Performance of wheat cultivars at varying fertility levels under system of wheat intensification and conventional method of wheat production system

Kaushik Chatterjee, C.S. Singh, A.K. Singh, Ashok Kr. Singh and S.K. Singh[*]

Department of Agronomy, Birsa Agricultural University, Kanke, Ranchi-834006 (Jharkhand), INDIA
[*]Corresponding author E-mail: sksinghbau@gmail.com

Abstract: A field experiment was conducted during *rabi* season of 2009-10 at Ranchi, Jharkhand to evaluate the performance of wheat cultivars at varying fertility levels under system of wheat intensification and conventional method of cultivation. The morpho-physiological analysis of growth and yield in wheat revealed that system of wheat intensification manifested higher total tillers m^{-2}, leaf area index, dry matter accumulation, crop growth rate, number of spikes m^{-2}, grains per spike and 1000-grain weight resulting in higher grain and straw yield over conventional method of cultivation. The net return and benefit: cost ratio as well as the nutrient uptake of nitrogen, phosphorus and potash was also recorded significantly higher under system of wheat intensification. Higher fertility level of 120 kg N ha^{-1}, 60 kg P_2O_5 ha^{-1} and 40 kg K_2O ha^{-1} also significantly improved the plant height, total tillers m^{-2}, leaf area index, dry matter accumulation, crop growth rate, number of spikes m^{-2}, grains per spike, 1000-grain weight, grain yield, straw yield, net return, benefit: cost ratio and nutrient uptake of nitrogen, phosphorus and potash. Among the wheat cultivars, K 9107 manifested significant improvement in growth attributes at all the growth stages resulting in significantly higher yield attributes, grain yield, straw yield, net return, benefit: cost ratio and nutrient uptake of nitrogen, phosphorus and potash than Birsa Gehu 3, HUW 468 and K 0307. Thus it can be concluded that the wheat variety K 9107 fertilized with 120 kg N ha^{-1}, 60 kg P_2O_5 ha^{-1} and 40 kg K_2O ha^{-1} under System of Wheat Intensification may able to boost up the wheat productivity under irrigated ecosystem of Chhotanagpur plateau region, India

Keywords: Crop growth rate, Leaf area index, Net assimilation rate, Relative growth rate, System of wheat intensification

INTRODUCTION

Agricultural production being an interactive effect of soil-water-fertilizer-ultimate continuum, a wise scientific management of this complies system is crucial for enhancing crop productivity on a sustained manner without giving any detrimental effect on environmental ecology. But, today the major part of the cereal growing areas is now threatened by issues like resource degradation, declining productivity, escalating input cost and diminishing return. However, our countries need further higher production to feed the ever increasing population at a rate of 1.8 per cent annually. This can be achieved only through changes in management practices to exploit the soil-water-fertilizer-climate continuum efficiency. System of Wheat Intensification (SWI) is a set of agronomic practices which has the potential for improvement of yield and factor productivity. It is based on the insights that wheat has the potential to produce more tillers and grains than now observed and wider spacing and optimal growth conditions can fulfill this potential. However, the potentiality of system of wheat intensification can only be judged under adequate and balanced fertilization (Chatterjee *et. al.* 2012). In SWI, wider spacing is recommended for vigorous root growth and profuse tiller-

ing, however, it is variety dependent and location specific. So, the efficiency of production system coupled with suitable soil fertility can be further improved with the choice of right genotype of wheat well adapted to this region. Therefore, it is high time to strengthen the research programme on such management technology like system of wheat intensification not only to maximize production but also to make it sustainable. Hence, present experiment was undertaken to evaluate wheat cultivars at varying fertility level for their suitability under system of wheat intensification.

MATERIALS AND METHODS

A field experiment was undertaken at Agronomy Research farm, Birsa Agricultural University at Kanke, Ranchi under irrigated condition during *rabi* season of 2009-10. The soil (Alfisol) of the experimental site was poor in fertility, acidic in reaction (pH 5.6), sandy-clay loam in texture, low in organic carbon (3.7 g kg^{-1}), available nitrogen (253.42 kg ha^{-1}), medium in available phosphorus (12.18 kg ha^{-1}) and available potassium (155.0 kg ha^{-1}) The experiment was laid out in randomized block design with twenty treatments replicated thrice. The treatment combinations consisted of method of cultivation, i.e., System of Wheat intensification (M_1) and conventional method (M_2); two fer-

tility levels, i.e., 80 kg N ha^{-1}, 40 kg P_2O_5 ha^{-1} and 20 kg K_2O ha^{-1} (F_1) and 120 kg N ha^{-1}, 60 kg P_2O_5 ha^{-1} and 40 kg K_2O ha^{-1} (F_2) and 5 wheat cultivars i.e., K 9107 (V_1), Birsa Gehu3 (V_2), HUW 468 (V_3), HUW 234 (V_4) and K 0307 (V_5). Well rotten FYM @ 10 tonnes ha^{-1} was applied at the time of last ploughing. System of wheat intensification involves seed treatment with 60^0C hot water (20 litre per 10 kg seed) for ½ an hour. The infertile and damaged seeds floating over the water should be removed. Then seeds were soaked in a mixture of 4 litre cow urine, 5 kg vermicompost and 4 kg jaggery for 8 hours and left overnight in moist jute bag to break the dormancy of seeds. Single seed is sown at row to row and plant to plant spacing of 20 × 20 cm. The wheat crop under system of rice intensification was irrigated at 15, 25, 35, 65, 85 and 105 days after sowing. The nutrient requirement of the crop was met through diammonium phosphate (18% N and 15% P_2O_5), muriate of potash (60% K_2O) and urea (46% N). Full dose of phosphorus, 50 per cent of potash and 1/3 of nitrogen were applied as basal application and rest 2/3 of nitrogen is applied in two splits 2 days after 1st and 3rd irrigation as per treatment. The remaining 50 per cent of the potash is applied at the time of spike emergence. Weeding was done by using mechanical weeder at 3-4 days after 1st, 2nd and 3rd irrigation after top dressing of fertilizer. In conventional method seeds of particular cultivar were sown in regular rows of 20 cm with a seed rate of 125 kg ha^{-1}. A basal dose of full P_2O_5 in the form of diammonium phosphate (DAP), K_2O through muriate of potash and 1/3 of the nitrogen through urea was applied as basal application as per treatment. The remaining 2/3 of nitrogen was top dressed in two equal splits at 20 and 40 days after sowing. Altogether six irrigation were applied at an interval of 20 days throughout the crop growth period. Two hand weeding was done at 20 and 40 days after sowing. Need-based plant protection measures were given. Plants sampling was done at 20, 40, 60, 80, 100 days after sowing and at harvest to record the growth parameters such as plant height, total tiller m^{-2}, leaf area index and dry matter accumulation per m^2 while the yield attributes, grain yield and straw yield were recorded at harvest.

The plant samples collected at harvest were dried at 70ºC, powdered in Willey mill and digested to analyze the various nutrient compositions. The nitrogen, phosphorus and potassium content in plant parts were estimated by Kessler's reagent method (Nicholas and Nason, 1957), HNO_3:$HClO_4$ (9:4) digestion, colour development by Vandomolybdate solution followed by spectrophotometer determination (Jackson, 1973) and flame photometric determination after digestion in HNO_3:$HClO_4$ (9:4) (Jackson, 1973) respectively. The nutrient uptake was estimated by multiplying the nutrient concentration with the grain and straw yield. The data were subjected to statistical analysis as prescribed by Gomez and Gomez (1984) and significant effects were presented and discussed in this paper. The economics was computed on the basis of prevailing market rates of produce and agro-inputs. Net return was the difference between the gross returns and total cost of cultivation. The benefit: cost ratio was calculated by dividing the net returns by the cost of cultivation.

RESULTS AND DISCUSSION

Plant height: There was a gradual increase in plant height till maturity. This was mainly due to increase in the length of leaves and spike till harvest (Table 1). System of wheat intensification recorded significantly higher plant height than conventional method of cultivation at 20 days after sowing. This might be due to early germination of seeds in system of wheat intensification than conventional method. At later stages, conventional method of cultivation had higher plant height than SWI method as dense plant population in conventional method favour the vertical growth of plant in search of light while, greater spacing provided in system of wheat intensification leading to lesser competition between the plants thus favouring horizontal spread to utilize the available space resulting in shorter plant than conventional method. Increasing fertility level increased the plant height and maximum plant height was observed with 120 kg N ha^{-1}, 60 kg P_2O_5 ha^{-1} and 40 kg K_2O ha^{-1} due to improved N, P, K supplying capacity of soil at higher fertility level. Plant height is the genetic character of the cultivar which is much dependent on management practices as such K 9107 was higher in plant height than Birsa Gehu 3, HUW 234, HUW 468 and K 0307 (Bhardwaj *et al.* 2010).

Total tillers per m^2: Total tillers m^{-2} was higher at 80 days after sowing and then declined afterwards till harvest (Table 1). The reduction in tillers after 80 DAT was due to intra species competition for higher space and nutrients which are responsible for degeneration of late formed tillers. System of wheat intensification had higher tiller numbers as under wider spacing each individual plant could have effectively utilized the more available resources such as space, foraging area for root system, better root spread, more light interception *etc.*, which resulted in enhanced tiller production as compared to conventional system of cultivation (Thakur *et. al.* 2010). Number of tillers m^{-2} were increased significantly at higher fertility level *i.e.*, 120 kg N ha^{-1}, 60 kg P_2O_5 ha^{-1} and 40 kg K_2O ha^{-1} at all the growth stages. Cultivars influenced the tiller growth throughout the growth period. At maturity, K 9107 produced the highest tiller number and was followed by HUW-234, K 0307; HUW-468 and Birsa Gehu-3 as the cultivar differ in their ability to produce tillers due to differences in genetic constitution (Mehla and Gupta 1998).

Leaf area index: Leaf area index increased successively as the growth progressed upto 80 days after sowing and thereafter it declined till harvest due to

Table 1. Effect of cultivation method and fertility levels on plant height, total tillers, leaf area index and dry matter accumulation of wheat cultivars.

Treatments	20 DAS	40 DAS	60 DAS	80 DAS	100 DAS	At Maturity	Treatments	20 DAS	40 DAS	60 DAS	80 DAS	100 DAS	At Maturity
Plant height (cm)							**Tillers / m^2**						
Method of cultivation							**Method of cultivation**						
SWI	8.72	24.61	51.06	82.52	96.29	96.14	SWI	49.93	117.93	451.39	520.41	485.92	454.10
Conventional	8.31	26.19	54.78	85.88	99.04	98.83	Conventional	280.39	350.39	400.27	476.51	428.75	410.48
CD (P=0.05)	0.35	1.23	2.83	NS	NS	NS	CD (P=0.05)	11.29	11.29	23.91	32.04	23.74	23.33
Fertility levels (kg N-P$_2$O$_5$-K$_2$O/ha)							Fertility levels (kg N-P$_2$O$_5$-K$_2$O/ha)						
80-40-20	8.26	24.21	50.01	80.50	94.69	94.12	80-40-20	160.52	218.02	369.62	458.75	432.67	407.58
120-60-40	8.76	26.59	55.83	87.90	100.63	100.85	120-60-40	169.79	250.29	482.04	538.17	482.00	457.01
CD (P=0.05)	0.35	1.23	2.83	4.43	4.77	4.90	CD (P=0.05)	NS	11.29	23.91	32.04	23.74	23.33
Cultivars							Cultivars						
K 9107	9.37	27.77	59.25	92.94	108.59	108.48	K 9107	170.62	251.12	480.10	538.66	497.29	473.32
Birsa Gehu 3	7.59	21.93	45.79	77.41	87.28	87.01	Birsa Gehu 3	157.53	205.53	346.35	467.84	420.63	408.23
HUW 468	7.63	25.22	48.87	79.41	93.37	93.31	HUW 468	162.67	223.17	393.20	481.80	445.00	419.38
HUW 234	9.28	26.77	58.17	86.73	100.53	100.14	HUW 234	169.22	249.72	458.98	514.30	465.00	431.61
K 0307	8.70	25.32	52.52	84.51	98.54	98.49	K 0307	165.74	241.24	450.52	489.70	458.75	428.93
CD (P=0.05)	0.56	1.94	4.47	7.01	7.55	7.75	CD (P=0.05)	NS	17.85	37.81	50.66	37.54	36.88
Leaf area index							**Dry matter accumulation (g/m^2)**						
Method of cultivation							**Method of cultivation**						
SWI	0.33	1.24	2.52	3.71	2.83	1.42	SWI	7.43	57.86	197.87	568.43	920.61	1123.06
Conventional	0.44	1.15	2.29	3.53	2.69	1.35	Conventional	14.52	56.03	183.63	515.10	835.08	1004.31
CD (P=0.05)	0.02	0.06	0.15	0.18	NS	NS	CD (P=0.05)	0.71	NS	7.77	23.45	39.07	45.14
Fertility levels (kg N-P$_2$O$_5$-K$_2$O/ha)							Fertility levels (kg N-P$_2$O$_5$-K$_2$O/ha)						
80-40-20	0.36	1.10	2.18	3.38	2.55	1.27	80-40-20	10.67	52.05	172.12	485.37	798.29	954.18
120-60-40	0.41	1.28	2.63	3.85	2.97	1.50	120-60-40	11.67	61.84	209.38	598.16	957.40	1173.19
CD (P=0.05)	0.02	0.06	0.15	0.18	0.18	0.08	CD (P=0.05)	0.71	2.50	7.77	23.45	39.07	45.14
Cultivars							Cultivars						
K 9107	0.44	1.26	2.58	3.78	2.90	1.49	K 9107	11.92	60.94	206.91	602.75	960.94	1172.59
Birsa Gehu 3	0.32	1.12	2.22	3.37	2.56	1.25	Birsa Gehu 3	10.15	51.79	171.82	479.91	786.87	949.37
HUW 468	0.37	1.16	2.28	3.60	2.60	1.32	HUW 468	10.99	54.42	181.44	505.95	840.53	996.43
HUW 234	0.39	1.22	2.47	3.70	2.88	1.47	HUW 234	11.62	60.07	202.63	570.83	916.69	1117.36
K 0307	0.39	1.20	2.47	3.65	2.86	1.40	K 0307	11.18	57.51	190.94	549.38	884.20	1082.66
CD (P=0.05)	0.03	0.10	0.24	0.29	0.28	0.12	CD (P=0.05)	1.12	3.95	12.29	37.07	61.77	71.38

Table 2. Effect of cultivation method and fertility level on crop growth rate, relative growth rate and net assimilation rate of wheat cultivars.

Treatments	20-40 DAS	40-60 DAS	60-80 DAS	80-100 DAS	100DAS- Maturity
Crop growth rate (g m^{-2} day)					
Method of cultivation					
SWI	2.51	7.00	18.53	17.61	10.12
Conventional	2.07	6.38	16.57	16.00	8.46
CD (P=0.05)	0.14	0.42	1.26	1.45	0.91
Fertility levels (kg N-P$_2$O$_5$-K$_2$O/ha)					
80-40-20	2.07	6.00	15.66	15.65	7.79
120-60-40	2.51	7.38	19.44	17.96	10.79
CD (P=0.05)	0.14	0.42	1.26	1.45	0.91
Cultivars					
K 9107	2.45	7.30	19.79	17.91	10.58
Birsa Gahu-3	2.08	6.00	15.40	15.35	8.13
HUW 468	2.17	6.35	16.23	16.73	7.79
HUW 234	2.42	7.13	18.41	17.29	10.03
K 0307	2.32	6.67	17.92	16.74	9.92
CD (P=0.05)	0.21	0.66	1.99	2.30	1.44
Relative growth rate (g^{-1}g^{-1}day)					
Method of cultivation					
SWI	0.0441	0.0270	0.0228	0.0106	0.0042
Conventional	0.0297	0.0258	0.0224	0.0103	0.0041
CD (P=0.05)	0.0019	NS	NS	NS	NS
Fertility levels (kg N-P$_2$O$_5$-K$_2$O/ha)					
80-40-20	0.0368	0.0263	0.0225	0.0104	0.0041
120-60-40	0.0370	0.0265	0.0227	0.0105	0.0042
CD (P=0.05)	NS	NS	NS	NS	NS
Cultivars					
K 9107	0.0382	0.0266	0.0228	0.0106	0.0043
Birsa Gahu-3	0.0358	0.0261	0.0223	0.0103	0.0040
HUW 468	0.0358	0.0263	0.0225	0.0103	0.0040
HUW 234	0.0382	0.0264	0.0227	0.0105	0.0043
K 0307	0.0364	0.0264	0.0225	0.0105	0.0041
CD (P=0.05)	0.0030	0.0022	0.0021	0.0013	0.0007
Net assimilation rate (g m^{-2} day)					
Method of cultivation					
SWI	3.76	4.02	6.14	5.63	4.95
Conventional	2.87	4.01	6.13	5.68	4.41
CD (P=0.05)	0.23	NS	NS	NS	0.49
Fertility levels (kg N-P$_2$O$_5$-K$_2$O/ha)					
80-40-20	3.29	3.94	6.03	5.66	4.42
120-60-40	3.34	4.10	6.24	5.65	4.95
CD (P=0.05)	NS	NS	NS	NS	0.49
Cultivars					
K 9107	3.34	4.09	6.61	6.04	4.99
Birsa Gahu-3	3.30	3.81	5.74	5.59	4.34
HUW 468	3.31	4.03	6.06	5.26	4.75
HUW 234	3.32	4.07	6.21	5.45	4.89
K 0307	3.31	4.08	6.05	5.94	4.45
CD (P=0.05)	NS	NS	NS	NS	NS

drying of leaves. The leaf area index was higher in system of wheat intensification as compared to conventional method of cultivation except at 20 DAS during where due to higher plant population conventional method recorded significantly higher leaf area index than system of wheat intensification (Table 1). The leaf area index showed increasing trend at 120 kg N ha^{-1}, 60 kg P$_2$O$_5$ ha^{-1} and 40 kg K$_2$O ha^{-1} as compared to lower rate of application. As such, higher fertility level increased the supplying capacity of the soil which in turn resulted in a better leaf growth rate eventually leading to higher leaf area index. Among the cultivars, K 9107 produced the highest leaf area index followed by HUW 234, K 0307, HUW 468 and Birsa Gehu 3. The higher LAI might be due to higher number of tillers putting forth more leaves resulting in higher leaf area index. (Tripathi *et. al.* 2000).

Dry matter accumulation m^{-2}: The dry matter accu-

Table 3. Effect of method of cultivation and fertility level on yield attributes, yield, economics and nutrient uptake of wheat cultivars.

Treatments	Yield attributes				Grain yield (kg ha⁻¹)	Straw yield (kg ha⁻¹)	Net return (Rs ha⁻¹)	Bene-fit :cost ratio	Nutrient uptake (kg ha⁻¹)		
	Number of spikes m⁻²	Filled grains per spike (No)	Unfilled grains per spike (No)	1000 grain weight (g)					Nitrogen	Phosphorus	Potash
Method of cultivation											
SWI	417.86	51.90	2.92	38.82	4167	5952	31282	1.42	98.58	18.34	87.83
Conventional	388.27	46.04	3.99	38.55	3794	5580	24463	1.01	92.01	17.20	82.08
CD (P=0.05)	17.15	1.88	0.16	0.20	171	245	2162	0.09	3.99	0.68	3.61
Fertility levels (kg N-P₂O₅-K₂O/ha)											
80-40-20	369.75	47.90	3.92	38.50	3594	5402	23458	1.05	85.60	15.85	77.01
120-60-40	436.37	50.05	2.98	38.87	4367	6130	32286	1.38	104.99	19.69	92.91
CD (P=0.05)	17.15	1.88	0.16	0.20	171	245	2162	0.09	3.99	0.68	3.61
Cultivars											
K 9107	438.61	52.09	2.09	42.03	4374	6108	32862	1.44	104.00	18.84	88.63
Birsa Gahu-3	375.94	44.54	4.43	35.51	3581	5303	22783	0.99	85.29	16.53	79.49
HUW 468	388.09	48.43	3.98	36.49	3834	5610	26008	1.13	93.37	17.37	84.45
HUW 234	412.35	50.43	3.38	41.74	4134	6009	29842	1.30	98.55	18.25	87.22
K 0307	400.33	49.38	3.39	37.66	3979	5799	27867	1.22	95.26	17.89	85.01
CD (P=0.05)	27.12	2.98	0.25	0.31	271	387	3418	0.15	6.31	1.08	5.71

mulation m⁻² increased as the growth progressed and the maximum value was observed at harvest. The dry matter production is the sum total effect of overall growth. System of wheat intensification had significant influence on dry matter accumulation at all the stages (Table 1) except at 20 DAS, where conventional method due to higher number of plant stand had higher dry matter production. System of wheat intensification had higher tillers m⁻² and leaf area index indicating higher photosynthetic efficiency which in turn resulted in higher dry matter accumulation m⁻². Higher fertility level of 120 kg N ha⁻¹, 60 kg P_2O_5 ha⁻¹ and 40 kg K_2O ha⁻¹ had a significant influence on dry matter accumulation at all the growth stages of wheat. Among the cultivars, K 9107 and HUW 234 due to higher tiller number and leaf area index, led to higher dry matter accumulation than Birsa Gehu 3, HUW 468 and K 0307 throughout the growth period. Bhardwaj *et al.* (2010) also reported that enhancement in growth parameters i.e. plant height, total tillers and leaf area index were responsible for higher dry matter accumulation among the wheat cultivations.

Crop growth parameters: Pronounced improvement in crop growth rate (CGR) and net assimilation rate (NAR) were observed between 60-80 DAS and thereafter both declined till harvest. Relative growth rate (RGR) showed the declining trend from the beginning till maturity of the crop (Table 2). System of wheat intensification had positive influence on the crop growth parameters. This might be due to better vegetative growth under system of wheat intensification at the growth stages thus improving the crop growth rate, relative growth rate and net assimilation rate. Higher fertility rate of 120 kg N ha⁻¹, 60 kg P_2O_5 ha⁻¹ and 40 kg K_2O ha⁻¹ had significantly higher crop growth rate, relative growth rate and net assimilation rate due to better crop growth condition at higher fertility level. Among the cultivars, K 9107 recorded highest crop growth rate, relative growth rate and net assimilation rate as a result of better vegetative growth at all the stages.

Yield attributes: Significant improvement in yield attributes viz. number of spikes m⁻², spike length, filled grains per spike, spike weight and test weight was recorded under system of wheat intensification (Table 3). This may be attributed to adequate availability and supply of resources under system of wheat intensification and their translocation along with other nutrients to the sink. The changes in the management could form more photosynthetic organ, strengthen photosynthetic ability, produce higher dry matter and provide sufficient nutrient to sink continually making the seed more plump, increased 1000-grain weight, seed setting percentage and filled grains per panicle (Lu *et. al.,* 2005) under system of wheat intensification. Chapagain and Yamaji (2010) also reported that a wider spacing produced significantly longer panicles with higher number of filled spikelets as compared to lower spacing. Beneficial effect of fertility level on the yield

attributes i.e. spikes m^{-2}, spike length, filled grains per spike, spike weight and thousand grain weight was accompanied with higher fertility level i.e., 120 kg N ha^{-1}, 60 kg P_2O_5 ha^{-1} and 40 kg K_2O ha^{-1}. The increase in yield attributes might be ascribed to improved supply of nutrients at higher level, resulting into increase photosynthetic attributes and translocation of photosynthates, which promoted the growth, better partitioning of photosynthates in yield attributes and eventually produced more yield (Sen *et. al.,* 2003). Among cultivars, K 9107 was found significantly superior to other cultivars but remained at par with HUW-234 in respect of number of spikes m^{-2}, grains per spike and 1000-grain weight. This might be due to better vegetative growth which favoured effective translocation of photosynathate resulting in higher yield attributes.

Grain and straw yield: System of rice intensification recorded pronounced effect on grain and straw yield (Table 3). Hills with wider spacing had larger root dry weights, produced greater system exudates and transport these towards shoot at faster rates, which helped maintaining higher chlorophyll levels, enhanced fluorescence and photosynthetic rates of leaves and thereby increased the yield of individual hill than closely spaced plants. Better vegetative growth which contributed towards higher dry matter accumulation resulting in significantly higher straw yield under system of wheat intensification. Significant effect of fertility levels at 120 kg N ha^{-1}, 60 kg P_2O_5 ha^{-1} and 40 kg K_2O $ha^{-1}$was also recorded on grain yield. The higher values of grain yield at higher fertility level may be owing to greater availability of nutrients in soil, improvement of soil environment resulting in higher root proliferation leading to better absorption of moisture and nutrients and ultimately resulting in higher grain yield (Kumari *et. al.,* 2013). Increased fertility level delays senescence and increases the life cycle of plant resulting in higher economic yield. The straw yield significantly increased with increased fertility level of 120 kg N ha^{-1}, 60 kg P_2O_5 ha^{-1} and 40 kg K_2O ha^{-1} (Table 3). Straw yield of crop is closely related to the vegetative growth and increasing the fertility level proved instrumental in improving the growth attributes and ultimately led to higher straw yield. Cultivars like K 9107 and HUW 234 had favourably influenced dry matter accumulation and its portioning towards reproductive organs which consequently produced higher grain and straw yield.

Economics: Economics is the main factor governing the feasibility of any technology. System of wheat intensification recorded significantly higher net return and benefit cost ratio over conventional system of wheat cultivation due to higher gross return and low cost of cultivation under system of wheat intensification (Table 3). The net return and B:C ratio were found higher at the higher fertility level of 120 kg N ha^{-1}, 60 kg P_2O_5 ha^{-1} and 40 kg K_2O ha^{-1} due to higher yield.

Similarly in the case of cultivars, higher yield of K 9107 led to higher net return and benefit cost ratio followed by HUW 234, K 0307, HUW 468 and Birsa Gehu 3 in decreasing order.

Nutrient uptake: System of wheat intensification recorded higher uptake of nitrogen, phosphorus and potassium as compared to conventional method of cultivation which could be ascribed to better vegetative and reproductive growth under SWI method of cultivation. Total nitrogen, phosphorus and potassium uptake were higher when the crop was raised120 kg N ha^{-1}, 60 kg P_2O_5 ha^{-1} and 40 kg K_2O ha^{-1} (Table 3) compared to that raised with 80 kg N ha^{-1}, 40 kg P_2O_5 ha^{-1} and 20 kg K_2O ha^{-1}. Increase in uptake of N,P and K with higher nutrient doses was owing to increased availability of nutrients facilitating better root growth and as such better nutrient uptake (Singh *et. al.,* 2011). Among cultivars, K 9107 recorded the highest NPK uptake followed by K 9107 > HUW 234 > K 0307 > HUW 468 > Birsa Gehu 3. Nutrient uptake in the product of nutrient content and grain yield. The variation in nutrient content and yield of wheat cultivars were responsible for the variability in the nutrient uptake (Kumari and Singh, 2013).

Conclusion

Thus, based on one year data it can be concluded that wheat variety K 9107 fertilized with 120 kg N ha^{-1}, 60 kg P_2O_5 ha^{-1} and 40 kg K_2O ha^{-1} under System of Wheat Intensification may prove as biologically efficient, resource conservative, highly profitable system under irrigated ecosystem of Chhotanagpur plateau region, India which has the potential to serve as a viable and better alternative to the farmer.

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