Biological Forum – An International Journal 15(12): 242-246(2023)

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Weed Dynamics and Yield of Wheat as Influenced by N-Scheduling and Weed Management Practices

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(Received: 15 October 2023; Revised: 02 November 2023; Accepted: 21 November 2023; Published: 15 December 2023)
(Published by Research Trend)

ABSTRACT: In the year 2018 and 2019, a field trial on wheat was performed in the *Rabi* season. The experiment was laid out in split plot design and replicated thrice. The nitrogen scheduling includes N_1- ½ basal + ¼ at 4WAS + ¼ at 8 WAS, N_2 -⅓ at 4 WAS + ⅓ at 8 WAS + ⅓ at 10 WAS, N_3 -¼ at 4 WAS + ¼ at 6 WAS + ¼ at 8 WAS + ¼ at 10 WAS while weed management treatment were W_2 -clodinafop @ 60 g/ha, W_3 -sulfosulfuron @ 25 g/ha, W_4 -carfentrazone @ 20g/ha along with weed free and weedy check. The results revealed that the lowest weed density, dry matter accumulation, weed index, maximum weed control efficiency and yield were recorded under W_3- sulfosulfuron @ 25 g/ha which was at par W_4- carfentrazone @ 20 g/ha and found significantly superior over W_4- clodinafop @ 60 g/ha. N_3 -¼ at 4 WAS + ¼ at 6 WAS + ¼ at 8 WAS + ¼ at 10 WAS + W_3 -sulfosulfuron @ 25 g/ha recorded significantly maximum which was significantly superior at 30 and 60 DAS over all the treatments during both the year of experimentation.

Keywords: Weed density, Weed Dry Matter, Herbicide, Nitrogen Scheduling, Yield.

INTRODUCTION

Wheat (*Triticum aestivum* L.) is an important staple food in Asia, serving as a primary cereal crop globally with the highest acreage and production. In India, it stands as the second most crucial staple crop after rice. It has greater nutritional value with 12% protein, 1.72% fat, 69.60% carbohydrates and 27.20% minerals matter (BARI, 1997). The production of wheat can be improved by using appropriate fertilizer application, weed management and crop management factors. Thus, the use of nitrogen cannot be avoided (Massignam *et al.*, 2009). It is an essential component of chlorophyll, nucleic acid and protein etc. Chlorophyll acts as the primary receptor of sunlight for photosynthesis. Wheat crop require a balanced amount of nitrogen for vigorous growth and development processes. Judicious use of nitrogen ensures a greatest harvest with better quality (Leghari, 2016).

Plants is unable to uptake nutrients effectively if it is applied incorrectly, either at wrong time or in the wrong place. Resulted, the availability of nitrogen is diminished due to denitrification, leaching, immobilization, volatilization and surface runoff. These are the factor causing low nitrogen use efficiency. Consequently, there is need to improve N use efficiency through maximizing N uptake at critical growth stages. Split application of nitrogen is an essential approach to increase the N use efficiency in crop. The splitting of nitrogen increased all growth and yield characteristics (Muthukumar *et al.*, 2007). N scheduling is very effective against weed growth. It reduces the weed biomass and density. Because, split nitrogen is more likely to be taken by crops than weeds. However, herbicidal treatment also kills weeds and certain weeds are not able to extract nutrient because of their slower physiological growth (Reddy and Reddy 2015). Hence, there is greater requirement for the appropriate combination of herbicides with N scheduling to make out the effect on growth and yield of wheat crop (Singh *et al.*, 2015).

MATERIALS AND METHODS

A field trail was carried out at the Research Farm, Mata Gujri College, Shri Fatehgarh Sahib during *Rabi* season of year 2018-2020. The experiment laid out in Split plot design consisted of fifteen treatments. The nitrogen scheduling was subjected to main plot, viz. N_1- ½ Basal + ¼ at 4WAS + ¼ at 8 WAS, N_2- ⅓ at 4 WAS + ⅓ at 8

WAS + ⅓ at 10 WAS, N_3- ¼ at 4 WAS + ¼ at 6 WAS + ¼ at 8 WAS + ¼ at 10 WAS while, weed management was kept in sub plots, *viz*., W_0- weedy check, W_1- weed free, W_2- clodinafop @ 60 g/ha, W_3- sulfosulfuron @ 25 g/ha and W_4- carfentrazone @ 20 g/ha. The soil of experimental site was clay loam with pH 7.1, electrical conductivity (0.57 dS/m), organic carbon content (0.69 %) and moderately fertile with available nitrogen (392 kg N/ha), available phosphorus (18.31 kg P_2O_5/ha) and available potassium (168.5 kg K_2O/ha). N, P and K (120:60:40 kg/ha) was applied to all treatments uniformly. Nitrogen was applied according to specific treatments plans while the entire dose of P and K was applied as basal application during sowing. The wheat variety "PBW 725" was sown in the experimental field with a spacing of 22.5 cm. Regular biometric observations were recorded at periodic intervals of 30, 60, 90 DAS and at harvest stage. Yield parameters were observed just before the harvesting of crop. Statistical analysis was done as per the procedure given by Snedecor and Cochran (1968).

RESULT AND DISCUSSION

A. Effect of nitrogen scheduling and weed management on weed

The weed parameters were significantly influenced by N scheduling and weed management. Among N scheduling, the lowest weed density (Table 1), dry matter accumulation (Table 2) and maximum weed control efficiency (Table 3) were recorded with the application of N_3- ¼ at 4 WAS + ¼ at 6 WAS + ¼ at 8 WAS + ¼ at 10 WAS which was at par with the application of N_2- 1/3 at 4 WAS + 1/3 at 8 WAS +1/3 10 WAS and it was significantly inferior over N_1- ½ basal + ¼ at 4 WAS + ¼ at 8 WAS at 30 and 60 DAS during both the year of experimentation. The maximum weed index (Table 4) was recorded with the application of N_1- ½ basal + ¼ at 4 WAS + ¼ at 8 WAS followed by N_2- 1/3 at 4 WAS + 1/3 at 8 WAS +1/3 10 WAS and N_3- ¼ at 4 WAS + ¼ at 6 WAS + ¼ at 8 WAS + ¼ at 10 WAS. The reason behind that the treatments in which nitrogen was not applied at sowing time resulted in less nitrogen availability and unfavorable conditions to weeds during initial stages which led to poor weed density, weed dry matter, weed index, and maximum weed control efficiency. However, split application of nitrogen during crop growth improved the crop vigour and enhanced its competitiveness against weeds. The treatment N_1- ½ basal + ¼ at 4 WAS + ¼ at 8 WAS had the higher weed density, weed dry matter, weed index and lowest weed control efficiency because the majority of the nitrogen was applied during critical period of the crop and weed competition in wheat resulted greater number of weed plants due to favorable conditions. Similar results were reported by Choudhary *et al.* (2019); Raj *et al.* (2020) and Raghuvansh *et al.* (2021).

Amongst weed management, during 2018-19 at 30 DAS, the minimum weed density, weed dry matter accumulation, highest weed control efficiency was recorded under W_2- clodinafop @ 60 g/ha which was at par with the W_4- carfentrazone @ 20 g/ha. During 2019-20 at 30 DAS the lowest weed density, weed dry matter accumulation and maximum weed control efficiency was recorded in W_4- carfentrazone @ 20 g/ha which was at par with the W_3- sulfosulfuron @ 25 g/ha *fb* W_2- clodinafop @ 60 g/ha.

Table 1: Effect of nitrogen scheduling and weed management on total weed density (m^2) at 30, 60 DAS.

Treatments	30 DAS		60 DAS	
	2018-19	2019-20	2018-19	2019-20
MAIN PLOT (Nitrogen Scheduling)				
N_1- ½ basal + ¼ at 4WAS + ¼ at 8 WAS	5.67 (38.13)	5.89 (41.20)	4.22 (22.47)	4.39 (23.53)
N_2- ⅓ at 4 WAS + ⅓ at 8 WAS + ⅓ at 10 WAS	5.31 (33.27)	5.34 (33.67)	3.77 (18.60)	3.83 (19.27)
N_3- ¼ at 4 WAS + ¼ at 6 WAS + ¼ at 8 WAS + ¼ at 10 WAS	5.15 (31.13)	5.27 (32.87)	3.69 (17.67)	3.75 (17.80)
SEm±	**0.09**	**0.10**	**0.06**	**0.09**
CD 5 %	**0.34**	**0.40**	**0.25**	**0.34**
SUB PLOT (Weed Management)				
W_0- Weedy check	6.74 (45.22)	6.87 (47.56)	7.43 (54.89)	7.29 (52.78)
W_1- Weed free	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)
W_2- Clodinafop @ 60 g/ha	6.03 (36.33)	6.86 (46.89)	4.47 (19.78)	4.72 (22.00)
W_3- Sulfosulfuron @ 25 g/ha	6.79 (45.89)	6.79 (45.89)	3.22 (10.22)	3.44 (12.00)
W_4- Carfentrazone @ 20 g/ha	6.60 (43.44)	6.28 (39.22)	3.64 (13.00)	3.78 (14.22)
SEm±	**0.20**	**0.20**	**0.16**	**0.16**
CD 5 %	**0.60**	**0.57**	**0.46**	**0.46**
N×W	**NS**	**NS**	**NS**	**NS**

Table 2: Effect of nitrogen scheduling and weed management on total weed dry matter accumulation (g/m^2) at 30, 60 DAS.

Treatments	30 DAS		60 DAS	
	2018-19	2019-20	2018-19	2019-20
MAIN PLOT (Nitrogen Scheduling)				
N_1- ½ basal + ¼ at 4WAS + ¼ at 8 WAS	3.96 (16.21)	4.02 (17.28)	5.49 (38.29)	5.53 (39.13)
N_2- ⅓ at 4 WAS + ⅓ at 8 WAS + ⅓ at 10 WAS	3.52 (14.26)	3.70 (15.78)	5.01 (32.99)	5.02 (33.21)
N_3- ¼ at 4 WAS + ¼ at 6 WAS + ¼ at 8 WAS + ¼ at 10 WAS	3.25 (11.84)	3.36 (12.78)	4.83 (30.93)	4.86 (30.94)
SEm±	**0.10**	**0.12**	**0.11**	**0.08**
CD 5 %	**0.38**	**0.48**	**0.44**	**0.30**
SUB PLOT (Weed Management)				
W_0- Weedy check	4.67 (21.22)	4.92 (23.40)	9.60 (91.90)	9.64 (92.49)
W_1- Weed free	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)
W_2- Clodinafop @ 60 g/ha	3.75 (13.88)	4.63 (19.51)	5.87 (34.44)	5.84 (34.53)
W_3- Sulfosulfuron @ 25 g/ha	4.55 (18.54)	4.32 (18.53)	4.47 (20.20)	4.46 (19.88)
W_4- Carfentrazone @ 20 g/ha	4.20 (16.87)	3.88 (14.96)	4.90 (23.81)	5.04 (25.23)
SEm±	**0.19**	**0.17**	**0.18**	**0.21**
CD 5 %	**0.55**	**0.50**	**0.53**	**0.61**
N×W	**NS**	**NS**	**NS**	**NS**

Table 3: Effect of nitrogen scheduling and weed management on total weed control efficiency (%) at 30, 60 DAS.

Treatments	30 DAS		60 DAS	
	2018-19	2019-20	2018-19	2019-20
MAIN PLOT (Nitrogen Scheduling)				
N_1- ½ basal + ¼ at 4WAS + ¼ at 8 WAS	32.95	32.19	58.94	59.73
N_2- ⅓ at 4 WAS + ⅓ at 8 WAS + ⅓ at 10 WAS	30.89	36.80	64.14	64.39
N_3- ¼ at 4 WAS + ¼ at 6 WAS + ¼ at 8 WAS + ¼ at 10 WAS	23.99	25.02	65.21	64.46
SEm±	**5.39**	**9.04**	**1.74**	**0.75**
CD 5 %	**21.18**	**35.50**	**6.83**	**2.94**
SUB PLOT (Weed Management)				
W_0- Weedy check	0.00	0.00	0.00	0.00
W_1- Weed free	100.00	100.00	100.00	100.00
W_2- Clodinafop @ 60 g/ha	28.75	11.90	62.10	62.81
W_3- Sulfosulfuron @ 25 g/ha	8.65	12.32	77.91	78.73
W_4- Carfentrazone @ 20 g/ha	8.98	32.47	73.80	72.75
SEm±	**6.76**	**6.68**	**2.30**	**2.36**
CD 5 %	**19.73**	**19.48**	**6.72**	**6.90**
N×W	**NS**	**NS**	**NS**	**NS**

Table 4: Effect of nitrogen scheduling and weed management on total weed index (%).

Treatments	Weed Index	
	2018-19	2019-20
MAIN PLOT (Nitrogen Scheduling)		
N_1- ½ basal + ¼ at 4WAS + ¼ at 8 WAS	23.52	22.38
N_2- ⅓ at 4 WAS + ⅓ at 8 WAS + ⅓ at 10 WAS	19.65	19.45
N_3- ¼ at 4 WAS + ¼ at 6 WAS + ¼ at 8 WAS + ¼ at 10 WAS	17.79	15.97
SEm±	**2.72**	**2.21**
CD 5 %	**10.66**	**8.66**
SUB PLOT (Weed Management)		
W_0- Weedy check	49.43	48.41
W_1- Weed free	0.00	0.00
W_2- Clodinafop @ 60 g/ha	24.28	24.78
W_3- Sulfosulfuron @ 25 g/ha	13.00	10.88
W_4- Carfentrazone @ 20 g/ha	14.88	12.26
SEm±	**1.54**	**2.13**
CD 5 %	**4.49**	**6.21**
N×W	**NS**	**NS**

However, the minimum weed density, weed dry matter accumulation, weed index and highest weed control efficiency was observed in W_3- sulfosulfuron @ 25 g/ha which was at par with the W_4- carfentrazone @ 20 g/ha at 60 DAS and which was significantly inferior over the rest of the treatments during both the year of experimentation. Because sulfosulfuron control both grassy and broadleaf weeds and it also inhibits ALS enzyme and production of amino acids.

Carfentrazone controls both broadleaf and sedge weeds in cereal grain crops and it inhibits the action of protoporphyrinogon oxidase, causing cell death in weed resulted low density of weed was observed ultimately higher weed control efficiency as well as low weed index. Instead, clodinafop controls only grassy weeds and it inhibits synthesis of acetyl CoA carboxylase (ACC-ase) enzyme. The maximum weed density, dry matter accumulation, weed index, minimum weed control efficiency was recorded in the weedy check treatment due to more infestation of weed. Similar results were recorded by Yadav *et al.* (2018); Meena *et al.* (2019) and Rana *et al.* (2021).

B. Effect of nitrogen scheduling and weed management on crop yield

The maximum grain yield (q/ha), straw yield (q/ha), biological yield (q/ha) and harvest index (%) (Table 5) were recorded under N_3- ¼ at 4 WAS + ¼ at 6 WAS + ¼ at 8 WAS + ¼ at 10 WAS which was at par with the N_2- 1/3 at 4 WAS + 1/3 at 8 WAS +1/3 10 WAS and it was significantly superior over N_1- ½ basal + ¼ at 4 WAS + ¼ at 8 WAS. The wheat yield was increased with increasing nitrogen splitting. This approach not only improved nitrogen use efficiency but also reduced the risk of nitrogen losses such as leaching, immobilization, volatilization and denitrification etc. Additionally, the lower weed population reduced competition, contributing to enhance crop yield. Split application of nitrogen ensured a consistent nutrient supply, leading to improved translocation of photosynthates from source to sink which was responsible for good growth and yield characteristics. The minimum yield was recorded with the nitrogen scheduling as N_1 -½ Basal + ¼ at 4WAS + ¼ at 8 WAS due to inadequate nutrient supply and more nutrients losses occurred due to leaching, denitrification as well as higher weed population in this treatment. Similar results were found by Chauhan *et al.,* (2017), Kaur and Kumar (2018) and Belete *et al.,* (2018).

The maximum value of crop yield was recorded with the application of W_3- sulfosulfuron @ 25 g/ha followed by W_4- carfentrazone @ 20 g/ha (Table 5). It might be due to minimal competition for nutrients, enhanced dry matter accumulation in crop and high weed control efficiency. The outcome was an increase in grain yield, straw yield and biological yield. The lowest value of crop yield was recorded in weedy check treatment due to high weed population and higher competition for nutrients, space, light and moisture. Similar results were recorded by Kaur *et al.* (2017) and Meena *et al.* (2019).

Table 5: Effect of nitrogen scheduling and weed management on yield and harvest index.

Treatments	Grain Yield (q/ha)		Straw Yield (q/ha)		Biological Yield (q/ha)		Harvest Index (%)	
	2018-19	2019-20	2018-19	2019-20	2018-19	2019-20	2018-19	2019-20
MAIN PLOT (Nitrogen Scheduling)								
N_1- ½ basal + ¼ at 4WAS + ¼ at 8 WAS	37.74	39.23	57.58	61.30	95.31	100.53	39.36	38.83
N_2- ⅓ at 4 WAS + ⅓ at 8 WAS + ⅓ at 10 WAS	42.62	43.20	64.29	67.09	106.90	110.29	39.58	39.08
N_3- ¼ at 4 WAS + ¼ at 6 WAS + ¼ at 8 WAS + ¼ at 10 WAS	46.06	47.23	68.97	69.34	115.03	116.57	39.67	40.33
SEm±	**1.10**	**1.20**	**1.77**	**1.21**	**2.57**	**2.14**	**0.62**	**0.53**
CD 5 %	**4.31**	**4.73**	**6.94**	**4.76**	**10.09**	**8.41**	**2.44**	**2.08**
SUB PLOT (Weed Management)								
W_0- Weedy check	26.76	27.62	53.20	47.59	79.96	75.20	33.56	36.75
W_1- Weed free	52.85	53.50	71.65	79.43	124.50	132.93	42.59	40.32
W_2- Clodinafop @ 60 g/ha	40.03	40.26	59.95	58.84	99.98	99.09	40.13	40.58
W_3- Sulfosulfuron @ 25 g/ha	46.04	47.82	67.54	72.21	113.58	120.02	40.65	39.78
W_4- Carfentrazone @ 20 g/ha	45.01	46.91	65.72	71.49	110.73	118.40	40.75	39.63
SEm±	**0.82**	**1.71**	**2.40**	**1.89**	**2.47**	**2.76**	**1.15**	**0.63**
CD 5 %	**2.40**	**3.41**	**7.01**	**5.51**	**7.22**	**8.05**	**3.35**	**1.84**
N×W	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**

CONCLUSIONS

On the basis of results summarized above, it can be concluded that the application of N_3 -¼ at 4 WAS + ¼ at 6 WAS + ¼ at 8 WAS + ¼ at 10 WAS + W_3- sulfosulfuron @ 25 g/ha gave best results in respect to all the weed and yield parameters and second-best treatment was N_3 -¼ at 4 WAS + ¼ at 6 WAS + ¼ at 8

WAS + ¼ at 10 WAS + W_4- carfentrazone @ 20 g/ha during both the year of experimentation.

Acknowledgements. I am expressing my venerable regards to my advisor for their suggestion in preparing the manuscript.
Conflict of interest: None.

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How to cite this article: Vivek Bhagat, Santosh Kumar, Dhamni Patyal, Kamaldeep Kaur, Teesha Manhas and Shivani Thakur (2023). Weed Dynamics and Yield of Wheat as Influenced by N-Scheduling and Weed Management Practices. *Biological Forum – An International Journal, 15*(12): 242-246.