Original Research Article
Herbicidal and nitrogen efficacy on weed management in wheat fields of Eastern Uttar Pradesh

ABSTRACT

A field research study was conducted during the winter (Rabi) season of 2018-19 at the agricultural research farm of Banaras Hindu University, Varanasi, to evaluate the effects of nitrogen levels and herbicides on weed populations and wheat production. The study identified nine prevalent weed species in wheat fields, including *Phalaris minor, Anagallis arvensis, Cynodondactylon, Melilotus indicus, Chenopodium album, Vicia sativa, Medicago denticulata, Solanum nigrum, and Cyperus rotundus*, with *Anagallis arvensis, Chenopodium album* and *Vicia sativa* being the most dominant. The application of Sulfosulfuron (25 g ha^{-1}) combined with 2, 4-D (750 ml ha^{-1}) resulted in the lowest weed density and biomass and the highest weed control efficiency. Additionally, performing hand weeding twice (30 and 60 days after sowing) in conjunction with 180 kg N ha^{-1}, followed by the application of Sulfosulfuron (25 g ha^{-1}) + 2, 4-D (750 ml ha^{-1}), significantly reduced *Anagallis arvensis, Chenopodium album* and *Vicia sativa* population and biomass and improved weed control effectiveness. Higher weed dryweight and population results in lower plant nutrient uptake and lower dry matter of crop plant and yield.

Keywords: Nitrogen levels; sulfosulfuron; 2, 4-DEE; weeds; wheat.

1. INTRODUCTION

Weeds are a major biotic obstacle to achieving the maximum potential wheat yield and are often the most costly factor inhibiting production. This issue exacerbates poverty and food insecurity. Effectively managing weed infestations, whether grassy or broad-leaved, requires a comprehensive strategy that integrates both chemical and non-chemical control methods [1].To tackle complex weed populations, it is necessary to use multiple herbicides together. Combining herbicides enhances the effectiveness of weed control against difficult-to-manage species and also helps delay the development of herbicide resistance [2]. Wide leaved weeds and grassy weeds both have the potential to diminish wheat grain production by up to 52.2 percent and 55.7 percent, respectively revealed by [3]. [4] reported that Weeds in the weedy check decreased the wheat grain production by 47.5% as compared to other treatments. The management of complex weed flora necessitates the use of several herbicides; this combination not only increases the efficacy of weed control against composite weed flora but also postpones the emergence of herbicide resistance [5]. [6] revealed that increasing the level of nitrogen from 0 to 45, 45 to 90 and 90 to 135 kg ha^{-1} increased the nitrogen uptake by 28.20, 14.90, 7.70%, phosphorus by 26.20, 13.60, 8.50 % over the preceding levels. It was found that both the quantity of inputs and the timing of their application significantly affected weed presence and density in the field. Increasing nitrogen fertilization from 120 to 150 kg N ha^{-1} improved grain production and straw yield by enhancing dry matter accumulation, increasing the number of tillers, and boosting nutrient uptake [7].

2. MATERIALS AND METHODS

The fieldwork was conducted at the Banaras Hindu University's Agricultural Research Farm in Varanasi during the winter (rabi) of 2018–19, Uttar Pradesh, in the subtropical Indo-gangetic Plains at 25^{0}18' North Latitude and 83^{0} 03' East Longitude, which is located in the left bank of the River Ganga at an altitude of 75.70 metre above mean sea level. A sandy clay loam with a pH of 7, low organic carbon (0.21 percent), accessible nitrogen (152 kg ha^{-1}), medium phosphorus (23.5 kg ha^{-1}), and readily available potassium were present in the soil (188 kg ha^{-1}). The experiment was set up using a split plot design with three replications.

The treatments comprised of 3 nitrogen levels and 5 weed control methods, *viz.*, nitrogen levels: 120 kg ha^{-1}, 150 kg ha^{-1}, 180 kg ha^{-1}, weed control treatments: Weedy check, Hand weeding at 30 DAS and 60 DAS, Pinoxaden 5.1% EC (40 ml a.i ha^{-1}) + 2,4-DEE 38% EC (750 ml a.i ha^{-1}), Pendimethalin

30% EC at 1000 ml a.i ha^{-1} and 2,4-DEE 38% EC (750 ml a.i ha^{-1} at 30-35 DAS), Sulfosulfuron 75% WG (25 g a.i ha^{-1})+ 2,4-DEE 38% EC at 750 ml a.i ha^{-1}. On December 9th, 2018, 100 kg ha^{-1} of the wheat variety "HD-2967" were sowed, and irrigation was given during crucial crop growth phases. At rates of 60 kg ha^{-1} for single super phosphate (SSP) and 60 kg ha^{-1} for muriate of potash (MOP), respectively, the necessary doses of phosphorous and potassium were applied. Urea is used to apply nitrogen in accordance with the therapy. The remaining half of the nitrogen was administered as a top-dressing in two equal portions after the first and second irrigations, along with the full doses of phosphorus, potassium, and the remaining half of the nitrogen at the time of sowing. In terms of weed population, weed dry matter buildup, nutritional content, depletion (N, P, and K), and efficiency of various treatments. Each plot had a 25 × 25 cm quadrant where weeds were gathered at random and sun-dried. Samples were dried in an electric oven at a temperature of 60 to 65°C for 48 hours after being exposed to the sun. The dry weight resulting from this process was given in g m^{-2}. At 15, 30, 60, and 90 days after treatment application (DAA), weed dry weight, weed control effectiveness, and weed population (pre-treatment) were all recorded. After 90 DAA, nutrient content and weed depletion of it were recorded. Data related to weed components were analyzed using various statistical methods and square root transformation ($\sqrt{x+0.5}$) was undergone for uniformity.

Weed control efficiency: Weed control efficiency (W.C.E.) can be calculated on the basis of dates of observation by using the formula suggested by [9].

Weed control efficiency = [(DWC – DWT)/DWC]*100

Where DWC = dry weight of weeds in control (unweeded) plot

DWT = dry weight of weeds in the treated plot

3. RESULTS AND DISCUSSION

3.1. Weed flora

During the field investigation, several common weed species were identified in the experimental field, including *Phalaris minor, Cynodondactylon*, and various broad-leaved weeds such as *Medicago denticulata, Anagallis arvensis, Melilotus indicus, Vicia sativa, Chenopodium album, and Solanum nigrum*, with *Cyperus rotundus* being the only sedge present. The study explored the impact of nitrogen levels and pesticides on prominent weeds like*Anagallis arvensis*, *Chenopodium album* and *Vicia sativa* were examined how these factors influence its growth characteristics.

3.2. Herbicides and nitrogen levels on weed density and weed dry weight

Critical analysis of data revealed that population and dryweight of *Anagallis arvensis* was significantly influenced by different treatments as presented in Table 2 and 5. At 15 DAA, HW twice (30&60 DAS) plot and under herbicidal treatments, application of Pendimethalin (1000 ml) *fb* 2, 4-DEE (750 ml ha^{-1}) (1000 *fb* 750 ml ha^{-1}) recorded the lowest weed density and dryweight, which was significantly superior over the weedy check and statistically at par with rest of the herbicidal treatments. Whereas at 30 and 60 DAA, application of sulfosulfuron (25 g ha^{-1}) + 2, 4-DEE (750 ml ha^{-1}) significantly exhibited lower density and dryweight of *Anagallis arvensis* over the weedy check but it was statistically at par with other herbicidal treatments whereas at 90 DAA, application of sulfosulfuron (25 g ha^{-1}) + 2, 4-DEE (750 ml ha^{-1}) followed by Pendimethalin (1000 ml) *fb* 2, 4-DEE (750 ml ha^{-1}) (1000 *fb* 750 ml ha^{-1}) significantly exhibited lower density of *Anagallis arvensis* over the weedy check but it was statistically at par with other herbicidal treatments. Close examination of data revealed that at all the dates of observation, weed density and dryweight has observed non-significant differences by different levels of nitrogen application. Critical analysis of data revealed that population of *Chenopodium album* was significantly influenced by different treatments as presented in Table 1 and 4. Application of sulfosulfuron (25 g ha^{-1}) + 2, 4-DEE (750 ml ha^{-1}) significantly exhibited lower density of *Chenopodium album* over the weedy check but it was statistically at par with the other herbicidal treatments except at 15 DAA where, HW twice (30&60 DAS) plot followed by pendimethalin (1000 ml ha^{-1}) *fb* 2, 4-DEE (750 ml ha^{-1}) significantly superior over the weedy check and statistically at par with rest of the herbicidal treatments. Close examination of data revealed that at all the dates of observation, weed density and dryweight has observed non-significant differences by different levels of nitrogen application except at 60 DAA, application of 120 kg N ha^{-1} recorded the highest density of *Chenopodium album*. These results were in close conformity with the findings reported by **[14], [15], and [12].**

Critical analysis of data revealed that population of *Vicia sativa* significantly influenced by different treatments as presented in Table 3 and 5. The lower weed density was recorded at pendimethalin

(1000 ml ha^{-1}) *fb* 2, 4-DEE (750 ml ha^{-1}) over the weedy check but it was significantly at par with other herbicidal treatments except at 60 DAA where, application of sulfosulfuron (25 g ha^{-1}) + 2, 4-DEE (750 ml ha^{-1}) significantly exhibited lower density and dryweight of *Vicia sativa* over the weedy check but it was significantly at par with other herbicidal treatments. The data related to weed control efficiency are directly proportional to crop yield. The data associated with weed control efficiency as influenced periodically by different treatments are presented in Table (7-9). These findings were in close conformity with the findings of [16] and [8].

3.3. Weed control efficiency of different herbicide combinations and nitrogen levels on weeds

Critical analysis of data revealed that weed control efficiency (WCE) of *Anagallis arvensis* was influenced by different treatments are presented in Table 8. Higher weed control efficiency was recorded under Pendimethalin 30% EC (1000 ml) *fb* 2, 4-DEE 38%EC (750 ml ha^{-1}) (1000 *fb* 750 ml ha^{-1}) at 15 DAA whereas, at 30DAA, higher weed control efficiency was recorded under pendimethalin (1000 ml ha^{-1}) *fb* 2, 4-DEE (750 ml ha^{-1}) and lowest under application of sulfosulfuron (25 g ha^{-1}) + 2,4- DEE (750 ml ha^{-1}). Further at 60 and 90 DAA, higher weed control efficiency w recorded under application of sulfosulfuron (25 g ha^{-1}) + 2, 4-DEE (750 ml ha^{-1}) followed by and the lowest weed control efficiency under pendimethalin (1000 ml ha^{-1}) *fb* 2, 4-DEE (750 ml ha^{-1}).These findings were in close conformity with the findings of [14] and [15].
Close examination of data revealed that higher weed control efficiency was observed under application of 150 kg N ha^{-1}at 15 DAA whereas, higher weed control efficiency was recorded under 120 kg N ha^{-1} during 30 and 90 DAA. However, higher weed control efficiency was observed under 180 kg N ha^{-1} during 60 DAA. Critical analysis of data revealed that weed control efficiency (WCE) of *Chenopodium album* was influenced by different treatments are presented in Table 7. At 15 DAA, higher weed control efficiency was recorded under application of pendimethalin (1000 ml ha^{-1}) *fb* 2, 4-DEE (750 ml ha^{-1}) and lower weed control efficiency was recorded under HW twice (30&60 DAS) plot. At 30, 60, 90 DAA, higher weed control efficiency was recorded under application of sulfosulfuron (25 g ha^{-1}) + 2, 4- DEE (750 ml ha^{-1}) followed by pendimethalin (1000 ml ha^{-1}) *fb* 2, 4-DEE (750 ml ha^{-1}) and lower weed control efficiency was recorded under HW twice (30&60 DAS) plot. Critical analysis of data revealed that weed control efficiency (WCE) of *Vicia sativa* was influenced by different treatments are presented in Table 9. At 15 and 30 DAA, higher weed control efficiency was recorded under application of pendimethalin (1000 ml ha^{-1}) *fb* 2, 4-DEE (750 ml ha^{-1}) followed by HW twice (30&60 DAS) plot, sulfosulfuron (25 g ha^{-1}) + 2, 4- DEE (750 ml ha^{-1}) and the lowest weed control efficiency was recorded under pinoxaden (40 ml ha^{-1}) + 2, 4-DEE (750 ml ha^{-1}). These results were in close conformity with the findings reported by [9], [10], and [11].Higher weed control efficiency was recorded under application of sulfosulfuron (25 g ha^{-1}) + 2, 4- DEE (750 ml ha^{-1}) followed by pinoxaden (40 ml ha^{-1}) + 2, 4-DEE (750 ml ha^{-1}) and the lowest weed control efficiency was recorded under HW twice (30&60 DAS) plot. Close examination of data revealed that application of 120 kg N ha^{-1} recorded higher weed control efficiency at 15, 30, 90 DAA. However, higher weed control efficiency was observed under application of 150 kg N ha^{-1} at 60 DAA.These findings were in close conformity with the findings of [12] and [13].

Table 1. Effect of herbicides and nitrogen levels on density (No. m^{-2}) of *Chenopodium album* in wheat

Treatments	Weed density (No. m^{-2})				
	Pre-treatment	15 DAA	30 DAA	60 DAA	90 DAA
Nitrogen levels (kg ha^{-1})					
120	2.94 (8.67)	2.26 (4.67)	2.27 (4.67)	1.87 (3.00)	2.04 (3.67)
150	3.18 (9.67)	2.67 (6.67)	1.72 (3.00)	1.76 (2.67)	1.95 (3.33)
180	2.67 (6.67)	2.48 (5.67)	2.34 (5.00)	1.68 (2.33)	1.95 (3.33)
SEm ±	0.262	0.212	0.08	0.042	0.065
CD (P=0.05)	NS	NS	NS	0.165	NS
Herbicides					
Weedy check	3.37 (11.00)	3.53 (12.00)	3.80 (14.00)	2.76 (7.67)	2.80 (7.67)
HW twice (30&60 DAS)	2.97 (8.33)	1.72 (2.67)	1.87 (3.00)	1.50 (2.00)	2.05 (3.78)
Pinoxaden 5.1% EC (40 ml) + 2,4-DEE* 38% EC (750 ml ha^{-1})	2.60 (6.33)	2.12 (4.00)	1.48 (1.67)	1.77 (3.00)	1.73 (2.89)
Pendimethalin 30% EC (1000 ml) *fb* 2,4-DEE 38% EC (750 ml ha^{-1})	2.67 (6.67)	1.76 (2.67)	1.35 (1.67)	1.41 (1.67)	1.40 (1.78)
Sulfosulfuron 75% WG (25 g) + 2,4-DEE 38% EC (750 ml ha^{-1})	3.18 (9.67)	2.57 (7.00)	1.22 (1.00)	1.10 (1.00)	1.22 (1.00)
SEm ±	0.205	0.14	0.23	0.176	0.203
CD (P=0.05)	0.598	0.40	0.68	0.513	0.594

*Ethyl ester, DAA= Days after treatment application, NS= Non-significant
Data subjected to square root ($\sqrt{x}$ + 0.5) transformation and original data presented in parenthesis

Table 2. Effect of herbicides and nitrogen levels on density (No. m^{-2}) of *Anagallis arvensis*in wheat

Treatments	Weed density (No. m^{-2})				
	Pre-treatment	15 DAA	30 DAA	60 DAA	90 DAA
Nitrogen levels (kg ha^{-1})					

120	2.39 (5.67)	2.48 (5.67)	1.92 (3.67)	1.80 (3.33)	1.71 (2.67)
150	2.34 (5.33)	2.85 (7.67)	2.12 (4.00)	1.92 (3.67)	1.95 (3.33)
180	2.39 (5.67)	2.57 (6.00)	2.20 (4.33)	2.12 (4.00)	1.95 (3.33)
SEm ±	0.73	0.07	0.43	0.08	0.15
CD (P=0.05)	NS	NS	NS	NS	NS
Herbicides					
Weedy check	2.19 (4.33)	3.48 (11.67)	3.53 (12.00)	3.08 (9.00)	3.01 (8.67)
HW twice (30&60 DAS)	2.12 (4.00)	1.63 (2.33)	1.78 (2.67)	1.71 (2.67)	2.04 (3.67)
Pinoxaden 5.1% EC (40 ml) + 2,4-DEE* 38% EC (750 ml ha^{-1})	2.19 (4.33)	2.89 (8.33)	1.95 (3.33)	1.76 (2.67)	1.47 (1.67)
Pendimethalin 30% EC (1000 ml) *fb* 2,4-DEE 38% EC (750 ml ha^{-1})	2.19 (4.33)	2.19 (4.33)	1.78 (2.67)	1.63 (2.33)	1.22 (1.00)
Sulfosulfuron 75% WG (25 g) + 2,4-DEE 38% EC (750 ml ha^{-1})	1.95 (3.33)	2.48 (6.00)	1.68 (2.33)	1.22 (1.00)	1.08 (0.67)
SEm ±	0.41	0.174	0.43	0.149	0.148
CD (P=0.05)	1.19	0.50	1.26	0.434	0.431

*Ethyl ester, DAA= Days after treatment application, NS= Non-significant

Data subjected to square root ($\sqrt{x}$ + 0.5) transformation and original data presented in parenthesis

Table 3. Effect of herbicides and nitrogen levels on density (No. m^{-2}) of *Vicia sativa* in wheat

Treatments	Weed density (No. m^{-2})				
	Pre-treatment	**15 DAA**	**30 DAA**	**60 DAA**	**90 DAA**
Nitrogen levels (kg ha^{-1})					
120	1.79 (2.67)	1.64 (2.60)	1.76 (3.33)	1.63 (2.33)	1.76 (2.67)
150	1.69 (2.67)	1.54 (2.33)	1.63 (2.33)	1.63 (2.33)	1.50 (2.00)

180	2.04 (3.67)	1.81 (3.00)	2.04 (3.67)	2.04 (3.67)	1.85 (3.00)
SEm ±	0.136	0.084	0.150	0.095	0.087
CD (P=0.05)	NS	NS	NS	NS	NS
Herbicides					
Weedy check	2.04 (3.67)	2.07 (4.00)	3.01 (8.67)	2.97 (8.33)	2.74 (4.00)
HW twice (30&60 DAS)	1.79 (2.67)	1.63 (2.33)	2.04 (3.67)	1.22 (1.00)	1.60 (2.33)
Pinoxaden 5.1% EC (40 ml) + 2,4-DEE* 38% EC (750 ml ha^{-1})	1.45 (3.00)	1.87 (3.00)	1.48 (1.67)	1.60 (2.33)	1.95 (3.33)
Pendimethalin 30% EC (1000 ml) *fb* 2,4-DEE 38% EC (750 ml ha^{-1})	1.50 (2.00)	1.00 (0.67)	1.08 (0.67)	1.35 (1.33)	1.53 (0.67)
Sulfosulfuron 75% WG (25 g) + 2,4-DEE 38% EC (750 ml ha^{-1})	1.95 (3.33)	1.87 (3.00)	1.22 (1.00)	1.00 (0.67)	1.85 (3.00)
SEm ±	0.119	0.128	0.148	0.166	0.182
CD (P=0.05)	0.346	0.373	0.431	0.484	0.532

*Ethyl ester, DAA= Days after treatment application, NS= Non-significant

Data subjected to square root ($\sqrt{x}$ + 0.5) transformation and original data presented in parenthesis

Table 4. Effect of herbicides and nitrogen levels on drymatter (g m^{-2}) of *Chenopodium album*in wheat

Treatments	**Weed drymatter (g m^{-2})**			
	15 DAA	**30 DAA**	**60 DAA**	**90 DAA**
Nitrogen levels (kg ha^{-1})				
120	0.83 (0.21)	0.90 (0.37)	0.92 (0.40)	1.13 (0.89)
150	0.96 (0.51)	0.96 (0.54)	1.06 (0.74)	1.15 (0.94)
180	1.00 (0.58)	1.01 (0.73)	1.05 (0.75)	1.21 (1.14)
SEm ±	0.010	0.024	0.020	0.031
CD (P=0.05)	0.038	NS	0.078	NS

Herbicides				
Weedy check	1.36 (1.43)	1.61 (2.20)	1.60 (2.12)	1.79 (2.74)
HW twice (30&60 DAS)	0.89 (0.31)	0.85 (0.23)	0.89 (0.31)	1.26 (1.10)
Pinoxaden 5.1% EC (40 ml) + 2,4-DEE* 38% EC (750 ml ha^{-1})	0.80 (0.14)	0.80 (0.15)	0.90 (0.33)	1.01 (0.53)
Pendimethalin 30% EC (1000 ml) *fb* 2,4-DEE 38% EC (750 ml ha^{-1})	0.77 (0.10)	0.78 (0.11)	0.85 (0.24)	0.91 (0.36)
Sulfosulfuron 75% WG (25 g) + 2,4-DEE 38% EC (750 ml ha^{-1})	0.83 (0.20)	0.73 (0.04)	0.81 (0.17)	0.84 (0.23)
SEm ±	0.019	0.060	0.041	0.056
CD (P=0.05)	0.055	0.174	0.120	0.162

*Ethyl ester, DAA= Days after treatment application, NS= Non-significant

Data subjected to square root ($\sqrt{x}$ + 0.5) transformation and original data presented in parenthesis

Table 5. Effect of herbicides and nitrogen levels on drymatter (g m^{-2}) of *Anagallis arvensis*in wheat

Treatments	Weed drymatter (g m^{-2})			
	15 DAA	**30 DAA**	**60 DAA**	**90 DAA**
Nitrogen levels (kg ha^{-1})				
120	0.89 (0.30)	0.88 (0.29)	1.09 (0.8)	1.19 (1.21)
150	0.91 (0.33)	0.94 (0.40)	1.12 (0.88)	1.19 (1.15)
180	0.91 (0.32)	0.96 (0.46)	1.10 (0.89)	1.23 (1.28)
SEm ±	0.013	0.010	0.018	0.069
CD (P=0.05)	NS	0.054	NS	NS
Herbicides				
Weedy check	0.98 (0.47)	1.21 (0.97)	1.82 (2.82)	2.16 (4.19)
HW twice (30&60 DAS)	0.84 (0.21)	0.85 (0.22)	0.92 (0.35)	1.15 (0.83)
Pinoxaden 5.1% EC (40 ml) + 2,4-DEE* 38% EC (750 ml ha^{-1})	0.88 (0.28)	0.90 (0.32)	0.96 (0.42)	0.97 (0.48)
Pendimethalin 30% EC (1000 ml) *fb* 2,4-DEE 38% EC (750 ml ha^{-1})	0.89 (0.30)	0.85 (0.23)	0.95 (0.40)	0.89 (0.33)
Sulfosulfuron 75% WG (25 g) + 2,4-DEE 38% EC (750 ml ha^{-1})	0.91 (0.33)	0.82 (0.18)	0.88 (0.28)	0.85 (0.25)

SEm ±	0.013	0.020	0.025	0.050
CD (P=0.05)	0.037	0.070	0.072	0.145

*Ethyl ester, DAA= Days after treatment application, NS= Non-significant

Data subjected to square root ($\sqrt{x}$ + 0.5) transformation and original data presented in parenthesis

Table 6. Effect of herbicides and nitrogen levels on drymatter (g m^{-2}) of *Vicia sativa* in wheat

Treatments	**Weed drymatter (g m^{-2})**			
	15 DAA	**30 DAA**	**60 DAA**	**90 DAA**
Nitrogen levels (kg ha^{-1})				
120	0.85 (0.23)	0.87 (0.27)	0.90 (0.36)	0.97 (0.51)
150	0.90 (0.18)	0.91 (0.33)	0.86 (0.30)	0.98 (0.51)
180	0.91 (0.32)	0.93 (0.39)	0.89 (0.34)	1.05 (0.67)
SEm ±	0.032	0.028	0.018	0.016
CD (P=0.05)	NS	NS	NS	NS
Herbicides				
Weedy check	1.04 (0.58)	1.05 (0.61)	1.27 (1.13)	1.41 (1.49)
HW twice (30&60 DAS)	0.82 (0.18)	0.88 (0.28)	0.83 (0.20)	1.05 (0.62)
Pinoxaden 5.1% EC (40 ml) + 2,4-DEE* 38% EC (750 ml ha^{-1})	0.90 (0.32)	0.90 (0.32)	0.80 (0.15)	0.86 (0.25)
Pendimethalin 30% EC (1000 ml) *fb* 2,4-DEE 38% EC (750 ml ha^{-1})	0.80 (0.14)	0.80 (0.14)	0.79 (0.13)	0.87 (0.26)
Sulfosulfuron 75% WG (25 g) + 2,4-DEE 38% EC (750 ml ha^{-1})	0.88 (0.29)	0.88 (0.29)	0.73 (0.04)	0.83 (0.20)
SEm ±	0.030	0.028	0.039	0.042
CD (P=0.05)	0.087	0.083	0.113	0.123

*Ethyl ester, DAA= Days after treatment application, NS= Non-significant

Data subjected to square root ($\sqrt{x}$ + 0.5) transformation and original data presented in parenthesis

Table 7. Effect of herbicides and nitrogen levels weed control efficiency of *Chenopodium album*in wheat

Treatments	Weed control efficiency (%)			
	15 DAA	**30 DAA**	**60 DAA**	**90 DAA**
Nitrogen levels (kg ha^{-1})				
120	52.58	72.87	64.47	59.39
150	72.26	71.35	69.79	63.96
180	70.97	74.88	72.59	64.58
Herbicides				
Weedy check	0.00	0.00	0.00	0.00
HW twice (30&60 DAS)	66.66	85.47	82.42	56.86
Pinoxaden 5.1% EC (40 ml) + 2,4-DEE* 38% EC (750 ml ha^{-1})	85.65	89.37	83.78	78.77
Pendimethalin 30% EC (1000 ml) *fb* 2,4-DEE 38% EC (750 ml ha^{-1})	91.18	94.49	87.55	85.90
Sulfosulfuron 75% WG (25 g) + 2,4-DEE 38% EC (750 ml ha^{-1})	82.86	95.83	90.99	91.67

*Ethyl ester, DAA= Days after treatment application

Table 8. Effect of herbicides and nitrogen levels on weed control efficiency (%) of *Anagallis arvensis*in wheat

Treatments	Weed control efficiency (%)			
	15 DAA	**30 DAA**	**60 DAA**	**90 DAA**
Nitrogen levels (kg ha^{-1})				
120	31.78	63.62	68.21	72.59
150	37.00	55.01	68.46	70.20
180	24.50	61.53	71.88	70.66
Herbicides				
Weedy check	0.00	0.00	0.00	0.00

HW twice (30&60 DAS)	52.75	76.16	87.61	79.96
Pinoxaden 5.1% EC (40 ml) + 2,4-DEE* 38% EC (750 ml ha^{-1})	38.35	64.91	84.71	88.55
Pendimethalin 30% EC (1000 ml) *fb* 2,4-DEE 38% EC (750 ml ha^{-1})	36.73	77.35	85.39	92.55
Sulfosulfuron 75% WG (25 g) + 2,4-DEE 38% EC (750 ml ha^{-1})	27.63	81.85	89.87	94.69

Table 9. Effect of herbicides and nitrogen levels on weed control efficiency (%) of *Vicia sativa* in wheat

Treatments	**Weed control efficiency (%)**			
	15 DAA	**30 DAA**	**60 DAA**	**90 DAA**
Nitrogen levels (kg ha^{-1})				
120	51.11	49.78	67.25	64.88
150	48.52	42.83	73.19	60.99
180	43.40	43.73	68.88	60.25
Herbicides				
Weedy check	0.00	0.00	0.00	0.00
HW twice (30&60 DAS)	70.78	52.10	81.39	58.39
Pinoxaden 5.1% EC (40 ml) + 2,4-DEE* 38% EC (750 ml ha^{-1})	42.27	46.92	85.82	82.87
Pendimethalin 30% EC (1000 ml) *fb* 2,4-DEE 38% EC (750 ml ha^{-1})	73.33	76.30	84.90	81.95
Sulfosulfuron 75% WG (25 g) + 2,4-DEE 38% EC (750 ml ha^{-1})	52.00	51.92	96.75	86.98

4. CONCLUSION

On the grounds of the above-summarized results, the following conclusions have been drawn. Due to better weed control effectiveness, the application of sulfosulfuron (25 g ha^{-1}) + 2,4-DEE (750 ml ha^{-1}) resulted in lower weed density and weed drymatter of *Chenopodium album*, *Anagallis arvensis* and *Vicia sativa*. Higher weed control efficiency, lower weed dry weight and weed density the application of 180 kg N ha^{-1} together with sulfosulfuron (25 g ha^{-1}) + 2,4-DEE (750 ml ha^{-1}).

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