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Effect of different nitrogen management on growth, yield and economics of wheat + chickpea strip cropping

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ABSTRACT

A field experiment was carried out at the KuthuliaFarm, College of Agriculture, Rewa (M.P.) under AICR Project for Dryland Agriculture during rabi season 2020-21. Application of 100 % N by inorganic (T_2) preformed the best which recorded maximum growth parameters, yield attributes yield economics of wheat and chickpea under wheat + chickpea strip cropping. Ultimately the grain yield of wheat and chickpea in $T_2$was 11.05 and 7.46 q/ha, respectively. Consequently, the total net income was upto Rs. 30153 with 1.88 B:C ratio. The wheat equivalent yield in $T_2$was highest up to 30.08 q/ha. Amongst the Integrated nutrient management treatments, T_7 having 50 % N by inorganic + 50 % N by compost + Rhizobium/Azotobacter recorded highest growth parameters, yield attributes and wheat yield 9.94 q/ha and chickpea yield 6.61 q/ha, along with total economical gain up to Rs. 20803/ha from both the crops. The findings indicated that in order to maintain sustainable crops productivity, the combined input of organic + inorganic + biofertilizers (T_7) inorganic and 50 % by organic is essential to achieve maximum benefit in this region.

Key words: Integrated nutrient management, wheat + chickpea strip cropping.

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INTRODUCTION

The use of inorganic fertiliser has led to a growth in the country's food grain output, and this trend is expected to continue. To safeguard agricultural output and the national economy, a balanced fertiliser application is essential. Organic farming is gaining popularity in India's agricultural sector, in part because of self-governing farmer collectives. Organic manures are readily decomposed by soil microorganisms because they contain all the essential nutrients for plant growth.

In order to increase soil fertility and crop productivity, it is recommended to use both inorganic and organic materials. Plants can thrive on organic nutrients alone, but the best results and longest crop life come from using both organic and inorganic fertilisers. Soil physical and chemical properties, including water status and runoff, are enhanced when organic amendments are incorporated. After harvest, adding organic material to the soil helps maintain moisture and nutrients for the following crop (Hegde, 1998). Biofertilizers, inorganic fertilisers, and compost all work to increase and sustain soil fertility and crop yields (Patil,2013). Rhizobium/Azotobacter may facilitate better plant growth by increasing the number of beneficial bacteria in the rhizosphere.

Nitrogen being a dominant and major nutrient occupies central role in crop nutrition to enhance productivity. Nitrogen use efficiency would definitely be increased by the crop nitrogen as per crop need is the most appropriate fertilizer N management strategy to improve nitrogen use efficiency. Strip cropping of cereals and legumes may be used to generate profitable relationship towards increased yield, stability, better use of available resources, reduced weed interaction and to keep soil and plants healthy. Therefore, it becomes necessary to know the suitable combination of inorganic, organic and biofertilizers sources of nutrients for profitable wheat and chickpea production under wheat + chickpea strip cropping of both these crops.

MATERIALS AND METHODS

Kuthulia Farm, J.N.K.V.V. College of Agriculture, Rewa, was the site of the experiment in 2020-21. (M.P.). pH 6.7, electrical conductivity 0.75 dSm-1, organic carbon 0.50, available N 230.4, available P2O5 16.6, and available K2O 340.5 kg/ha were the characteristics of the soil in the experimental field. There were a total of 10.2 millimetres of rain during the growing season. Three sets of all possible wheat + chickpea strip cropping treatments were analysed. Each of the nine treatments included inorganic, organic, and biological fertilisers. (T1 = control, T2 = 100 % N by inorganic, T3 = 100 N by compost, T4 = 50 % N by inorganic + 50 % N by compost, T5 = 50 % N by inorganic + 25 % N by compost, T6 = 25 % N by inorganic + 25 % N b compost, T7 = 50 % N by inorganic + 50 % N by compost + Rhizobium /Azotobacter, T8 = 25 N by inorganic + 50 % N by compost + Rhizobium /Azotobacter and T9 = 25 N by inorganic + 25 % N by compost + Rhizobum /Azotobacter. The wheat var. JW 3211 and Chickpea var. JG-12, were sown on 15 November, 2020. The crop was nurtured using the advised set of procedures. The crop was picked between March 20 and March 20, 2022.

RESULTS AND DISCUSSION

Growth parameters of wheat and chickpea: - Nutrient management treatments, application of 100% applied through inorganic (T2) significantly higher plant height (82.93cm), tillers (206.2/ m2) over control. This was followed by integrated nutrient management treatments having 50 % N by inorganic + 50 N by compost + Rhizobium/Azotobacter (T7), 50 % N by inorganic + 50 % N by compost (T4) and then 100 % N by compost (T3) (Table 1). Compost and applied inorganic fertilizers, both of which release their nutrients slowly, may have contributed to the increased tiller count and plant height. Kashyap et al. (2018), Singh et al. (2011), and Singh et al. (2017) all reported the same or very similar findings. Similar results were observed in chickpea, where 100% inorganic fertilization (T2) resulted in taller plants (48.83 cm) and more branches (4/plant) compared to the control.

The highest vegetative growth of wheat and chickpea under 100% Ninorganic (T2) may be due to the fact that initially adequate was available to the actively growing plants. The highest vegetative growth parameters of both the crops under strip cropping in integrated nutrient management treatments like 50 % N by inorganic + 50 N by compost + Rhizobium/Azotobacter (T7), 50 % N by inorganic + 50 % N by compost (T4) and 100 % N by compost (T3) may be growing to the fact that the combined input of nutrient sources provided maximum availability of nitrogen and other nutrients in addition to the improvement of physico-chemical and biological properties of the soil. These processes brought about increased photosynthesis, acceleration of cell elongation and cell division. Moreoverapplied urea- N with compost and biofertilizers in 50 % N by inorganic + 50 N by compost + Rhizobium/Azotobacter (T7), 50 % N by inorganic + 50 % N by compost (T4) and 100 % N by compost (T3) treatments have got different nutrients contents, variation in decomposition of organic residues, C:N ratio and nutrient release pattern under the existing agro-climatic conditions. These results corroborate with those ofGhanshyamet al. (2010), Singh and Aulakh (2015), Singh et al. (2019) and Raju et al. (2020).

Yield attributes and yield:-The yield attributes recorded and yield obtained under both the crops in strip cropping followed the same trend as in growth parameters with respect to the applied treatments (Table 1 and 2). Significantly higher yield attributes and grain yield of wheat under 100% applied through inorganic (T2) treatments were 12.98 cm spike length, 47.1 grains / spike,

44.95 g test weight, 11.05q/ha grain yield, 25.38q/ha straw yield and 30.54 % harvest index over control.Similar results were reported by Singh and Singh (2017) and Kashyap et al. (2018). In case of chickpea, significantly higher yield attributes were 31.67 pods/plant, 1.96 grains /pod, 123.26 g test weight, 7.46q/ha grain yield, 14.89q/ha straw yield and 33.54 % harvest index over control. Similar results were reported bySingh and Sharma (2011).The wheat equivalent yield was upto 30.08 q/ha. Integrated nutrient management treatments viz. 50 % N by inorganic + 50 N by compost + Rhizobium/Azotobacter (T7), 50 % N by inorganic + 50 % N by compost (T4) and then 100 % N by compost (T3) having combined application of input of nutrients from there sources. These results are in accordance with the findings of Pail and Wani (2008), Singh and Aulakh (2015), Patil et al. (2018), Seth and Kumar (2019), Singh et al. (2019) and Raju et al. (2020).

Economics: Application of 100 % N by inorganic source (T_2) provided maximum net monetary return up to Rs. 30153/ha, with 1.88 B:C ratio. Amongst the organic sources of nutrients, 50 % N by inorganic + 50 % N by compost + *Rhizobium/Azotobacter* (T_7) resulted in net monetary return up to Rs. 20803/ha with 1.51 B:C ratio by Ramesh *et al*. (2008), Devi *et al.* (2019), Diptanu et al. (2018) and Seth and Kumar (2019).

CONCLUSION

From this study, it was concluded that combined use of 50 % inorganic + 50 % compost + Rhizobium/Azotobacter (T7) biofertilizers could efficiently enhance the soil fertility and productivity thereby achieving maximum yield of wheat and chickpea under wheat + chickpea strip cropping system.

Conflict of interest: On behalf of all authors, the corresponding author states that there is no conflict of interest.

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Table 1. Growth, yield attributes, yield of wheat as influenced by INM treatments under wheat + chickpea strip cropping

Treatments		Plant height (cm)	Tillers/m^2	Spike length (cm)	Grains $spike^{-1}$	Test weight (g)	Grain yield (q/ha)	Straw yield (q/ha)	Harvest index (%)
T_1	0% Control	79.15	139.89	9.78	34.39	36.44	4.81	13.58	26.17
T_2	100% N (Inorganic)	82.93	206.21	12.98	47.06	44.95	11.05	25.38	30.54
T_3	100 % N (compost)	80.15	177.63	11.77	40.08	40.37	8.99	22.51	29.10
T_4	50 % N (Inorganic) + 50 % N (compost)	79.95	182.00	12.50	41.19	41.15	9.11	22.27	30.13
T_5	50 % N (Inorganic) + 25 % N (compost)	77.24	170.02	10.59	38.01	38.61	8.12	20.06	29.24
T_6	25 % N (Inorganic) + 25 % N (compost)	81.32	162.59	9.89	35.22	38.22	7.07	18.25	27.27
T_7	50 % N Inorganic) + 50 % N compost + *Rhizobium/Azotobacter*	81.38	186.58	11.87	45.10	44.14	9.94	24.18	30.25
T_8	25 % N (Inorganic) + 50 % N (compost) + *Rhizobium/ Azotobacter*	79.03	177.35	11.35	39.01	39.59	8.28	22.17	28.82
T_9	25 % N (Inorganic) + 25 % N (compost) + *Rhizobium/ Azotobacter*	78.15	172.50	11.62	38.22	38.72	8.12	21	28.09
	S.Em±	**1.02**	**7.65**	**0.33**	**1.0**	**1.39**	**0.39**	**0.54**	**1.01**
	C.D. (P=0.05)	**3.07**	**22.93**	**1.00**	**3.19**	**4.15**	**1.17**	**1.61**	**3.01**

Table 2. Growth, yield attributes, yield and economics of chickpea as influenced by INM treatments under wheat + chickpea strip cropping

Treatments		Plant height (cm)	Branches /plant	Pods/ plant	Grains /pod	Test weight (g)	Grain yield (q/ha)	Straw yield (q/ha)	Harvest index (%)	WEY (q/ha)	NMR (Rs/ha)	B:C ratio
T_1	0% Control	42.69	2.91	20.41	1.49	121.14	3.31	9.76	26.42	13.49	1229	1.04
T_2	100% N (Inorganic)	48.83	4.00	31.67	1.96	123.26	7.46	14.89	33.54	30.08	30153	1.88
T_3	100 % N (compost)	47.04	3.62	29.94	1.86	122.60	6.03	12.90	32.16	25.69	6469	1.16
T_4	50 % N (Inorganic) + 50 % N (compost)	46.53	3.77	30.50	1.90	121.26	6.45	13.07	32.21	26.45	16037	1.49
T_5	50 % N (Inorganic) + 25 % N (compost)	45.32	3.57	29.59	1.82	121.26	5.49	11.98	31.48	22.49	12480	1.35
T_6	25 % N (Inorganic) + 25 % N (comost)	45.20	3.40	29.90	1.83	121.24	5.47	11.95	32.21	21.40	11022	1.32
T_7	50 % N Inorganic) + 50 % N compost + *Rhizobium/Azotobacter*	47.84	3.79	30.79	1.91	121.19	6.61	14.39	32.54	28.48	20803	1.51
T_8	25 % N (Inorganic) + 50 % N (compost) + *Rhizobium/ Azotobacter*	45.05	3.57	29.61	1.85	122.35	5.53	12.38	32.12	23.62	15140	1.43
T_9	25 % N (Inorganic) + 25 % N (compost) + *Rhizobium/ Azotobacter*	45.70	3.31	29.49	1.84	121.28	5.27	12.06	31.1	22.26	14840	1.43
	S.Em±	**0.97**	**0.34**	**0.49**	**0.08**	**0.99**	**0.33**	**0.43**	**1.01**	**0.46**		
	C.D. (P=0.05)	**2.90**	**1.02**	**1.46**	**0.24**	**2.96**	**1.0**	**1.33**	**3.04**	**1.37**		

WEY = Wheat equivalent yield **NMR =** Net monetary return