Weeds management =3.0127, Interaction=4.2606		

Table 9: Influence of integrated weeds management on 1000 grains weight (g) of wheat

Treatments	**Ujala-2016**	**Faisalabad 2008**	**Mean**
Hand weeding	39.850ab	40.027a	39.938AB
Organic mulching	40.350a	40.573a	40.462A
Eucalyptus extract	38.593ab	38.950ab	38.772A-C
Neem extract	39.680ab	39.253ab	39.467A-C
Clodinafop	39.463ab	39.197ab	39.330A-C
Bromoxynil + MCPA	38.010ab	38.963ab	38.487BC
Clodinafop + Bromoxynil + MCPA	39.810ab	39.940ab	39.875AB
Weedy Check	37.350b	38.157ab	37.753C
Mean	39.138	39.383	
LSD 0.05*p*=	Cultivar=NS, Weeds management =1.8703, Interaction=2.6451		

Table 10: Influence of integrated weeds management on grain yield (kg ha^{-1}) of wheat

Treatments	**Ujala-2016**	**Faisalabad 2008**	**Mean**
Hand weeding	4184.4ab	3916.4a-d	4050.4A
Organic mulching	4292.7a	4036.5a-d	4164.6A
Eucalyptus extract	3740.5b-e	3415.6ef	3578.0C
Neem extract	4028.6a-d	3703.8c-e	3866.2A-C
Clodinafop	4081.7a-c	3775.1b-e	3928.4AB
Bromoxynil + MCPA	3735.4b-e	3594.3de	3664.9BC
Clodinafop + Bromoxynil + MCPA	4155.6a-c	3877.3a-e	4016.4A
Weedy Check	3044.0f	2966.8f	3005.4D
Mean	3907.9A	3660.7B	
LSD 0.05*p*=	Cultivar=167.89, Weeds management =335.78, Interaction=474.87		

Table 11: Influence of integrated weeds management on straw yield (kg ha^{-1}) of wheat

Treatments	**Ujala-2016**	**Faisalabad 2008**	**Mean**
Hand weeding	5913.9ab	5598.0a-c	5756.0A-C
Organic mulching	6148.4a	5794.7a-c	5971.5A
Eucalyptus extract	5632.7a-c	5290.7cd	5461.7C
Neem extract	5976.1ab	5670.2a-c	5823.1A-C
Clodinafop	6038.4a	5700.8a-c	5869.6AB
Bromoxynil + MCPA	5607.6a-c	5457.5bc	5532.5BC
Clodinafop + Bromoxynil + MCPA	5949.0ab	5720.8a-c	5834.9A-C
Weedy Check	4735.5de	4614.0e	4674.7D
Mean	5750.2 A	5480.8 B	
LSD 0.05*p*=	Cultivar=197.29, Weeds management =394.58, Interaction=558.02		

Table 12: Influence of integrated weeds management on biological yield (kg ha^{-1}) of wheat

Treatments	**Ujala-2016**	**Faisalabad 2008**	**Mean**
Hand weeding	10098ab	9514a-d	9806AB
Organic mulching	10441a	9831a-c	10136A
Eucalyptus extract	9373b-d	8706de	9040C
Neem extract	10005a-c	9374b-d	9689A-C
Clodinafop	10120ab	9476a-d	9798AB
Bromoxynil + MCPA	9343b-d	9052cd	9197BC
Clodinafop + Bromoxynil + MCPA	10105ab	9598a-d	9851AB
Weedy Check	7779ef	7581f	7680D
Mean	9658.1 A	9141.6 B	
LSD 0.05*p*=	Cultivar=341.94, Weeds management= 683.88, Interaction=967.15		

Table 13: Influence of integrated weeds management on harvest index (%) of wheat

Treatments	**Ujala-2016**	**Faisalabad 2008**	**Mean**
Hand weeding	41.367a	41.150ab	41.258A
Organic mulching	41.137ab	41.013a-c	41.075AB
Eucalyptus extract	39.847a-c	39.247bc	39.547CD
Neem extract	40.210a-c	39.530a-c	39.870B-D
Clodinafop	40.330a-c	39.807a-c	40.068A-D
Bromoxynil + MCPA	39.913a-c	39.700a-c	39.807B-D
Clodinafop + Bromoxynil + MCPA	41.097ab	40.403a-c	40.750A-C
Weedy Check	39.113c	39.110c	39.112D
Mean	40.377	39.995	
LSD 0.05*p*=	Cultivar=NS, Weeds management =1.3540, Interaction= 1.9149		

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