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Article

ASSESSMENT OF INTEGRATED WEED MANAGEMENT APPROACHES ON *Asphodelus tenuifolius* IN CHICKPEA

Avaliação de Taxas Aproximadas do Manejo Integrado de Plantas Daninhas em Grão-de-Bico

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ABSTRACT - Chickpea is the third most important crop of rainfed areas of Pakistan, and it is severely affected by noxious weed *Asphodelus tenuifolius*. Therefore, a field trial was conducted to evaluate the effect of different allelopathic weed extracts, herbicides and mulches in controlling *A. tenuifolius* and other associated weeds in chickpea at "District Karak" Khyber Pakhtunkhwa-Pakistan. The experiment was carried out in a Randomized Complete Block Design (RCBD) and replicated thrice using a chickpea cultivar (Chattan) which was grown for the experimental trial. There were 9 treatments along with control for comparison. The treatments Stomp 330 EC (Pre-emergence) at 2.5 L ha^{-1}, Fenoxaprop-p-ethyl, Bromoxanil+MCPA (Tank mix), Starane-M, mulching (Eucalyptus leaves), mulching (Wheat straw mulch), allelopathic weed extract (*A. tenuifolius*) + Stomp, allelopathic weed extract (*Cyperus rotundus*), allelopathic weed extract (*Sorghum halepense*) and control treatment were used in this trial. Data were recorded on *A. tenuifolius* density m^{-2} before and after application of weed management practices (m^{-2}), *A.tenuifolius* fresh weight (m^{-2}), seed yield (kg.ha^{-1}), biological yield (kg ha^{-1}) and cost-benefit ratio. Weed density before weed management was found to be non-significant. The data showed that minimum *A. tenuifolius* density after weed management and fresh weight (m^{-2}) were found for Stomp 330 EC (6.33 m^{-2} and 1.98 kg m^{-2}), which is statistically similar to Fenoxaprop-p-ethyl 6.9 EC (10.33 m^{-2} and 3.03 kg m^{-2}) while maximum *A. tenuifolius* density and fresh weight (m^{-2}) were recorded for control plots (74.33 m^{-2} and 287.46 kg m^{-2}). Maximum seed yield (1,781.7 kg ha^{-1}), biological yield (3,823 kg ha^{-1}) and cost-benefit ratio (3.47) were recorded for plots treated with Stomp 330 EC, while the lowest seed yield (851.7 kg ha^{-1}), biological yield (3,126.3 kg ha^{-1}) and cost-benefit ratio (1.53) were observed for the control plot. Among the nutritive parameters in chickpea, maximum crude protein (17.40%), crude fat content (4.90%) and oil content (5.98%) were recorded for plots treated with Stomp 330 EC, while minimum crude protein (16.18%), crude fat content (4.12%) and oil content (5.01%) were found in the control plots. Thus, it is recommended that herbicides Stomp 330 EC and Fenoxaprop-p-ethyl should be used at pre-emergence at their recommended doses for control of *A.tenuifolius* and other associated weeds in chickpea crops.

Keywords: allelopathy, *Cicer arietinum* L., herbicides, mulches, and wild onion.

RESUMO - O grão-de-bico é a terceira cultura mais importante das áreas de sequeiro do Paquistão, mas é gravemente afetado pela planta daninha nociva ***Asphodelus tenuifolius****. Por esse motivo, foi realizado um experimento de campo para avaliar o efeito de diferentes extratos alelopáticos de plantas daninhas, herbicidas e coberturas vegetais no controle de* ***A. tenuifolius*** *e outras plantas daninhas associadas ao grão-de-bico no distrito de Karak, na província de Khyber*

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*Pakhtunkhwa, Paquistão. O delineamento experimental utilizado foi em blocos casualizados (DBC) com três repetições, usando o cultivar de grão-de-bico Chattan, cultivado para o experimento. Foram utilizados neste estudo nove tratamentos, juntamente com o controle, para fins de comparação: Stomp 330 CE (pré-emergência) a 2,5 L ha^{-1} , fenoxaprop-p-ethyl, bromoxanil + MCPA (mistura em tanque), Starane-M, cobertura vegetal (folhas de eucalipto), cobertura vegetal (palha de trigo), extrato alelopático de planta daninha (**A. tenuifolius**) + Stomp, extrato alelopático de planta daninha (**Cyperus rotundus**) e extrato alelopático de planta daninha (**Sorghum halepense**), e o tratamento controle. Foram registrados dados sobre a densidade m^{-2} de **A. tenuifolius** antes e depois da aplicação das práticas de manejo de plantas daninhas (m^{-2}), peso fresco de A. tenuifolius (m^{-2}), rendimento de sementes (kg ha^{-1}), rendimento biológico (kg ha^{-1}) e relação custo-benefício. A densidade de plantas daninhas antes do manejo foi considerada não significativa. Os dados mostraram que a densidade mínima de **A. tenuifolius** após o manejo de plantas daninhas e o peso fresco (m^{-2}) foram observados com Stomp 330 EC (6,33 m^{-2} e 1,98 kg m^{-2}), que é estatisticamente semelhante ao fenoxaprop-p-ethyl 6,9 EC (10,33 m^{-2} e 3,03 kg m^{-2}), enquanto a densidade máxima de A. tenuifolius e o peso fresco (m^{-2}) foram registrados para as parcelas de controle (74,33 m^{-2} e 287,46 kg m^{-2}). Os maiores rendimento máximo de sementes (1.781,7 kg ha^{-1}), rendimento biológico (3.823 kg ha^{-1}) e relação custo-benefício (3,47) foram registrados para as parcelas tratadas com Stomp 330 EC, ao passo que os menores rendimento de sementes (851,7 kg ha^{-1}), rendimento biológico (3.126,3 kg ha^{-1}) e relação custo-benefício (1,53) foram observados para a parcela de controle. Entre os parâmetros nutritivos do grão-de-bico, os teores máximos de proteína bruta (17,40%), gordura bruta (4,90%) e óleo (5,98%) foram registrados para parcelas tratadas com Stomp 330 EC, enquanto os menores teores de proteína bruta (16,18%), gordura bruta (4,12%) e óleo (5,01%) foram encontrados nas parcelas de controle. Assim, recomenda-se que os herbicidas Stomp 330 EC e fenoxaprop-p-ethyl sejam utilizados em pré-emergência nas doses recomendadas para o controle de **A. tenuifolius** e outras plantas daninhas associadas em culturas de grão-de-bico.*

Palavras-chave: alelopatia, *Cicer arietinum* L., herbicidas, coberturas vegetais, cebola-selvagem.

INTRODUCTION

Chickpea (*Cicer arietinum* L.), which belongs to the family Leguminosae, is the third most important legume crop in the world after peas and dry beans (FAOSTAT, 2007). It is widely used in every type of foods, and in various commodities and recipes. Chickpea has a great nutritive value as it contains a high percentage of protein (Emenky et al., 2010). As it is a source of protein, chickpea is considered to be a healthy food in many developed countries (Abbo et al., 2003).

In Pakistan, chickpea (*Cicer arietinum* L.) is also very important because it is used in many products. The area which was cultivated under chickpea crop in 2008-09 in Pakistan was 1080.6 thousand ha and the production was 740.5 thousand tons, with an average yield of 685 kg ha^{-1}. In Khyber Pakhtunkhwa, it was cultivated in an area of 42 thousand ha with production of 20 thousand tons (MINFAL, 2009). For several reasons, the average yield of chickpea is low in Pakistan as compared to other chickpea producing countries worldwide but the most important reason is the presence of weeds.

The important weeds present in chickpea crop in rainfed areas are *Asphodelus tenuifolius* L., *Lathyrus aphaca* L., *Cyperus rotundus* L., *Convolvulus arvensis* L., *Medicago ploymorpha* L., *Anagallis arvensis* L., *Fumaria indica*, *Cynodon dactylon* (L.) Pers, and *Carthamus oxycantha* L. Saxena (1980). Wild onion (*A. tenuifolius*) is a weed of 15 crops (Holm et al., 1997). It is a serious weed of chickpea (*Cicer arietinum* L.), wheat (*Triticum aestivum* L.), mustard (*Brassica juncea* L.), lentil (*Lens culinaris* Medic.), and linseed (*Linum usitatissimum* L.) in India and Pakistan (Gupta et al., 1977; Poonia et al., 2001; Tiwari et al., 2001). Tiwari et al. (2001) found a reduction of 80% in chickpea yield and Yaduraju et al. (2000) reported a 56% reduction of mustard yield when wild onion was allowed to compete for the full season.

The competition of weeds with crops is mainly for available nutrients, moisture, space and sunlight, thus causing a significant crop yield loss (Khan et al., 2012). The quality of chickpea seed can also be deteriorated by weed infestation, which creates storage problems and also affects market rates (Saxena, 1980).

Yield losses caused by weeds in chickpeas have been estimated at 40 to 87% in India, 41 to 42% in the former Union of Soviet Socialist Republics (USSR), and 23 to 54% in West Asia (Bhan and Kukula, 1987). Mohammadi et al. (2005) estimated a 1% reduction in chickpea seed yield for every additional 3.85 g m^{-2} of weed dry weight. Additional losses from weeds include added cost for harvest and reduced crop quality (Miller et al., 2002). Weed control is the basic requirement and the major component of crop management in the production system (Young et al., 1996). Bhalla et al. (1998) reported that the herbicide treatment resulted in 50-54% weed control in chickpea. Hassan and Khan (2007) reported an increase of 12-14% after application of pre-emergence herbicides and 6-23% for post emergence herbicides in a chickpea crop. Allelopathy is a chemical (biochemical) relationship among plants. (Rice, 1984). Today, allelopathy is widely studied both in weeds and crops. Khan et al. (2012) reported that Parthenium and Eucalyptus extracts significantly reduced weed density as compared to the control check. At the same time, mulching is a recent and effective non-chemical weed control method (Ramakrishna et al., 1992). Regar et al. (2010) reported that straw mulching resulted in better grain yield and significantly enhanced water use efficiency in different chickpea cultivars.

Weeds are of crucial importance and in order to combat wild onion and other associated weeds in chickpea, a proper and effective weed control program should be set to get higher chickpea seed yield. Therefore, the main objectives of this experiment were: 1) to control *Asphodelus tenuifolius* and other associated weeds in chickpea; 2) to evaluate different control methods against *A. tenuifolius* and other associated weeds in chickpea; and 3) to select the best weed control method suitable to local environment of the Karak district and to boost up chickpea yield.

MATERIALS AND METHODS

A field trial was carried out at the Ahmadwala Research Station "District Karak" Khyber Pakhtunkhwa-Pakistan to study the effects of different herbicides, mulches and allelopathic weed extracts for control of wild onion (*A. tenuifolius*) and other associated weeds in chickpea. The experiment was laid out in Randomized Complete Block (RCB) design with three replications. Chickpea cultivars (Chattan) were grown in Rabi season 2015. The size of each plot was 1.5 m x 3 m and each row was 30 cm apart from each other. All other agronomic practices were kept constant. The details of the treatments are described below.

Stomp 330 EC (Pre- emergence) at 2.5 L ha^{-1} was used as a pre-emergence herbicide, while Fenoxaprop-p- ethyl, Bromoxanil +MCPA (tank mixture of both herbicides), and Starane-M were used as post-emergence herbicides. Half of the recommended dose of the herbicide was used because the soil was sandy. The herbicides and allelopathic extracts were applied with a hand operated sprayer (Jacto Brass Pump Knapsack Hand Sprayer made in Jiaojiang Jiangnan Agricultural Machinery Factory, Taizhou, China.) Eucalyptus leaf mulch and wheat straw mulch were applied on the crop in the row spacing, and the area was covered with mulch. Allelopathic weed extract (*Asphodelus tenuifolius*) + Stomp, Allelopathic weed extract (*Cyperus rotundus*), Allelopathic weed extract (*Sorghum halepense*) and weedy check (for comparison).

Parameters recorded:

1: *A. tenuifolius* density m^{-2} before application of weed management practices (m^{-2}).

2: *A. tenuifolius* density m^{-2} after application of weed management practices (m^{-2})

3: *A. tenuifolius* fresh weight (m^{-2})

4: Seed yield (kg ha^{-1})

5: Biological yield (kg ha^{-1})

6: Cost-benefit ratio

7: Determination of Crude protein

8: Determination of Crude fat

9: Oil content (%)

Procedure for data recording:

***A. tenuifolius* parameters**

***A. tenuifolius* density m^{-2} before application of weed management practices (m^{-2})**

A. tenuifolius density was determined 30 days after sowing date by randomly throwing a 50 x 50 cm quadrate three times in each subplot. The specimens of *A. tenuifolius* inside the quadrate were counted before application of weed management practices. The mean was calculated and was then converted into density m^{-2}.

***A. tenuifolius* density m^{-2} after application of weed management practices (m^{-2})**

A. tenuifolius density was determined by randomly throwing a 50 x 50 cm quadrate three times after 60 days of crop sowing in each subplot. The specimens of *A. tenuifolius* inside the quadrate were counted after application of weed management practices. The mean was calculated and was then converted into density m^{-2}.

***A. tenuifolius* fresh weight (m^{-2})**

For calculating fresh weight of *A. tenuifolius* after 72 days of crop sowing, a quadrate was thrown inside the plots and *A. tenuifolius* weed was harvested and weighed on an electric balance. The recorded data were converted into m^{-2}.

Agronomic parameters

Seed yield (kg ha^{-1})

Three central rows from each treatment were harvested and the seeds were separated from pods, weighed and adjusted to 14% moisture content. Data for seed yield in kg ha^{-1} were converted by using the following formula:

$$\text{Seed yield (kg ha}^{-1}) = \frac{\textit{Seed yield (kg) from the net plot}}{\textit{Harvested area } (m^2)} \times 10{,}000$$

Biological yield (kg ha^{-1})

The central three rows from each subplot were harvested at maturity. Bundles were made, tied, air dried and weighed through a spring balance. The recorded data were subsequently converted to kg ha^{-1} by using the following formula:

$$\text{Biological yield (kg ha}^{-1}) = \frac{\textit{Biological yield (kg) from the net plot}}{\textit{Harvested area } (m^2)} \times 10{,}000$$

Nutritive value parameters

Determination of crude protein:

Protein content was determined by the Kjeldahl Method. Protein content in each sample was measured according to procedures prescribed by AOSA (2000) with the following formula.

% Crude Protein =% N x 6.25 (*factor for legume)

% N = (S-B) x N x 0.014 x D x 100 / Wt of sample x V

S = Sample titration reading, D = Dilution of sample after digestion, V = Volume taken for titration, N = Normality of HCl, B = Blank titration reading and 0.14 m.q.wt of Nitrogen

Determination of crude fat:

Crude fat was determined by the ether extract method using a Soxtec apparatus. Percent of fat in the sample was calculated according to the following procedures of AOSA (2000).

% Crude fat = {(Wt of beaker + Ether extract) – (Wt of beaker) / wt of Sample} x 100

Oil content (%):

Oil was extracted from chickpea seeds at PCSIR laboratories, Peshawar. The chickpea samples were ground to obtain flour with IKA1 all basic mill (IKA Works Inc., Wilmington, NC, USA) and the flour was passed through 60-mesh sieves. The seed powder was extracted with the help of n-hexane/2-propanol (3:1 V/V) in a Soxlet apparatus for six hours, and oil content was measured.

Cost-Benefit Ratio (BCR)

Cost-Benefit Ratio (BCR) was calculated by using the formula:

$$\text{Cost-Benefit Ratio (BCR)} = \frac{\textit{Added Income}}{\textit{Added cost}}$$

Statistical Analysis

The recorded data for each trait were subjected individually to the ANOVA technique by using the MSTATC computer software (Steel et al., 1997).

RESULTS AND DISCUSSION

***A. tenuifolius* density (m^{-2}) before and after weed management treatments**

The data in Table 1 show *Asphodelus tenuifolius* density before and after weed management treatments. The means of the data showed that weed density was found to be non-significant before the application of different weed control treatments, but after weed management treatments to different plots, a significant variation was recorded.

In addition, after weed management treatments, the data in Table 1 showed that maximum *A. tenuifolius* density (74.33 m^{-2}) was recorded for weedy check plots followed by Bromoxanil +MCPA 40 EC and Starane-M 50 EC (39.67 m^{-2} and 38.00 m^{-2}), while minimum *A. tenuifolius* density (6.33 m^{-2}) was found in Stomp 330 EC, which is statistically similar to Fenoxaprop-e- ethyl 6.9 EC having *A. tenuifolius* density (10.33 m^{-2}). Wild onion (*A. tenuifolius*) is a highly competitive weed species in the sandy area of Pakistan. Hassan et al. (2010) mentioned that high weed infestation, farmers' poor economic status and ineffective weed management approaches are the major threats to production in the southern districts of Khyber Pakhtunkhwa. For controlling wild onion, pre-emergence herbicides are the best method (Khan et al., 2011). Elkoca et al. (2004) reported that pre-emergence herbicides are efficient and secure for weed control. Our results are greatly similar to the findings of Marwat et al. (2005), who described the minimum weed density in the plots treated with Stomp 330 EC. Pre-emergence herbicides are more effective than post-emergence ones or manual weeding (Rapparini, 1996). It is recommended that Stomp 330 EC and fenoxaprop-p-ethyl6.9 EC should be used at pre-emergence at their recommended dose for controlling wild onion in chickpea. Among mulches, wheat straw mulch is a good option as an alternate source for weed control to enhance crop yield. All applied treatments used for controlling *Asphodelus tenuifolius* can significantly affect weed density and yield related parameters.

A. tenuifolius fresh weight

Statistical analysis of data revealed that different applied treatments significantly affect *A. tenuifolius* fresh weight (Table 1). The data on the Table indicated that maximum *A. tenuifolius* fresh weight (287.46 kg m^{-2}) was recorded for control plots followed by Bromoxanil +MCPA and Starane-M (8.07 kg m^{-2} and 7.93 kg m^{-2}) as minimum *A. tenuifolius* fresh weight (1.98 kg m^{-2}) was found after application of stomp, which is statistically similar to Fenoxaprop-e- ethyl (3.03 kg m^{-2}). The results are in conformity with those of Lyon and Wilson (2005), who reported that the minimum weed biomass in chickpea was found in herbicide treated plots. Khan et al. (2010) recorded the highest fresh weed biomass in weedy check plots. Similarly, Khan et al. (2007) reported that herbicide dose greatly affect fresh and dry weed biomass of *A. tenuifolius*. Bromoxanil +MCPA and Starane-M herbicides suppressed the growth of the *A. tenuifolius* weed in chickpea crops and reduced its fresh weight. The results are also in conformity with those of Iqbal et al. (1991), Poonia et al. (1993) and Hassan and Khan (2007), who also reported that herbicides significantly reduced dry biomass of weeds in chickpea crops.

Table 1 - *Asphodelus tenuifolius* as affected by different treatments

Treatment	Parameter for *A. tenuifolius*		
	Density before application (m^{-2})	Density after application (m^{-2})	Fresh weight (kg m^{-2})
Stomp 330EC	72.00	6.33 f	1.98 c
Fenoxaprop-e- ethyl 6.9 EC	62.67	10.33 ef	3.03 bc
Bromoxanil +MCPA 40 EC	64.00	39.67 b	8.07 b
Starane-M 50 EC	44.00	38.00 bc	7.93 b
Eucalyptus leaf mulch	55.67	16.33 e	5.03 bc
Crops or weed straw mulch	60.33	17.00 e	4.10 bc
(*Asphodelus tenuifolius* extract) + Stomp	56.00	24.67 d	6.52 bc
Cyperus rotundus extract	69.33	14.67 e	5.47 bc
Sorghum halepense extract	61.67	32.00 cd	7.42 bc
Control	70.66	74.33 a	287.46 a
LSD	NS	7.81	5.51

Seed yield (kg ha^{-1})

Different weed control practices in chickpea significantly affect seed yield. The mean comparison showed that maximum seed yield (1,781.7 kg ha^{-1}) was recorded in the stomp 330 EC treated plot, which is statistically at par with Fenoxaprop-p- ethyl 6.9 EC (1,765.3 kg ha^{-1}), followed by straw mulch (1,613.0 kg ha^{-1}). In contrast, minimum seed yield (kg ha^{-1}) was noted for control plots, which is statistically similar to Bromoxanil +MCPA 40 EC and Starane-M 50 EC having seed yield (851.7 kg ha^{-1} and 824.0 kg ha^{-1}). The minimum seed yield might have been due to maximum weed density, as weeds are strong competitors against crops, as they compete for nutrients and other available resources. Mohammadi et al. (2005) estimated a 1% reduction in chickpea seed yield for every additional 3.85 g m^{-2} of weed dry weight. Proper weed management practices are the basic requirements and one of the important parts of crop management in the production system (Young et al., 1996). Bhalla et al. (1998) reported that herbicide application resulted in 50-54% weed control in chickpea. Similarly, Hassan and Khan (2007) reported an increase in seed yield of 12-14% by controlling weeds properly. Marwat et al. (2005) also reported higher grain yield of canola with application of pre-emergence herbicides, compared to post-emergence herbicides. When properly used, pre-emergence herbicides accomplish effective and economic weed control and, consequently, chickpea seed yields are similar to or only slightly lower than those of weed free treatments (Hassan and Khan, 2007).

Biological yield (kg ha^{-1})

Analysis of variance for biological yield of chickpea showed that it was significantly affected by different weed control methods. Remarkable variation was found among the applied treatments. The mean values regarding biological yield showed that maximum biological yield (3,823 kg ha^{-1}) was recorded for Stomp 330 EC application followed by Fenoxaprop-p- ethyl 6.9 EC and straw mulch having biological yield (3,666.3 kg ha^{-1} and 3,624.7 kg ha^{-1}) respectively. Similarly, among different weed control methods, minimum biological yield (3,126.3 kg ha^{-1}) was recorded for control plots followed by Bromoxanil +MCPA 40 EC and Starane-M 50 EC having biological yield (3,337.3 kg ha^{-1} and 3,274.7 kg ha^{-1}), correspondingly. The finding revealed that the lower biological yield in control plots was due to heavy weed infestation, thus causing a reduction in the green portion of chickpea crop and resulting in low biological yield. As in Stomp, Fenoxaprop-p-p-ethyl and wheat straw mulch plots, because of better weed control, enhance the leaf area which leads to high photosynthesis activities and enables chickpea crops to gain maximum resources, thus leading to high biological yield. Ram et al. (2004) and Yadav et al. (2007) reported higher chlorophyll content in chickpea treated with herbicides as compared to weedy check. Our findings are in line with Ali et al. (2003), who found higher biological yield in herbicide treated plots than control plots.

Cost-Benefit Ratio (CBR)

The cost-benefit ratio is the ratio between gross income of a weed management practice and the added cost of that practice. The cost-benefit ratio was calculated only for weed management techniques i.e. herbicides, mulches, allelopathic weed extract and control only. All the applied treatment significantly affected yield and was carried out with various costs. Maximum cost-benefit ratio was found for Stomp 330 EC (3.47), followed by Fenoxaprop-p-ethyl 6.9 EC (3.27), while minimum cost-benefit ratio (1.53) was found for Mulching (Eucalyptus leaves), as shown in Table 2. The results show that Stomp 330 EC and Fenoxaprop-p-ethyl 6.9 EC herbicide are effective in obtaining a higher cost-benefit ratio because both herbicides control weeds effectively, especially *A. tenuifolius*, which reduces the yield of chickpea crops. Our results are in line with those of Chaudhary et al. (2011) and Iqbal et al. (2010), who stated that maximum net return was achieved by Stomp 330EC. Among the treatments, Stomp 330 EC, Fenoxaprop-p-ethyl and wheat straw mulch significantly controlled *A. tenuifolius*. These treatments not only controlled weeds but also increased chickpea yield in a right direction. Similarly, a high benefit cost ratio was recorded for Stomp 330 EC and Fenoxaprop-e-ethyl6.9 EC.

Table 2 - Chickpea parameters as affected by different treatments

Treatment	Chickpea parameter		
	Seed Yield (kg ha^{-1})	Biological Yield (kg ha^{-1})	BCR (%)
Stomp 330EC	1781.7 a	3823.0 a	3.47
Fenoxaprop-e- ethyl 6.9 EC	1765.3 a	3666.3 b	3.27
Bromoxanil +MCPA 40 EC	851.7 d	3337.3 f	1.66
Starane-M 50 EC	824.0 d	3274.7 f	1.60
Eucalyptus leaf mulch	1577.3 b	3587.0 bc	1.53
Crops or weed straw mulch	1613.0 b	3624.7 b	1.59
(*Asphodelus tenuifolius* extract) + Stomp	1498.7 c	3472.0 de	1.61
Cyperus rotundus extract	1515.7 c	3530.0 cd	2.37
Sorghum halepense extract	1489.3 c	3431.3 e	2.33
Control	796.0 d	3126.3 g	-
LSD	57.86	82.47	

Crude protein

Table 3 shows crude protein of chickpea seeds treated with different weed control methods. The results revealed that the highest crude protein content was found in Stomp 330 EC (17.40%) followed by Fenoxaprop-p-ethyl 6.9 EC (17.36%) while the lowest crude protein content was found in weedy check plots (16.18%) followed by Bromoxanil +MCPA 40 EC (16.28%) and Starane-M 50 EC (16.27%). However, the results were not significant. Jukanti et al. (2012) reported a higher content of protein (19%), carbohydrates (61%) and fiber (17%) in chickpea seeds. The herbicides Stomp 330 EC and Fenoxaprop-p- ethyl 6.9 EC suppressed the weeds competing against the chickpea crop and enhanced the growth of the crop which, as a result, increased crude protein content in chickpea seeds. The protein content reduction might have been due to the damage of vascular tissue that affects the supply channel which results into low protein accumulation. (Perveen et al., 2002).

Table 3 **-** Chickpea Nutritive Parameters as affected by different treatments

Treatment	Nutritive parameter		
	Crude protein	Crude fats	Oil content
Stomp 330EC	17.40	4.90	5.98
Fenoxaprop-e- ethyl 6.9 EC	17.36	4.87	5.96
Bromoxanil +MCPA 40 EC	16.28	4.23	5.34
Starane-M 50 EC	16.27	4.19	5.27
Eucalyptus leaf mulch	17.07	4.77	5.70
Crops or weed straw mulch	17.12	4.78	5.73
(*Asphodelus tenuifolius* extract) + Stomp	16.35	4.58	5.59
Cyperus rotundus extract	16.69	4.69	5.66
Sorghum halepense extract	16.32	4.48	5.55
Control	16.18	4.12	5.01
LSD	NS	NS	NS

Crude fats

Table 3 shows crude fat content of chickpea seeds treated with different weed control methods. The results revealed that the highest crude fat content was found in Stomp 330 EC (4.90%) followed by Fenoxaprop-e- ethyl 6.9 EC (4.87%) while the lowest crude fat content was found in weedy check plots (4.12%) followed by Bromoxanil +MCPA 40 EC (4.23%) and Starane-M 50 EC (4.19%). Gul et al. (2013) showed that the variability of chickpea fatty acid composition could be attributed to genotypic variation and climate conditions. Crude fat content was increased as a result of the effective weed management of the growing weeds in the chickpea crop. The herbicides Stomp 330 EC and Fenoxaprop-p- ethyl 6.9 EC were found to be efficient in decreasing weed competition with the crop and resulted in higher crude content. Khan et al. (2006) also found a différence in crude fat content because of diffèrent weed control stratégies.

Oil content

Table 3 indicated oil content of chickpea seeds treated with different weed control methods. The results indicated that the highest oil content was found in Stomp 330 EC (5.98%) followed by Fenoxaprop-p-ethyl 6.9 EC (5.96%) while the lowest oil content was noted in weedy check plots (5.01%) followed by Bromoxanil +MCPA 40 EC (5.34) and Starane-M 50 EC (5.27). The means were not significant. The oil fraction in chickpea is the highest among dry pulses and represents 3% to 10% of total dry seed weight (Wood and Grusak, 2007). Crude oil content was increased because of the effective weed management of the growing weeds in the chickpea crop. The plots treated with herbicide Stomp 330 EC and Fenoxaprop-p-ethyl 6.9 EC were found to have higher oil content and both herbicides decreased crop-weed competition due to which crop resulted into higher oil content in comparison to other treatments. Zia-Ul-Haq et al. (2007) found a similar oil composition in chickpea crops.

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