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Influence of different nitrogen doses and cow based bio-enhancers on quality, nutrient content, uptake, soil fertility status and soil microbial population in late sown wheat

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Abstract
A field experiment was conducted at Agronomy Instructional Farm, Chimanbhai Patel College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar during *rabi* 2021-22 on loamy sand to study the influences of different nitrogen doses and cow based bio-enhancers in late sown wheat on quality, nutrient content, uptake, soil fertility status and soil microbial population. Nitrogen as well as phosphorus uptake by grain and straw recorded significantly higher with T_2 treatment *i.e.*, 100% RDN + *panchagavya* as foliar spray @ 3% at 30, 45 and 60 DAS. Available nitrogen content in soil after harvest of the wheat crop was recorded significantly the higher in 100% RDN + *jivamrut* @ 500 litre/ha with irrigation at sowing, 21 and 45. Organic carbon, available P_2O_5 and available K_2O status in soil after harvest of crop did not exert significantly with the different treatments. The population of beneficial bacteria (*Rhizobium* and PSB) was increased in all the treatments except in T_1 (100% RDN) over its initial population.

Keywords: Wheat, grain yield, straw yield, *panchgavya*, economical

Introduction
Wheat [*Triticum aestivum* (L.) emend. Fiori & Paol.] is the most important staple food crop of the world and emerged as the backbone of India's food security. It is grown all over the world for its wider adaptability and high nutritive value. It is an important winter cereal contributing about 38% of the total food grain production in India.

In India, wheat is the second most important cereal crop after rice covering an area of 31.36 million hectares. Total annual production of wheat in India is 107.8 million tonnes with the productivity of 3.44 tonnes per hectare during 2020-22 (Anon. 2020-21) [1, 2]. India is the second largest wheat producer (Approximately 12 per cent World's wheat production) and consumer after China. In Gujarat, wheat is an important *rabi* crop and is grown almost throughout the state with 1.36 million hectares area under cultivation, total production of 4.37 million tonnes and an average yield of 3.20 tonnes per hectare during 2020-21 (Anon. 2020-21) [1, 2], Whereas in the World, wheat is grown in an area of 220.83 million hectares with the production of 775.7 million tonnes and productivity of 3.51 tonnes per hectare (USDA, 2020-21).

Material and Methods
A field experiment was conducted at Agronomy Instructional Farm, Chimanbhai Patel College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar during *rabi* 2021-22 on loamy sand. The experiment was laid out in a randomized block design with four replications consisted of nine treatments *viz*., 100% RDN (80 kg N/ha), 100% RDN + *panchgavya* as foliar spray @ 3% at 30, 45 and 60 DAS, 100% RDN + *jivamrut* @ 500 l/ha with irrigation at sowing, 21 and 45 DAS, 100% RDN + *amrutpani* @ 500 l/ha with irrigation at sowing, 21 and 45 DAS, 100% RDN + *sanjivak* @ 500 l/ha with irrigation at sowing, 21 and 45 DAS, 75% RDN + *panchgavya* as foliar spray @ 3% at 30, 45 and 60 DAS, 75% RDN + *jivamrut* @ 500 l/ha with irrigation at sowing, 21 and 45 DAS, 75% RDN + *amrutpani* @ 500 l/ha with irrigation at sowing, 21 and 45 DAS, 75% RDN + *sanjivak* @ 500 l/ha with irrigation at sowing, 21 and 45 DAS.

Results and Discussion

Effect on quality parameters

Protein content (%) and Gluten content (%) of wheat was not significantly influenced by various treatments. Numerically higher value (10.25%) of protein content and (28.35%) of gluten content of wheat was observed under 100% RDN + *panchagavya* as foliar spray @ 3% at 30, 45 and 60 DAS (T_2) (Table 1).

Effect on content and uptake of nutrients

Nitrogen and Phosphorus content (%) in grain and straw of wheat was not significantly influenced by various treatments. Numerically higher value of nitrogen content in grain (1.80%) and straw (0.630%) as well as phosphorus content in grain (0.408%) and straw (0.205%) of wheat was observed under 100% RDN + *panchagavya* as foliar spray @ 3% at 30, 45 and 60 DAS (T_2) (Table 1).

Table 1: Protein content, gluten content, nitrogen content and phosphorus content in grain and straw of wheat as influenced by various treatments

	Treatment	Protein content (%)	Gluten content (%)	Nitrogen content (%)		Phosphorus content (%)	
				Grain	Straw	Grain	Straw
T_1	100% RDN	9.88	27.25	1.73	0.600	0.388	0.200
T_2	100% RDN + *panchgavya* as foliar spray @ 3% at 30, 45 and 60 DAS	10.25	28.35	1.80	0.630	0.408	0.205
T_3	100% RDN + *jivamrut* @ 500 litre/ha with irrigation at sowing, 21 and 45 DAS	10.12	28.21	1.78	0.620	0.403	0.203
T_4	100% RDN + *amrutpani* @ 500 litre/ha with irrigation at sowing, 21 and 45 DAS	9.98	27.84	1.75	0.613	0.393	0.202
T_5	100% RDN + *sanjivak* @ 500 litre/ha with irrigation at sowing, 21 and 45 DAS	9.92	27.77	1.74	0.610	0.390	0.201
T_6	75% RDN + *panchgavya* as foliar spray @ 3% at 30, 45 and 60 DAS	9.80	26.61	1.72	0.580	0.385	0.196
T_7	75% RDN + *jivamrut* @ 500 litre/ha with irrigation at sowing, 21 and 45 DAS	9.66	26.55	1.70	0.568	0.378	0.193
T_8	75% RDN + *amrutpani* @ 500 litre/ha with irrigation at sowing, 21 and 45 DAS	9.56	26.08	1.68	0.565	0.371	0.191
T_9	75% RDN + *sanjivak* @ 500 litre/ha with irrigation at sowing, 21 and 45 DAS	9.52	26.00	1.67	0.563	0.367	0.190
	S.Em.±	0.25	1.00	0.04	0.022	0.014	0.005
	C.D.(P=0.05)	NS	NS	NS	NS	NS	NS
	C.V.%	5.13	7.37	5.13	7.41	7.03	4.74

Nitrogen uptake (kg/ha) and phosphorus uptake (kg/ha) by grain and straw

Data summarized in Table 2 indicated that nitrogen uptake by grain and straw of wheat was significantly affected by different treatments. Application of 100% RDN + *panchagavya* as foliar spray @ 3% at 30, 45 and 60 DAS (T_2) recorded significantly maximum nitrogen by grain (76.11 kg/ha) and straw (37.12 kg/ha) as well as phosphorus uptake by grain (17.28 kg/ha) and straw (12.06 kg/ha), and it remained at par with T_3, T_4, T_5 and T_1 for both N and P uptake by grain and straw (Fig 1 and 2). While lowest nitrogen uptake by grain (57.76 kg/ha) and straw (27.11 kg/ha) as well as phosphorus uptake by grain (12.73 kg/ha) and straw (9.21 kg/ha) were recorded in T_9 (75% RDN + *sanjivak* @ 500 litre/ha with irrigation at sowing, 21 and 45 DAS).

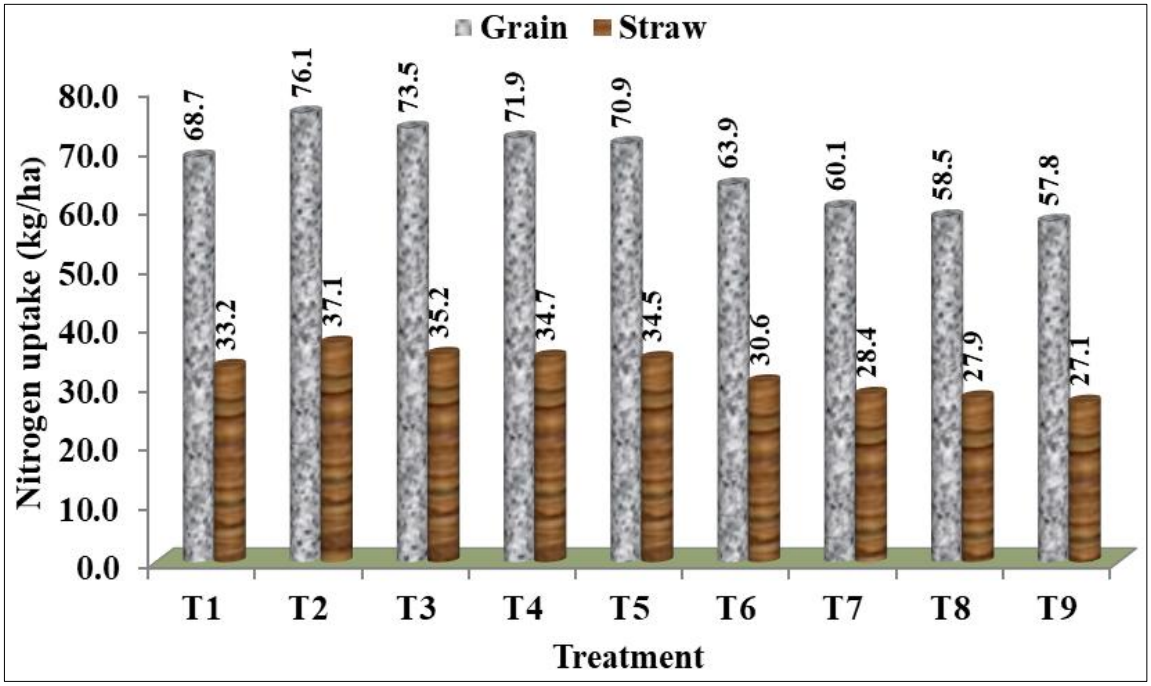

Fig 1: Nitrogen uptake by grain and straw of wheat as influenced by various treatments

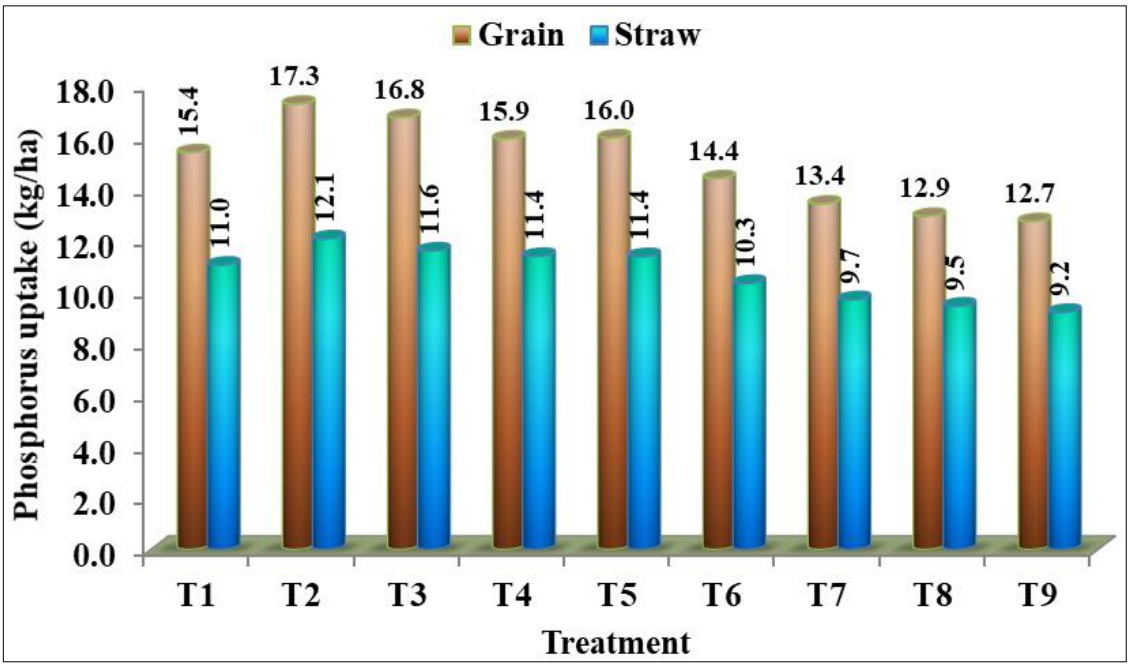

Fig 2: Phosphorus uptake by grain and straw of wheat as influenced by various treatments

Table 2: Nitrogen and phosphorus uptake by grain and straw of wheat as influenced by various treatments

	Treatment	Nitrogen uptake (kg/ha)		Phosphorus uptake (kg/ha)	
		Grain	Straw	Grain	Straw
T_1	100% RDN	68.67	33.17	15.40	11.04
T_2	100% RDN + *panchgavya* as foliar spray @ 3% at 30, 45 and 60 DAS	76.11	37.12	17.28	12.06
T_3	100% RDN + *jivamrut* @ 500 litre/ha with irrigation at sowing, 21 and 45 DAS	73.52	35.21	16.76	11.59
T_4	100% RDN + *amrutpani* @ 500 litre/ha with irrigation at sowing, 21 and 45 DAS	71.89	34.74	15.93	11.38
T_5	100% RDN + *sanjivak* @ 500 litre/ha with irrigation at sowing, 21 and 45 DAS	70.92	34.51	15.97	11.37
T_6	75% RDN + *panchgavya* as foliar spray @ 3% at 30, 45 and 60 DAS	63.94	30.56	14.39	10.33
T_7	75% RDN + *jivamrut* @ 500 litre/ha with irrigation at sowing, 21 and 45 DAS	60.13	28.44	13.41	9.70
T_8	75% RDN + *amrutpani* @ 500 litre/ha with irrigation at sowing, 21 and 45 DAS	58.53	27.85	12.93	9.45
T_9	75% RDN + *sanjivak* @ 500 litre/ha with irrigation at sowing, 21 and 45 DAS	57.76	27.11	12.73	9.21
	S.Em.±	4.03	2.11	0.98	0.59
	C.D.(P=0.05)	11.77	6.16	2.87	1.73
	C.V.%	12.07	13.15	13.15	11.12

This might be due to higher content of nitrogen and phosphorus in grain and straw (Table 2) as well as higher grain and straw yield. Nutrient accumulation in plants is a function of nutrient content and dry matter accumulation. The increase in supply of plant nutrients from foliar application of *panchagavya* provides nutrients in available form which might have increased the accumulation of dry matter concomitantly by affecting the ramification of roots favourably. The increased dry matter in above ground parts favours translocation of more carbohydrates towards developing roots. Similar findings have been reported by Choudhary *et al*. (2014) [3] and Gowthamchand *et al*. (2019) [4]. Application of *panchagavya* @ 4% + soil application of *jivamrut* @ 500 litre/ha at both the stages, *i.e*., at branching + flowering stages registered significantly higher uptake of N by kernel and haulm of groundnut (Patel *et al*., 2018) [5].

Effect on available nutrients in soil

The data indicated in Table 3 revealed that different treatments failed to produced their significant effect on organic carbon, available P_2O_5 and available K_2O in soil after harvest of wheat crop. However, numerically higher organic carbon, available P_2O_5 and available K_2O noted when crop furnished with 100% RDN + *jivamrut* @ 500 litre/ha with irrigation at sowing, 21 and 45 DAS (T_3).

Available nitrogen (kg/ha) status in soil at initial and after harvest as affected by various treatments in experiment was presented in Table 3 and graphically depicted in Figure 2. An appraisal of data presented in Table 3 revealed that significantly higher available nitrogen (167.8 kg/ha) in soil was found with treatment T_3 (100% RDN + *jivamrut* @ 500 litre/ha with irrigation at sowing, 21 and 45 DAS) but it was found statistically at par with treatments T_4, T_5, T_2 and T_1 which recorded the residual available nitrogen left in soil after harvest of wheat was 166.1, 165.7, 163.5 and 162.2 kg/ha, respectively. Higher available nitrogen content in soil after harvest of wheat crop due to increase in nutrient supply through *jivamrut* enhanced the root establishment, better absorption and translocation of nutrients from the soil, vigorous plant growth and higher grain and straw yield. These results are similar to those reported by Patel *et al.* (2018) [5].

Effect on microbial counts in soil

The data indicated in Table 3 revealed that different treatments failed to produced their significant effect on microbial counts in soil after harvest of wheat crop. The

population of beneficial bacteria (*Rhizobium* and PSB) was increased in all the treatments except in T_1 (100% RDN) over its initial population. The prevailing data indicated that treatment T_3 (100% RDN + *jivamrut* @ 500 litre/ha with irrigation at sowing, 21 and 45 DAS) registered higher microbial counts of *Azotobacter* (225 CFU x 10^4/g soil) and PSB (220 CFU x 10^4/g soil) than other treatments. Whereas, least count of microbial count of *Azotobacter* (192 CFU x 10^4/g soil) and PSB (187 CFU x 10^4/g soil) was observed with 100% RDN (T_1) treatment.

Table 3: Organic carbon, available N, P_2O_5, K_2O and Microbial counts after harvest of wheat as influenced by various treatments

Treatment		O. C. (%)	Available nutrients (kg/ha)			Microbial counts (CFU × 10^4/g soil)	
			N	P_2O_5	K_2O	*Azotobacter*	PSB
T_1	100% RDN	0.243	162.2	38.78	267.1	192	187
T_2	100% RDN + *panchgavya* as foliar spray @ 3% at 30, 45 and 60 DAS	0.245	163.5	38.98	266.7	202	202
T_3	100% RDN + *jivamrut* @ 500 litre/ha with irrigation at sowing, 21 and 45 DAS	0.250	167.8	40.18	268.6	225	220
T_4	100% RDN + *amrutpani* @ 500 litre/ha with irrigation at sowing, 21 and 45 DAS	0.249	166.1	39.95	268.1	223	217
T_5	100% RDN + *sanjivak* @ 500 litre/ha with irrigation at sowing, 21 and 45 DAS	0.248	165.7	39.75	268.0	222	215
T_6	75% RDN + *panchgavya* as foliar spray @ 3% at 30, 45 and 60 DAS	0.240	151.7	38.00	264.1	199	200
T_7	75% RDN + *jivamrut* @ 500 litre/ha with irrigation at sowing, 21 and 45 DAS	0.243	155.5	38.38	265.9	220	217
T_8	75% RDN + *amrutpani* @ 500 litre/ha with irrigation at sowing, 21 and 45 DAS	0.242	154.0	38.26	265.5	218	216
T_9	75% RDN + *sanjivak* @ 500 litre/ha with irrigation at sowing, 21 and 45 DAS	0.241	153.6	38.20	265.4	217	214
	S.Em.±	0.009	4.01	1.45	7.40	7.84	7.45
	C.D.(P=0.05)	NS	11.69	NS	NS	NS	NS
	C.V.%	7.46	5.01	7.44	5.56	7.36	11.89
	Initial	0.240	158.3	38.20	270.4	194	190

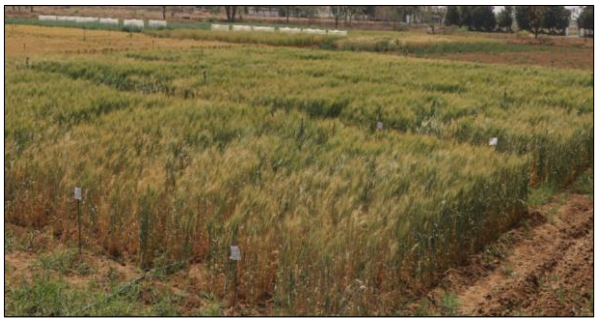

Fig 3: General view of field experiment

Conclusion

From the results of one year of experimentation, it is concluded that late sown wheat should be fertilized with 75% recommended dose of nitrogen (60 kg N/ha) with *panchgavya* as foliar spray @ 3% at 30, 45 and 60 DAS along with 40 kg P_2O_5 to obtain higher yield with 25% saving of nitrogen.

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