EFFECT OF NUTRIENT MANAGEMENT AND WEED CONTROL PRACTICES ON WEED DYNAMICS IN WHEAT (*Triticumaestivum* L.)

Abstract

A field experiment was conducted at Agronomy Research Farm of AcharyaNarendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya (Uttar Pradesh) during Rabi season (2022-23 & 2023-24) to find out the effect of nutrient management and weed control practices on weed dynamics of different treatments in wheat crop. The experiment was laid out in split plot design with three nutrient levels and six weed control practices and replicated thrice. Among nutrient management 75% RDF + 10 t ha^{-1} FYM + one spray of nano-urea @ 4ml/lit found better for effective control of weed density, weed dry weight, weed control efficiency (%),and weed index (%)during both years of experimentation. Sequential spray of Clodinofop + Metsulfuron (60 + 4 g a.i. ha^{-1}) minimized the density and dry weight of weeds, however recorded maximum weed control efficiency (89.57% & 90.77%) and minimum weed index (1.99 & 1.96) during 2022-23 and 2023-24 respectively. This treatment having better weed control and higher nutrient uptake resulted in higher yield. It can be concluded that application of 75% RDF +10 t ha^{-1} FYM + one spray of nano-urea @ 4ml/lit with the spraying of Clodinofop + Metsulfuron (60 + 4 g a.i. ha^{-1})proved better to minimize the weed infestation in wheat crop.

Keywords: Nutrient, Herbicide, nano-urea, dynamics, wheat

Introduction

Wheat (*Triticumaestivum* L.) is the important and widely grown cereal crop of the globe. It is a selfpollinated crop having chromosome (2n = 42) belonging to the family Poaceae. It is an annual, hexaploid, long day plant, having C3 anatomy and grown largely as a staple food crop in the world (Choudhary*et al.*2023). It is the most important staple food of about two billion people (36 % of the world population) worldwide. It is grown in the world with an area of 215.9 million hectare, production 771.78 million tonnes and productivity of 3.53 tonnes per hectare. In India, it is grown in an area of 31.61 million hectare, production 109.52 million tonnes with a productivity of 3464 kg per hectare and Uttar Pradesh having first rank in respect to both area (9.85 million hectare) and production (31.16 million tonnes) with a productivity of 3664 kg per hectare (Agriculture Statistics at a Glance, 2021). It is the leading cereal grain produced,

consumed and traded in the world today (Olson, 1994). Hence, interest in maximizing winter wheat yields has led to the development of intensive cereal management practices. These practices integrate the management of nutrient and weed, seeding dates and rates, row spacing, soil fertility, diseases, insects and lodging to maximize the grain yield (Wireman *et al*., 1986).

Among the different management practices, nutrient management is crucial in crop nutrition for achieving higher yields (Raun and Johnson, 1999). Nutrient application in agricultural system is expected to increase in the coming years to produce more food, feed and fiber from lesser land area. Efficient utilization of applied nutrients will be the key to sustainability in such high input-high output systems. Efficient fertilization is important from both economic and environmental point of view. It is synonymous with minimizing nutrient losses to the environment, while optimizing crop yields. It is appropriate here to mention that efficient nutrient use is essentially an offspring of balanced fertilizer use and sound management practices and decision.

The balance nutrition plays an important role in raising the production potential of wheat because the wheat crop is extremely responsive to applied nutrient through numerous sources. Among various nutrients, nitrogen is required by wheat crop in large amount and usually supplied through outside sources like fertilizer and manures as most of the soil in wheat growing areas are deficient in nitrogen availability. Nitrogen fertilization always result in increase in above ground dry matter and root biomass production which result in to higher productivity as well as higher residues left in the soil after the harvest of the crop which helps in improving the fertility of the soil other nutrients like P and K are also required to be applied through manures and fertilizers. Application of fertilizer alone has a detrimental effect on soil health and crop productivity therefore, integration of various sources of nitrogenous (organic and inorganic) fertilizer are more suitable because this reduces the application of chemical fertilizer and cost of cultivation, besides being an environment friendly approach also indicated the beneficial effect of FYM in combination with chemical fertilizer to wheat (Ram and Mir, 2006; Gupta *et al*., 2006).

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Nano-fertilizers are the important tools in agriculture to improve crop growth, yield and quality parameters with increase nutrient use efficiency, reduce wastage of fertilizers and cost of cultivation. Nano-fertilizers are very effective for precise nutrient management in precision

agriculture with matching the crop growth stage for nutrient and may provide nutrient throughout the crop growth period. Nano-fertilizers increase crop growth up to optimum concentrations further increase in concentration may inhibit the crop growth due to the toxicity of nutrient (Qureshi*et al*., 2018).

Among numerous factors answerable for low yield, weeds infestation and their management is one of the important factors. Weed competes with crop plants which results in yield reduction by 20-50% (Chaudhary*et al.*, 2008). In order to eradication of weeds cultural, mechanical and chemical methods are commonly used. Inaccessibility of labour in peak season and adverse weather condition don't allow timely control of weeds. Therefore, weed control by mechanical means and hand or manual weeding alone isn't achievable. So, the chemical weed control is a crucial substitute. Weed killers have shown to be helpful and extremely effective means of controlling weeds in wheat as a result ~~of~~ they are quite effective and efficient (Azad *et al*., 1997).

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Material and Methods

The experiment was carried out during Rabi season 2022-23 and 2023-24 at Agronomy Research farm, AcharyaNarendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya (U.P.). Geographically the experimental site falls under sub- tropical climate of Indo-gangatic plains (IGP) having alluvial calcareous soil and the soil of experimental field was "silty loam" saline in texture, low in organic carbon and available nitrogen while medium in phosphorous and rich in potassium. The treatment comprised of three nutrient levels 100% RDF (150:60:40 kg ha^{-1}), 75% RDF + 10 t ha^{-1} FYM + one spray of nano-urea @ 4ml/lit and 50% RDF + 15 t ha^{-1} FYM + one spray of nano-urea @ 4ml/lit and six weed control practices Sulfosulfuron + Metsulfuron (30 + 2 g a.i. ha^{-1}), Clodinofop + Metsulfuron (60 + 4 g a.i. ha^{-1}), Sulfosulfuron + Carfentrazone (25 + 20g a.i. ha^{-1}), Sulfosulfuron + Carfentrazone (25 + 20g a.i. ha^{-1}), Clodinofop + Carfentrazone (60 + 20g a.i. ha^{-1}), Weed free (two hand weeding at 20 and 45 DAS), Weedy check. In all, there were 18 treatment combinations included in the experiment. The experiment was laid out in Split Plot Design with three replications. The wheat variety HD-2967 was sown manually at distance of 20 cm in rows withthe seed rate of 100 kg ha^{-1}on 20th November 2022-23and 25November 2023-24. The herbicides were dissolved in water and applied 35 days after sowing, and spray of nono-urea was done at 45 DAS with 315 liter water solution ha^{-1}using knapsack sprayer fitted with flat- fan nozzle. The experimental field was

divided into 54 plots. Each gross plot size was 5.0 m x 4.0 m and net plot size was 4.0 m x 3.6 m and row to row distance was maintained 20 cm.FYM was applied as per the treatments and incorporated into the soil before the sowing of wheat crop.

Weeds counting was taking for dominated weed species *viz*.; *Phalaris minor*, *Avenaludoviciana*, *Chenopodium album*, *Melilotusindica* and other weeds individual in each plots. Weeds which are except these were counted as other weeds. Weed count was taken in 30, 60, 90 DAS and harvest stage of crop growth and reported as number of weeds m^{-2}. The data on number of weeds were subjected to square-root transformation using ($\sqrt{x+0.5}$).

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For dry matter of weeds all the weeds inside the quadrate were cut close to the ground level in each plot and collected for the dry matter accumulation. The samples were first dried in sun to remove the moisture and then kept in oven at 70°C ± 2°C for 48 hours to remove remaining moisture as till a constant weight was achieved. The weight of dried samples were taken and expressed in gram per square meter.

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Weed control efficiency was determined by the following formula:

WCE (%) $=\frac{DWc-DWt}{DWc}\times 100$

Where,

WCE = Weed control efficiency (%)

DWc = Dry weight of weeds (g m^{-2}) in weedy check

DWt = Dry weight of weeds (g m^{-2}) in treated plot whose efficiency was calculated.

Weed index was determined by following formula:

$$W.I.=\frac{Y_{wf}-Y_t}{Y_{wf}}\times 100$$

Where,

Y_{wf} = Grain yield of weed free plot

Y_t = Grain yield of treated plot

Results and Discussion

Effect on weed density (no. m^{-2}) and dry weight of weeds (g m^{-2})

The major weed flora in the experimental field comprised grasses, *viz. Phalaris minor* and*Avenafatua*; broad-leaf weeds, *viz*. *Chenopodium album*, *Anagallisarvensis* and *Melilotusalba*; and other weeds. Different nutrient management and weed control practiceswas significantly effective to minimize the density and dry weight of weeds as compared to weedy check during both year of experimentation. Density of weeds (no. m^{-2}) and dry weight of weeds (g m^{-2}) under different nutrient management and weed control practices is presented in (Table 1). In case of nutrient management application of 75% RDF + 10 t ha^{-1} FYM + one spray of nano-urea @ 4ml/lit recorded significantly minimum weed density and dry weight of weeds as compared to rest of the nutrient levels at each stages of crop growth, except 30 DAS. Among the herbicides, post- emergence application of Clodinofop + Metsulfuron (60 + 4 g a.i. ha^{-1}) recorded the lowest density and dry weight of grassy and BLWs. The maximum dry matter accumulation of weeds were found in weedy check at 60 and 90 DAS, while minimum weed dry weight recorded with weed free which was significantly lesser than the rest of the weed control practices. This might be due to more luxuriant growth of crop plant~~causes~~ critical period of crop weed competition, application of higher rate of nutrients shift the competitive advantage in favor of crop and also help in smothering of weed and poor germination of weeds and the above mentioned herbicide is more effective in reducing density of weeds as compared to other herbicides. The reduced weed density under this treatment ~~might result~~less weed dry weight. The similar results have been also reported by Deen*et al.* (2021), Jain *et al*. (2007), Kumar*et al*. (2021).

Interaction effect between fertility levels and weed management practices on density and dry weight of weed were found non-significant at all stages of crop growth.

Effect on weed control efficiency (%)

Weed control efficiency under different nutrient management and weed control practices is presented in Table 2 anddepicted in fig. (1a, 1b).Among the nutrient levels the maximum weed control efficiency is recorded with the application of 75% RDF + 10 t ha^{-1} FYM + one spray of nano-urea @ 4ml/lit (75.82%, 76.37%). In term of weed control practices, the highest weed control efficiency was found with weed free (100%) followed by Clodinofop + Metsulfuron (60 + 4 g a.i. ha^{-1}) (89.57%, 90.77), Sulfosulfuron + Metsulfuron (30 + 2 g a.i. ha^{-1}) (86.50%, 87.37) during both years of experimentation respectively. It ~~might be~~due to effectively control of

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narrow weeds as well as broad leaved weeds which is directly related to increase weed control efficiency. Similar findings also reported by Mishra *et al*. (2021) and Paighan*et al*. (2013).

Effect on Weed Index (%)

Weed index may be termed as the competition index. It indicates the reduction of yield due to competition offered by weeds and is expressed in percentage (%).

Perusal of data of two year presented in Table 2 and fig. (1a, 1b), revealed that the lowest yield reduction in wheat was observed in Clodinofop + Metsulfuron (60 + 4 g a.i. ha^{-1}) (1.99%, 1.96%), whereas, maximum yield reduction (31.47%, 30.92%) was recorded under weedy check during 2022-23 and 2023-24 respectively. Minimum yield reduction recorded with Clodinofop + Metsulfuron (60 + 4 g a.i. ha^{-1})might be due to effective control of weeds which is inversely related to weed index (%). Similar finding reported by Pandey*et al*. (2007) and Paswan*et al.* (2017).

Table 1: density of total weeds (No. m^{-2}) and dry weight of weed as influenced by nutrient and weed management practices:

Treatment	Density of total weeds						Weed dry weight (gm^{-2})					
	30 DAS		60 DAS		90 DAS		30 DAS		60 DAS		90 DAS	
	2022-23	2023-24	2022-23	2023-24	2022-23	2023-24	2022-23	2023-24	2022-23	2023-24	2022-23	2023-24
A. Main plot (Nutrient Management)												
F_1:100% RDF (150:60:40 kg ha^{-1})	6.93 (55.13)	6.78 (52.70)	5.54 (37.88)	5.43 (36.52)	5.33 (35.48)	5.23 (34.22)	3.29 (11.60)	3.22 (11.08)	4.50 (24.62)	4.42 (23.74)	4.27 (24.42)	3.73 (18.55)
F_2:75% RDF + 10 t ha^{-1}FYM + one spray of nano-urea @ 4ml/lit	7.48 (64.63)	7.32 (61.80)	5.06 (31.25)	5.01 (30.75)	4.88 (29.33)	4.80 (28.62)	3.53 (13.57)	3.46 (12.97)	4.12 (20.32)	4.04 (19.55)	3.63 (17.85)	3.15 (13.33)
F_3:50% RDF + 15 t ha^{-1}FYM + one spray of nano-urea @ 4ml/lit	7.85 (71.37)	7.68 (68.30)	5.94 (43.55)	5.83 (42.02)	5.73 (40.80)	5.62 (39.37)	3.70 (14.98)	3.63 (14.37)	4.83 (28.30)	4.74 (27.31)	4.56 (27.81)	3.94 (20.75)
SEm±	0.160	0.230	0.129	0.121	0.123	0.114	0.107	0.086	0.100	0.102	0.097	0.098
C.D. at 5%	0.628	0.902	0.507	0.473	0.485	0.446	NS	NS	0.391	0.400	0.381	0.385
B. Sub plot (Weed Management)												
W_1:Sulfosulfuron + Metsulfuron (30 + 2 g a.i. ha^{-1})	8.67 (74.93)	8.46 (71.20)	5.37 (28.43)	5.27 (27.37)	5.10 (25.60)	4.97 (24.30)	4.02 (15.73)	3.93 (14.97)	4.34 (18.47)	4.24 (17.57)	3.48 (11.85)	2.98 (8.50)
W_2:Clodinofop + Metsulfuron (60 + 4 g a.i. ha^{-1})	8.58 (73.33)	8.37 (69.70)	5.10 (25.67)	5.01 (24.73)	4.85 (23.13)	4.73 (21.97)	3.98 (15.40)	3.89 (14.63)	4.13 (16.67)	4.03 (15.86)	3.08 (9.21)	2.57 (6.28)
W_3:Sulfosulfuron+ Carfentrazone (25 + 20g a.i. ha^{-1})	8.77 (76.57)	8.55 (72.77)	5.77 (32.97)	5.66 (31.63)	5.48 (29.70)	5.34 (28.20)	4.07 (16.10)	3.97 (15.30)	4.67 (21.43)	4.55 (20.35)	3.90 (14.89)	3.37 (11.02)
W_4:Clodinofop + Carfentrazone (60 + 20g a.i. ha^{-1})	8.85 (77.70)	8.63 (73.83)	5.95 (34.50)	5.80 (33.10)	5.65 (31.07)	5.51 (29.57)	4.11 (16.33)	4.01 (15.53)	4.81 (22.43)	4.69 (21.30)	4.46 (18.04)	3.87 (13.33)
W_5:Weed free (two hand weeding at 20 and 45 DAS)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)
W_6:Weedy check	8.95 (79.73)	8.85 (78.10)	10.20 (103.80)	10.09 (101.73)	10.09 (101.73)	10.03 (100.37)	4.15 (16.73)	4.11 (16.40)	8.23 (67.47)	8.15 (66.13)	9.29 (86.17)	8.15 (66.13)
SEm±	0.181	0.199	0.139	0.130	0.133	0.124	0.095	0.095	0.107	0.110	0.102	0.097
C.D. at 5%	0.523	0.574	0.402	0.374	0.384	0.358	0.276	0.275	0.309	0.319	0.294	0.279
Interaction	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Data subjected to square root ($\sqrt{x + 0.5}$) transformation and original values are given in parentheses

Table:2 Weed control efficiency (%) and weed index (%) as influenced by various nutrient and weeds management practices

Treatment		Weed control efficiency (%)		Weed index (%)	
		90 DAS			
		2022-23	2023-24	2022-23	2023-24
A. Main plot (Nutrient Management)					
F_1	100% RDF (150:60:40 kg ha^{-1})	71.80	72.32	11.75	11.54
F_2	75% RDF + 10 t ha^{-1}FYM + one spray of nano-urea @ 4ml/lit	75.82	76.37	11.75	11.54
F_3	50% RDF + 15 t ha^{-1}FYM + one spray of nano-urea @ 4ml/lit	71.65	72.33	11.75	11.55
B. Sub plot (Weed Management)					
W_1	Sulfosulfuron + Metsulfuron (30 + 2 g a.i. ha^{-1})	86.50	87.37	3.78	3.72
W_2	Clodinofop + Metsulfuron (60 + 4 g a.i. ha^{-1})	89.57	90.77	1.99	1.96
W_3	Sulfosulfuron + Carfentrazone (25 + 20g a.i. ha^{-1})	82.93	83.57	14.14	13.89
W_4	Clodinofop + Carfentrazone (60 + 20g a.i. ha^{-1})	79.53	80.33	19.13	18.79
W_5	Weed free (two hand weeding at 20 and 45 DAS)	100.00	100.00	0.00	0.00
W_6	Weedy check	0.00	0.00	31.47	30.92

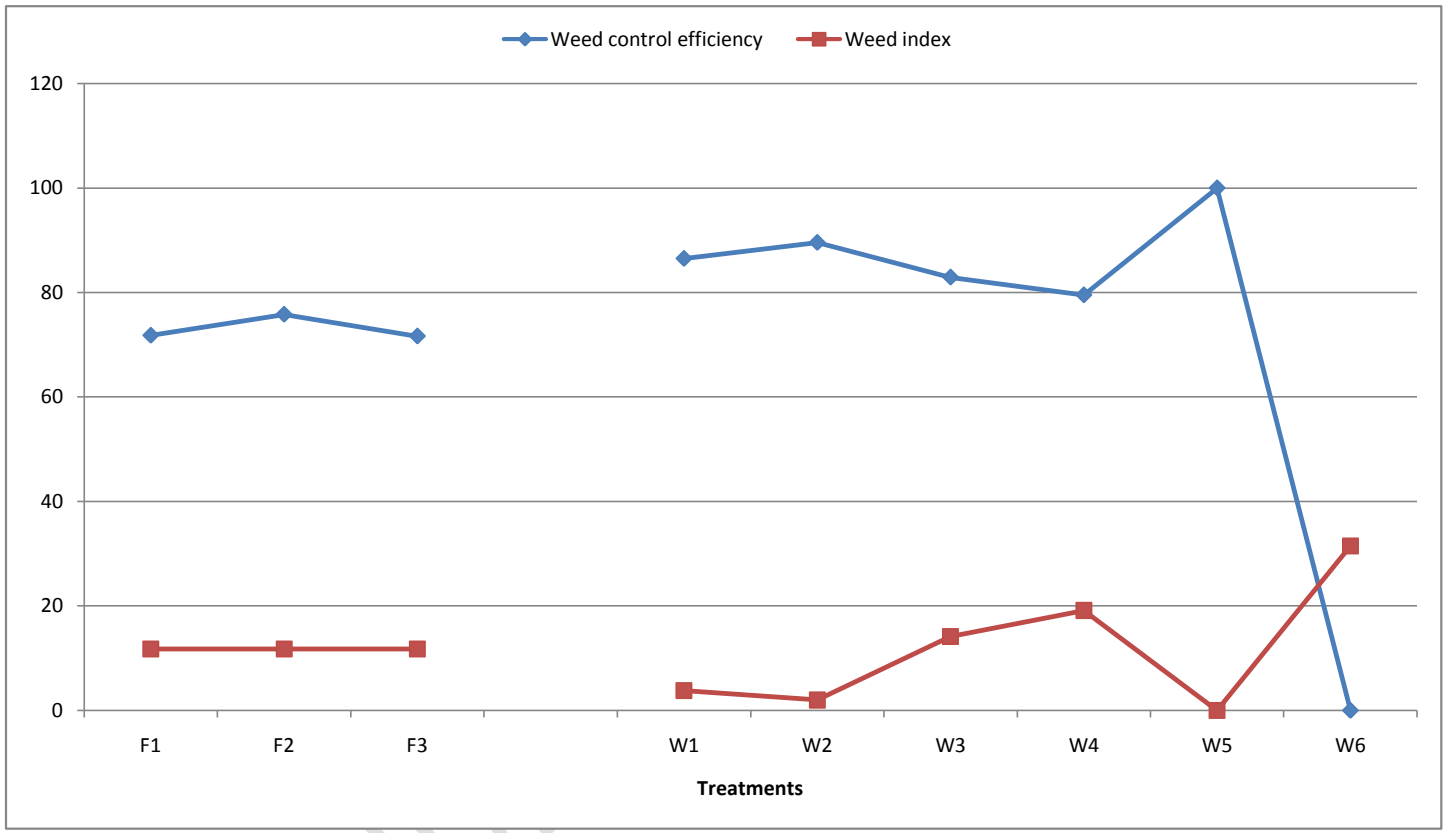

Fig.1a. Weed control efficiency (%) and weed index (%) as influenced by various nutrient and weeds management practices during 2022-23

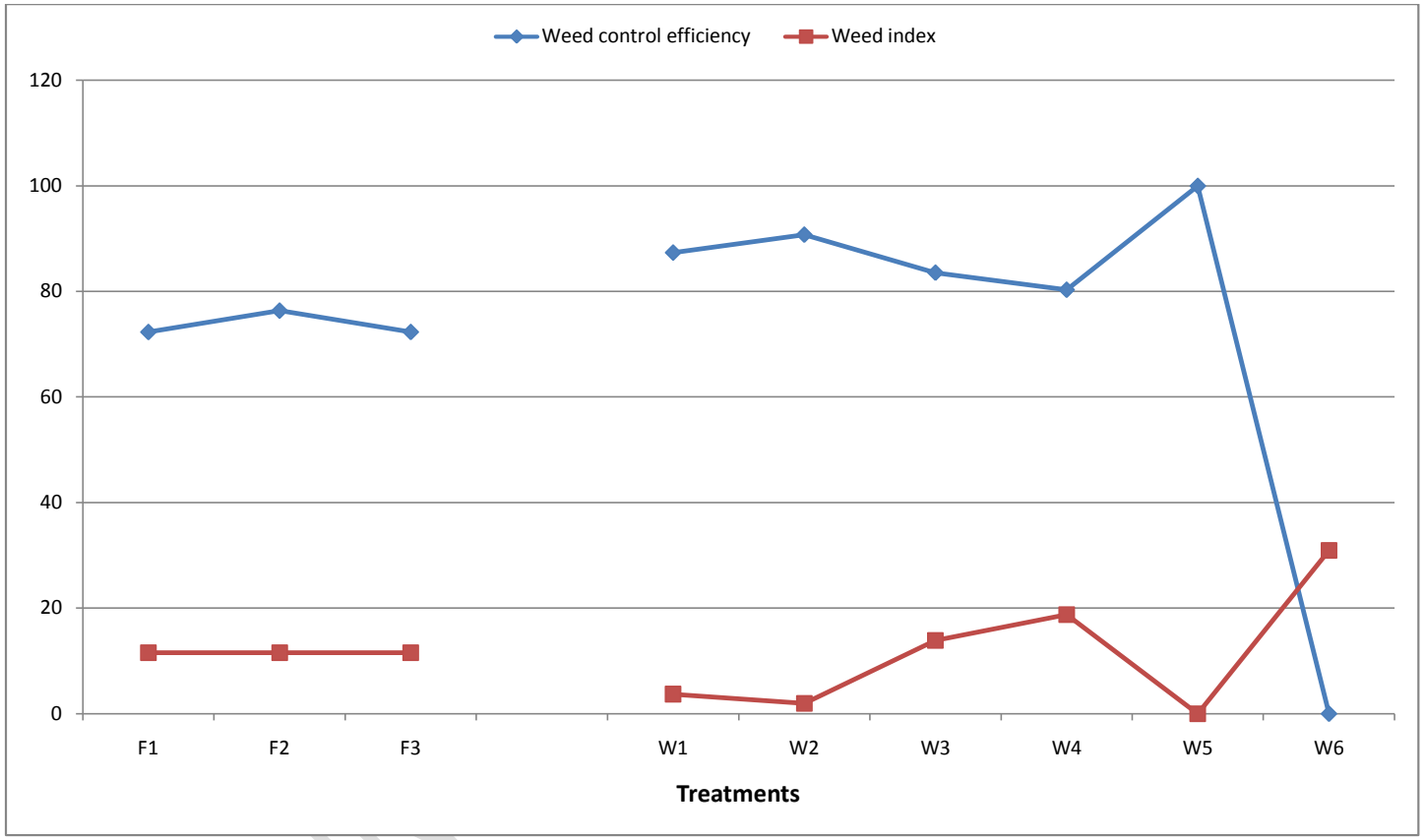

Fig.1b. Weed control efficiency (%) and weed index (%) as influenced by various nutrient and weeds management practices during 2023-24

Conclusion

From the overall studies, it can be concluded that application of 75% RDF + 10 t ha^{-1} FYM + one spray of nano-urea @ 4ml/lit with the spraying of herbicide Clodinofop + Metsulfuron (60 + 4 g a.i. ha^{-1}) found superior for effective control of weeds, weed control efficiency and less yield reduction(weed index) in such treatments.

Fig .2 Collecting and counting of weed flora from experimental field.

Reference

Agricultural statistics at a glance, 2021. Directorate of Economics and Statistics, Department of Agriculture and Co-operation, Ministry of Agriculture, Government of India, New Delhi.

Chaudhary, S. U., Hussain, M., Ali, M. A. and Iqbal, J. (2008). Effect of weed competition period on yield and yield components of wheat.*Ind. J. Agri. Res.*, **46**:47-53.

Choudhary, M. S. ,Intodia, S.K., Kaushik, M.K., Saharan, V., Singh, D.P., Lakhawat, S.S., and Choudhary M. 2023. Effect of Nano Urea on Growth indices and Grain Yield of Wheat (*Triticumaestivum* L.) under Southern Rajasthan Conditions.*Biological Forum – An International Journal***15**(8a): 326-331

Deen, K., Singh, R. P., Singh, A. K., Shekhar, C. and Kumar, A. (2021). Effect of fertility levels and weed management practices on yield attribute and yield of wheat crop (*Triticumaestivum*L.). *Journal of PharmacognosyPhytochemistry*, **10**(1): 2284-2286.

Gupta, V. Sharma, R. S. and Vishwakarma, S. H. (2006).Long term effect of integrated nutrient management on sustainability and soil fertility of rice (*Oryza sativa*) wheat (*Triticumaestivum*L.) cropping system.*Ind. J. Agro.*, 51**(3)**:160-164.

Jain, N., Mishra, J.S.,Kewat, M.L. and Jain, V. (2007). Effect of tillage and herbicides on grain yield and nutrient uptake by wheat (*Triticumaestivum)* and weeds.*Ind. J. Agro.*, 52 **(2):**131-134.

Kumar, D., Vivek, Kumar, S. and Kumar, V. (2021). Integrated Nutrient and Weed-Management Practices on Productivity and Profitability in Wheat (*Triticumaestivum*L.).*International Journal of Current Microbiology and Applied Sciences,* **10** (02): 3433-3443.

Mishra, H., Singh, R.S., Gupta, A., Shukla, V.K. andVerma, D. (2021). Effect of Fertility Levels And Weed Management Practices on Growth And Yield Attributes of Wheat (*TriticumAestivum*L.) Under Irrigated Condition.*The Pharma Innovation Journal*, **10**(10): 1639-1641.

Olson, B. T. 1994. World Wheat Production, Utilization and Trade. In: Bushuk, W. and Rasper V.F. (eds.) *"Wheat, Production, Properties and Quality"***.** Blackie Academic and Professional, London. pp. **(1)** 1-11.

Paighan, V. B., Gore, A. K. and Chavan, A. S. (2013). Effect of new herbicides on growth and yield of wheat.*Ind. J. Weed Sci.*, 45 **(4):**291-293.

Pandey, I. B., Dwivedi, D. K.,Pandey, R. K. (2007). Efficiency of herbicide and fertilizer management on weed dynamics in wheat (*Triticumaestivum). Ind. J. Agro.*, 52 **(1):**49-52.

Paswan, A.K., Mandal, D., Kumar, J. & Kumar, R. (2017). Influence of Weed Management Practices on Productivity of Wheat (*Triticumaestivum*L.) Under Middle Indo-Gangetic Plains of Eastern India.*International Journal of Current Microbiology and Applied Sciences*, **6** (6): 2486-2491.

Qureshi, A., Singh, D.K., and Dwivedi, S. 2018. Nano-fertilizers: A Novel Way for Enhancing Nutrient Use Efficiency and Crop Productivity. *Int.J.Curr.Microbiol.App.Sci***7**(2): 3325-3335.

Ram, T. and Mir, M. S. (2006).Effect of integrated nutrient management on yield and yield attributing characters of wheat (*Triticumaestivum*).*Ind. J. Agro.*, 31**(3):**189-192.

Raun, W. R., and Johnson, G.V. 1999. Improving nitrogen use efficiency for cereal production.*Agronomy Journal*, **91**, 357-363

Wireman, D. W., Oplinger, E. S. and Guy, S.O. 1986. Environment and Cultivar Effects on Winter Wheat Response to Ethephon Plant Growth Regulator.*Agron. J.* **78**: 761-764.