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Herbicides, Nitrogen-Scheduling and –Rates Effects on Economics of Wheat (*Triticum aestivum* L.)

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ABSTRACT

A field experiments was conducted during winter seasons of 2010-11 and 2011-12 at Agricultural Research Farm, Banaras Hindu University, Varanasi to study the effect of herbicide mixtures and differential rate of nitrogen application of economics of wheat under Indo-Gangetic Plains of eastern Uttar Pradesh. The experiment was laid out in factorial randomized complete block design and replicated thrice, having three factors. First factor comprised of three herbicides *viz.* weedy check, sulfosulfuron + metsulfuron [32 g ha^{-1}] and carfentrazone [10 g ha^{-1}] + fenoxaprop-p-ethyl [100 g ha^{-1}], whereas, second and third factors comprised of two nitrogen rates (120 kg N ha^{-1} and 160 kg N ha^{-1}) and three times of nitrogen application (50% basal + 50% CRI, 50% basal + 25% CRI + 25% flowering and 33.3% basal + 33.3% CRI + 33.3% flowering), respectively. Significantly highest grass return, net return and benefit cost ratio were observed with application of sulfosulfuron + metsulfuron [32 g ha^{-1}]. Increasing nitrogen level from 120 to 160 kg ha^{-1} significantly increased the economic return. Application of nitrogen in three split (50% basal + 25% CRI + 25% flowering) proved significantly in term of grass return, net return and benefit cost ratio over other split application of nitrogen.

Keywords: Net return, gross return and B: C ratio

Wheat (*Triticum aestivum* L.) is the second most important winter cereal in India after rice. Wheat crop contributes substantially to the national food security by providing more than 50% of the calories to the people who mainly depend on it. India has witnessed a significant increase in total food grain production to the tune of 264.38 mtons with a major contribution of wheat with 95.85 mtons (36.25%) during 2013-14(DAC, 2014). The availability of wheat has increased from about 79 g capita^{-1} day^{-1} to more than 185 g capita^{-1} day^{-1} despite the doubling of the population since 1961 (Bhardwaj *et al.*, 2010). Weed is major constraints in wheat production especially *Phalaris minor* is more prevalent in rice-wheat cropping system. Weed infestation during the crop period causes 46-52% reductions in grain yield, depending on the densities and type of weed flora present (Malik *et al*. 2012). Because of higher economic cost of labour for manual weeding and its lower efficacy, farmers are relying heavily on herbicides for effective weed control in different crops including wheat. Grassy weeds emerge as a serious problem in wheat (*Triticum aestivum* **L.), which pose a serious threat to its successful cultivation. Among the herbicides, isoproturon is being used since the 1980s for control of** *phalaris minor* (Malik *et al.* 2000). Repeated use of single herbicide i.e. isoproturon leads to development of isoproturon resistant biotypes of *P. minor* (Singh, 2007). Moreover, it leads to shift in weed flora (Singh, 2007). Numbers of molecules are tested for the management of grassy and broad-leaved weeds, but alone application of these

Table 1. Economics of wheat cultivation under herbicides, rates and time of nitrogen application

Treatment		Cost of cultivation (₹ ha^{-1})	Economics							
		Gross return (₹ ha^{-1})			Net return (₹ ha^{-1})			B:C ratio		
		I Year	II Year		I Year	II Year		I Year	II Year	
Herbicides (H)										
H_1	Weedy check [control]	26029.39	60997.41c	61415.37c		34968.02c	35385.98c		1.34c	1.36c
H_2	Sulfo+ Metsul (Total) [32 g/ha]	27640.89	82081.81a	83548.40a		54440.92a	55907.51a		1.97a	2.02a
H_3	Carfen [10g/ha]+ Fenoxa [100g/ha]	27714.99	77381.22b	78786.85b		49666.23b	51071.86b		1.79b	1.84b
	SEm ±		832.96	822.91		832.96	822.91		0.03	0.03
	CD (P = 0.05)		2393.93	2365.03		2393.94	2365.03		0.09	0.09
Nitrogen Rates (R)										
R_1	120 kg/ha	26870.17	69529.91b	70410.29b		42659.75b	43540.13b		1.58b	1.61b
R_2	160 kg/ha	27386.69	77443.71a	78756.79a		50057.03a	51370.11a		1.82a	1.87a
	SEm ±		680.11	671.900		680.11	671.90		0.02	0.02
	CD (P=0.05)		1954.64	1931.040		1954.64	1931.04		0.07	0.07
Time of Nitrogen Application (T)										
T_1	50% Basal + 50%CRI	27045.09	74068.31b	75134.88b		47023.22ab	48089.79b		1.73ab	1.77ab
T_2	50% Basal + 25% CRI + 25%Flowering	27170.09	76505.89a	77648.79a		49335.80a	50478.70a		1.81a	1.85a
T_3	33.3% Basal +33.3% CRI + 33.3%Flowering	27170.09	69886.24c	70966.96c		42716.15c	43796.87c		1.56c	1.60c
	SEm ±		832.96	822.91		832.96	822.91		0.03	0.03
	CD (P=0.05)		2393.94	2365.03		2393.94	2365.03		0.09	0.09
Interaction										
Herbicides (H) x Nitrogen rates (R)		-	S	S		S	S		NS	S
Herbicide (H)x Time of Nitrogen application (T)		-	NS	NS		NS	NS		NS	NS
Nitrogen rates(R) x Time of Nitrogen application (T)		-	S	S		S	S		S	S

Sulfo= Sulfosulfuron, Metsul= Metsulfuron, Carfen= Carfentrazone, Fenoxa= Fenoxaprop, CRI= Crown Root Initiation

NS- not significant, Number followed by same letter are not statistically different at 5% level of significance.

molecules not only increased the cost of cultivation but also results in poor weeds control. Furthermore, researches reveals that optimum quantity and time of application of plant nutrients, especially nitrogen improves crop growth, productivity and finally the income (Prasad *et al.* 2005 and Bhat *et al.* 2006). The information regarding use of new herbicides for holistic management of grassy and broad-leaved weeds as well as differential rate of nitrogen application on cost of cultivation of wheat is lacking. Keeping these points in view, the present study was conducted to investigate the effect of herbicide mixtures and differential rate of nitrogen application of economics of wheat under Indo-Gangetic Plains of eastern Uttar Pradesh.

Methodology

An investigation was conducted during winter (*Rabi*) seasons for two consecutive years of 2010-11 and 2011-12 at the Agricultural Research Farm, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi (25°18′ N, 83°03′ E and 128.93 m altitude). The soil of the experimental field was sandy clay loam in texture with slightly alkaline in reaction (pH 7.5) having low organic carbon (0.42 %) and available nitrogen (195.3 kg ha^{-1}); and medium in available phosphorus (21.8 kg ha^{-1}) and potassium (232.2 kg ha^{-1}).

It was a factorial experiment conducted in a randomized complete block design and replicated thrice, having three factors. First factor comprised of three herbicides *viz.* weedy check, sulfosulfuron + metsulfuron [32 g ha^{-1}] and carfentrazone [10 g ha^{-1}] + fenoxaprop-p-ethyl [100 g ha^{-1}], whereas, second and third factors comprised of two nitrogen rates (120 kg N ha^{-1} and 160 kg N ha^{-1}) and three times of nitrogen application (50% basal + 50% CRI, 50% basal + 25% CRI + 25% flowering and 33.3% basal + 33.3% CRI + 33.3% flowering), respectively. The 'PBW 343' wheat was sown in rows 22.5 cm apart using 100 kg seed/ha. Nitrogen applied as per treatment but full amount of P and K were applied at the time of sowing. The yield of wheat crop was converted into gross return in ₹ ha^{-1}on the basis of current price of the produce. The estimation of cost of cultivation figure given in the table 1 is used. The net return and benefit cost ratio were worked out by using following formula:

Net return (₹ ha^{-1}) = Gross return (₹ ha^{-1}) – Cost of cultivation (₹ ha^{-1})

Results and Discussion

The cost of cultivation was the highest (₹ 27714.99) under the tank mix application of carfentrazone [10 g ha^{-1}] + fenoxaprop-p-ethyl [100 g ha^{-1}]. The least cost of cultivation (₹ 26029.39 ha^{-1}) was recorded under weedy check due to no application of herbicides (Table 1). Herbicidal treatments recorded significantly higher gross return, net return and benefit cost ratio than weedy check. Among the herbicidal treatments, pre-mix application of sulfosulfuron + metsulfuron [32 g ha^{-1}] showed maximum gross return, net return and benefit cost ratio during both the years (Table 1). The lowest return was fetched from the crop sown in control plot (weedy check) which was the result of the production of lowest grain yield under this treatment. A similar result was also reported by Hari

Table 2: Interaction effects on herbicides and nitrogen rates on economics

Herbicide/Rate of nitrogen application	Gross return (₹ ha^{-1})				Net return (₹ ha^{-1})				B: C ratio	
	I year		II year		I year		II year		II year	
	R_1	R_2	R_1	R_2	R_1	R_2	R_1	R_2		
H_1	58773	63222	59101	63730	33002	36934	33330	37442	2.29	2.42
H_2	77714	86450	78998	88099	50331	58551	51615	60200	2.89	3.16
H_3	72103	82659	73132	84441	44646	54686	45676	56468	2.66	3.02
SEm ±	1178		1164		1178		1164		0.05	
CD (P = 0.05)	3386		3345		3386		3345		0.15	

Herbicide (H) x Nitrogen Rates (R)

Table 3: Interaction effects on nitrogen rate and time of nitrogen application on economics

Nitrogen rate/Time of application	Gross return (₹ ha^{-1})						Net return (₹ ha^{-1})						B: C ratio					
	I year			II year			I year			II year			I year			II year		
	T_1	T_2	T_3	T_1	T_2	T_3	T_1	T_2	T_3	T_1	T_2	T_3	T_1	T_2	T_3	T_1	T_2	T_3
R_1	70870	73657	64063	71731	74611	64890	44083	46745	37151	44944	47699	37978	2.64	2.73	2.38	2.67	2.76	2.41
R_2	77267	79355	75709	78539	80687	77044	49963	51927	48281	51236	53259	49616	2.82	2.89	2.75	2.87	2.93	2.80
SEm ±	1443			1425			1443			1425			0.05			0.05		
CD (P = 0.05)	4146			4096			4146			4096			0.15			0.15		

Nitrogen rates (R) x Time of Nitrogen application (T)

Om *et al.* (2006). Similarly, significantly higher gross return, net return and benefit cost ratio was recorded at higher dose of nitrogen 160 kg ha^{-1} as compared to recommended dose of nitrogen i.e. 120 kg ha^{-1}. The results are close conformity with the finding of Negi *et al.* (2013). Scheduling of nitrogen also showed significantly difference on gross return, net return and benefit cost ratio. Among the nitrogen scheduling, Split application of nitrogen 50% basal + 25% CRI + 25% flowering recorded significantly highest gross return, net return over other scheduling of nitrogen. Furthermore, it showed at par difference in case of net return during first year. However, the benefit cost ratio were significantly higher in split application of nitrogen 50% basal + 25% CRI + 25% flowering as compared to 33.3% basal + 33.3% CRI + 33.3% flowering, but at par with 50% basal + 50% CRI. This was perhaps due to production of highest grain yield. These observations substantiate finding of Sharma *et al.* (2002) and Gupta *et al.* (2007). The impact of treatments on improvement in grain yield might have helped in accrueing higher profit.

Interaction Effect

Significant interaction effect of herbicides (H) and nitrogen rate (R) was observed on economics of wheat during both the years (Table 2). Pre-mix application of sulfosulfuron + metsulfuron [32 g ha^{-1}] with higher level of nitrogen (160 kg ha^{-1}) recorded significantly highest gross return of (₹ 86450 and 88099 ha^{-1}) and net return of (₹ 58551 and 60200 ha^{-1}) as compare to tank mix of carfentrazone [10 g ha^{-1}] + fenoxaprop-p-ethyl [100 g ha^{-1}] during both the years, respectively. However, benefit cost ratio was interacted during second year. These values were lowest where no herbicide was applied i.e. weedy check. Also higher nitrogen rate (160 kg ha^{-1}) with time of nitrogen application (50% basal + 25% CRI + 25% flowering) was more economical with higher gross and net return as well as higher benefit cost ratio, rather than other scheduling of nitrogen, during both the years (Table 3). This proclivity in economic return is mainly due to the treatment effect on grain yield of wheat.

Conclusion

Analysis of data reveals that, there is significant increased in economics of wheat. However the application of sulfosulfuron + metsulfuron [32 g ha^{-1}] along with 160 kg N ha^{-1}applied at 50% basal + 25% CRI + 25% flowering showed more economic return i.e. gross return, net return and B:C ratio.

References

Bhat, M.A., Mahal, S.S., Kumar, Krishan and Mahey, R.K. 2006. Effect of nitrogen levels, irrigation regimes and weed control methods on competitiveness of bed planted Durum wheat (*Triticum durum* Desf.) with *Phalaris minor* Retz. *Indian Journal of Weed Science* **38**(3 and 4): 233-236.

Bhardwaj, V., Yadav, V. and Chauhan, B.S. 2010. Effect of nitrogen application timings and varieties on growth and yield of wheat grown on raised beds. *Archives of Agronomy and Soil Science* **56**(2): 211-222.

[DAC] Department of Agriculture and Cooperation, GOI, Agricultural Statistics at a Glance 2014, Available at :<http://dacnet.nic.in/eands/At_Glance_2014.htm>.

Gupta, M., Bali, A.S., Sharma, B.C., Kachroo, D. and Bharat, R. 2007. Productivity, nutrient uptake and economics of wheat (Triticum aestivum) under various tillage and fertilizer management practices. *Indian Journal of Agronomy* **52**(2): 127-130.

Hari Om., Nandal, D.P., Dhiman, S.D. and Mangat Ram. 2006. Weed control in wheat (Triticum aestivum) sown by zero-tillage. *Indian Journal of Agronomy* **51**(3): 199-201.

Malik, R.K., Yadav, A., Banga, R.S. and Singh, S. 2000. Zero till, where and alternate herbicides resistant phalaris minor in rice wheat cropping system. *Indian Journal of Weed Science* **37**(3 and 4): 220-222.

Malik, R.S., Ashok Yadav, Ramesh Kumari, Hasija, R.C. and Hooda, V.S. 2012. Suitable herbicides against complex weed flora in wheat. *Environment and Ecology* **30**(3A): 717-721.

Negi, S.C., Shekhar, J., Mankotia, B.S. and Singh, Gurudev. 2013. Fertilizer schedule under limited irrigation with zero-tilled wheat after rice in north-west Himalayas. *Indian Journal of Agronomy* **58**(2): 187-191.

Prasad, S., Singh, Y., Singh, R.P. and Singh, G. 2005. Effect of crop establishment, weed control method and time of nitrogen application on late sown wheat. *Indian Journal of Weeds Science* **37**(1 and 2): 93-95.

Singh, Samunder. 2007. Role of management practices on control of isoproturon-resistant little seed canarygrass (Phalaris minor) in India. *Weed Technology* **21**: 339-346.

Sharma, S.N., Bohra, J.S., Singh, P.K. and Shrivastava, RK. 2002. Effect of tillage and mechanization on production potential of rice-wheat cropping system. *Indian Journal of Agronomy* **47**(3): 305-310.