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RESIDUAL IMPACT OF IRRIGATION SCHEDULING THROUGH CLIMATOLOGICAL APPROACH AND N MANAGEMENT THROUGH DIFFERENT SOURCES ON SOIL FERTILITY IN SUMMER GREEN GRAM

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ABSTRACT

An experiment was carried out during *summer* seasons of 2020-21 and 2021-22 at Agronomy Farm, Anand Agricultural University, Anand, Gujarat. Experiment was executed in split-split plot design with treatments replicated thrice. Results revealed that soil parameters such as electric conductivity, pH, organic carbon, soil available nitrogen, phosphorus, available potassium, microbial count in soil after harvest of green gram were varied by residual IW/CPE based irrigation scheduling treatments and nitrogen management treatments. Among treatments of residual nitrogen management, 100% RDN from vermicompost had significant influence on soil available nitrogen, phosphorus and potassium, microbial count and organic carbon. The same parameters were enhanced by 100% RDN in greengram over no RDN. There was highly positive correlation between microbial count with available nitrogen content in soil (80.13%, 92.28% and 90.3% during first year, second year, on pooled analysis, respectively). Thus, optimizing irrigation scheduling and adopting balanced nitrogen management practices will help to enhance soil fertility maintain soil health further to sustainable production in long run.

Key words : Irrigation, Nitrogen management, Mustard, 0.8 IW/CPE ratio, Soil fertility, RDN, Vermicompost.

Introduction

Agricultural productivity is closely tied to effective water and nutrient management, particularly in regions with limited water resources. A climatological approach to irrigation scheduling involves adjusting water application based on specific climatic conditions, thereby optimizing water use efficiency and improving crop yield. Investigating the impact of this approach on *rabi* crops provides valuable insights into resource management policies that can benefit farmers mitigate water stress and enhance productivity. Nitrogen is a essential nutrient for plant growth, and its availability plays a significant role in determining crop yield. This study will examine the effects of nitrogen management using various sources, including organic and inorganic fertilizers, on *rabi* crops (Bisht *et al.*, 2018). Understanding the comparative effectiveness of these sources in terms for nutrient uptake, crop development, and yield will help farmers make better decisions about nitrogen inputs. Addressing water scarcity and maximizing the efficient use of nitrogen are essential for sustainable agriculture (Rana *et al.*, 2019). Furthermore, the inclusion of the residual effects on summer greengram cultivation expands the scope of the research, emphasizing the importance of crop rotations and the long-term consequences of current agricultural practices. Understanding how irrigation and nitrogen management in mustard crops affect subsequent crops is crucial not only for immediate productivity but also for the long-term health and sustainability of the farming system. This research will explore the combined effects of climatological-based irrigation scheduling & nitrogen management from diverse sources on mustard crops. Additionally, it will investigate the residual impact of these practices on the subsequent cultivation of summer greengram, examining how they influence soil health, nutrient availability and overall crop performance in the following season.

Materials and Methods

An experiment was conducted at the Agronomy Farm, B A College of Agriculture, AAU, Anand, Gujarat, during the *Rabi* and summer seasons of 2020-21 and 2021-22. Anand has a semi-arid, sub-tropical climate with hot summers and cool winters. The experimental field soil was loamy sand, low in organic carbon and available nitrogen, medium in available phosphorus, and high in available potassium, with a pH of 7.84. The experiment conducted in split-split plot design with 30 treatment combinations. Three residual irrigation levels (0.6, 0.8, and 1.0 IW/CPE ratio) were applied as main plots, and five residual nitrogen management treatments (ranging from 100% RDN from chemical fertilizer to combinations of chemical fertilizer, vermicompost and Bio NPK Consortium) were applied in sub-plots and two fertilizer treatments (No RDF and 100% RDF) as sub-sub plot treatments. The experiment used a mustard-green gram cropping system, with summer green gram sown after mustard harvest. The design included three replications, with treatments carried forward from mustard cultivation, incorporating two levels of RDF as a third factor. In total, 30 treatment combinations were tested. Fertilizers were applied according to the treatments in both mustard and summer green gram crops, following standard agronomic practices.

Chemical analysis of soil

Soil samples were taken from the 0-15 cm depth of the experimental site both before sowing and immediately after harvest. The samples were air-dried, ground, and passed through a 2.0 mm sieve for the analysis of physico-chemical properties using standard methods. Soil organic carbon was determined using the Wet Oxidation method of Walkley and Black (1934), and the value was calculated using the following formula:

$$\% \text{ of organic carbon in soil} = \frac{10\,(\text{B-T})}{\text{B}} \times \frac{0.003 \times 100}{\text{Wt. of the soil (g)}}$$

Where, B = Reading of blank sample

T = Reading of test sample

Available N in soil sample was determined by alkaline potassium permanganate method (Subbaiah and Asija, 1956) using formula

$$\text{Available N} = \frac{(\text{R-B}) \times 0.014 \times \text{Normality of } H_2SO_4 \times 100}{\text{Wt. of the soil (g)}}$$

Where, R = Reading of blank sample

B = Reading of test sample

Available phosphorus in the soil was estimated using Olsen's method (1954) with a spectrophotometer. The phosphorus content in the soil samples was calculated using the following formula:

$$\text{Available P} = \frac{\text{R} \times \text{Volume of extract}}{\text{Volume of aliquot}} \times \frac{2.24 \times 10^6}{\text{Wt. of the sample} \times 10^6}$$

Available potassium was estimated by flame photometry method (Jackson, 1973)

Biological analysis of soil

Colony forming unit (CFU) of soil sample by serial dilution method

Soil samples were taken separately from each plot before sowing and at harvest, then stored in polythene bags at 4°C until processing. Microbial counts were estimated using the serial dilution technique (Dhingra and Sinclair, 1993). The samples were serially diluted, and aliquots of the appropriate dilutions were spread on nutrient agar (NA) plates. These plates were incubated at 30-35°C for 2-3 days. After incubation, colonies were counted with colony counter and the total microbial count was calculated using the following formula:

$$\text{Final count (cfu/g)} = \frac{\text{Number of well isolated colonies} \times \text{Dilution factor}}{\text{Aliquot taken}}$$

Statistical analysis

The data on various aspects of mustard were analyzed statistically using the split-plot design procedure outlined by Cochran and Cox (1957). Statistical analysis was performed by SAS software to determine significant differences between treatments. The "F-test" was applied, and results were compared against the critical value from the F-distribution table at the 5% significance level.

Results and Discussion

Available nitrogen

After harvest of summer green gram, the available nitrogen (N) in soil varied from 231 to 239 kg/ha (pooled values) across three irrigation scheduling treatments (Table 1). The enhance in available N from the initial levels was 24.9%, 27.1%, and 29.2% for treatments I1, I2 and I3, respectively. Available N was significantly

Table 1 : Soil available N, available P & available potassium in soil after harvest of summer green gram as influenced by different treatments.

Treatment	Available N (kg/ha)			Available P (kg/ha)			Available potassium (kg/ha)		
	2020	2021	Pooled	2020	2021	Pooled	2020	2021	Pooled
Initial	185			38.40			287		
(A) Main plot treatment: Irrigation levels (I)									
I_1:	217	245	231	36.80	37.96	37.38	285	288	286
I_2:	221	249	235	38.27	39.31	38.74	289	292	291
I_3:	224	254	239	40.37	41.47	40.92	294	297	295
SEm ±	4	4.55	3.00	0.71	0.74	0.51	5	6	4
CD (P=0.05)	NS	NS	NS	NS	NS	1.48	NS	NS	NS
(B) Sub plot treatment: Nitrogen management (N)									
N_1:	209	235	222	37.05	38.16	37.60	275	280	277
N_2:	227	259	242	40.58	41.82	41.20	299	300	300
N_3:	219	245	233	37.29	38.38	37.84	285	289	287
N_4:	226	255	241	39.20	40.31	39.76	296	297	296
N_5:	224	252	238	38.12	39.23	38.68	292	295	293
SEm ±	4	5	4	0.55	0.57	0.39	5	6	4
CD (P=0.05)	13	15	9	1.61	1.65	1.12	19	NS	11
C) Sub plot: RDF levels (F)									
F_1 :	218	246	232	36.90	38.01	37.46	286	285	286
F_2:	224	253	238	39.99	41.15	40.57	293	299	296
SEm±	2	2.97	1.78	0.63	0.66	0.46	3	2	2
CD (P=0.05)	NS	NS	5.05	1.82	1.92	1.30	NS	8	6
Significant interaction	N x F	NS	N x F, I x N x F	NS	NS	I x N, I x N x F	NS	NS	I x N x F

I_1-0.6 IW: CPE, I_2- 0.8 IW: CPE, I_3-1.0 IW: CPE, N_1:100% RDN through chemical fertilizer, N_2:100% RDN through vermicompost, N_3: 75% RDN through chemical fertilizer + 25% RDN through vermicompost, N_4: 50% RDN through chemical fertilizer + 50% RDN through vermicompost, N_5: 25% RDN through chemical fertilizer + 50% RDN through vermicompost + Bio NPK Consortium @ 1.0 lit/ha. F_1: No RDF, F_2: 100% RDF.

influenced by the residual effects of nitrogen treatments. The highest available N was recorded with 100% RDN through vermicompost, with values 227, 259 and 242 kg/ha for individual years and the pooled data. This was significantly higher than other treatments except N1. In contrast, the lowest available N was observed under treatment N1 in all years and in the pooled analysis. The rise in available N under N2 likely resulted from the vermicompost application, which enhanced nitrogen mineralization and microbial activity, converting organically bound nitrogen to available form. These findings align with Mitra and Mandal (2012) in a mustard-green gram cropping- sequence. In pooled analysis, significantly the highest available N (238 kg/ha) was recorded under treatment F2 (100% RDF). This increase is due to the addition of both inorganic & organic manures, which improved nutrient use efficiency. This result align with the findings of Gorade *et al*. (2014), Patel *et al*. (2016), and Barkha *et al*. (2020).

There was a significant impact of treatment combinations on available N in soil after harvest, particularly during the first year and in the pooled analysis (Table 1a). The highest available N was observed under treatment combination N4F2 (50% RDN with chemical fertilizer + 50% RDN through vermicompost + 100% RDF), while the lowest was found under N1F1. Interaction effects between residual irrigation scheduling, nitrogen management, and direct fertilizer treatments on available N were significant in the first year and pooled analysis (Table 1b and c). The highest available N (233 and 249 kg/ha) was recorded under treatment combination I3N4F2, while the lowest (183 and 213 kg/ha) was observed under I1N1F1 in both the first year and pooled data.

Available Phosphorus

The available phosphorus (P) in soil after harvest varied from 37.38 to 40.92 kg/ha across the irrigation treatments (Table 1). Significant variation in available phosphorus was observed due to the residual effects of nitrogen management, both during individual years & in the pooled analysis. The highest available phosphorus (40.58, 41.82 and 41.20 kg/ha) was recorded under treatment N2 during the individual years and the pooled data. This was significantly greater than other treatments, except for N4, which showed similar results in individual years. The lowest available phosphorus was shown by treatment N1 in all years and in the pooled analysis. The phosphorus availability increased by 7.3% in the highest treatment compared to initial soil phosphorus levels. Vermicompost application is thought to enhance microbial activity, which stimulates the conversion of phosphorus which is unavailable into an available form by improve of soil physicochemical properties. The increase in available phosphorus by combined use of organic materials can be ascribed to the release of organic acids through decomposition. These acids solubilize native phosphorus, aiding in its release. Organic matter acts as coating on sesquioxides, making them inactive & reducing the soil's phosphate-fixing capacity, which ultimately facilitates release of more plant-available phosphorus. These findings remain consistent with work of Mitra and Mandal (2012) in a mustard-green gram cropping sequence. Available phosphorus was also significantly influenced with direct fertilizer treatments, both during individual years and on the pooled basis. The highest available

Table 1a : Interaction effect of residual nitrogen management and direct fertilizer treatment on available N in soil after harvest of summer green gram during 2020 and pooled basis.

2020	**Available N (kg/ha)**				
	Nitrogen management (N)				
Fertilizer treatment (F)	**N_1**	**N_2**	**N_3**	**N_4**	**N_5**
F_1	196	227	218	226	223
F_2	222	224	220	227	225
SEm±	4.38				
CD (P=0.05)	5.65				
Pooled	**Available N (kg/ha)**				
	Nitrogen management (N)				
Fertilizer treatment (F)	**N_1**	**N_2**	**N_3**	**N_4**	**N_5**
F_1	210	243	231	240	237
F_2	234	241	233	242	239
SEm ±	4				
CD (P=0.05)	11				

Table 1b : Interaction effect of residual irrigation and nitrogen management and direct fertilizer treatment on available N in soil after harvest of summer green gram during 2020.

Irrigation treatment	**Available N (kg/ha)**									
	Nitrogen management (N) x Fertilizer treatment (F)									
	N_1F_1	**N_1F_2**	**N_2F_1**	**N_2F_2**	**N_3F_1**	**N_3F_2**	**N_4F_1**	**N_4F_2**	**N_5F_1**	**N_5F_2**
I_1	183	203	228	230	213	215	220	222	218	220
I_2	205	207	233	232	217	219	224	226	222	224
I_3	201	255	221	209	225	230	232	233	229	230
SEm ±	4.38									
CD (P=0.05)	13.01									

Table 1c : Interaction effect of residual irrigation, nitrogen management & direct fertilizer treatment on available N in soil after harvest of summer green gram during pooled basis.

Fertilizer treatment (F)	Available N (kg/ha)														
	Irrigation levels (I) x Nitrogen management (N)														
	I_1N_1	I_1N_2	I_1N_3	I_1N_4	I_1N_5	I_2N_1	I_2N_2	I_2N_3	I_2N_4	I_2N_5	I_3N_1	I_3N_2	I_3N_3	I_3N_4	I_3N_5
F_1	213	245	226	235	231	218	249	230	239	236	198	236	237	246	243
F_2	214	247	228	237	234	218	251	232	241	238	271	228	240	249	246
SEm±	7														
CD (P=0.05)	20														

Table 1d : Interaction effect of residual irrigation scheduling & nitrogen management on available phosphorus (kg/ha) in soil after harvest of summer green gram on pooled basis.

Irrigation levels (I)	Available phosphorus				
	Nitrogen management (N)				
	N_1	N_2	N_3	N_4	N_5
I_1	35.28	41.39	35.58	36.65	37.99
I_2	37.91	40.75	37.76	39.43	37.86
I_3	39.62	41.46	40.17	43.18	40.18
SEm±	0.68				
CD (P=0.05)	1.94				

Table 1e : Interaction effect of residual irrigation scheduling, nitrogen management and direct fertilizer treatment on available phosphorus (kg/ha) in soil after harvest of summer green gram on pooled basis.

Fertilizer treatment (F)	Available phosphorus														
	Irrigation levels (I) x Nitrogen management (N)														
	I_1N_1	I_1N_2	I_1N_3	I_1N_4	I_1N_5	I_2N_1	I_2N_2	I_2N_3	I_2N_4	I_2N_5	I_3N_1	I_3N_2	I_3N_3	I_3N_4	I_3N_5
F_1	34.15	36.83	34.32	36.50	36.28	36.70	34.60	36.67	38.08	39.00	38.32	41.85	38.85	40.23	39.48
F_2	36.42	45.95	36.85	36.80	39.70	39.12	46.90	38.85	40.78	36.71	40.92	41.07	41.50	46.13	40.87
SEm ±	1.78														
CD (P=0.05)	5.02														

phosphorus of 40, 41.2 and 40.6 kg/ha was recorded with 100% RDF. This increase can be the effect of addition of both inorganic fertilizers and residual vermicompost, which improved nutrient efficiency and resulted in higher available phosphorus in the soil. These results are in agree with the findings by Gorade *et al.* (2014), Patel *et al.* (2016) and Barkha et al. (2020).

Significant effects of different combinations treatment on available phosphorus were observed on the pooled basis (Table 1d). Available phosphorus was significantly influenced by the residual effects of irrigation scheduling and nitrogen management treatments. The highest available phosphorus (43.18 kg/ha) was observed under the treatment combination I3N4, while the lowest (35.28 kg/ha) was recorded with 0.6 IW:CPE ratio and No RDF in the pooled data. Additionally, the interaction between residual irrigation scheduling, nitrogen management, and direct fertilizer treatments had significant effect on available phosphorus (Table 1e). The highest available phosphorus was observed under treatment combination I2N2F2 was recorded under I1N1F1.

Available Potassium (kg/ha)

Residual nitrogen management had statistically significant impact on available potassium in soil after harvest, particularly during the first year and on the pooled basis (Table 1). The highest available potassium (299 and 300 kg/ha) was observed in treatment with 100% RDN

Table 1f : Interaction effect of residual irrigation scheduling and nitrogen management and direct fertilizer treatment on available potassium of summer green gram on pooled basis.

Fertilizer treatment (F)	Available potassium (kg/ha)														
	Irrigation levels (I) x Nitrogen management (N)														
	I_1N_1	I_1N_2	I_1N_3	I_1N_4	I_1N_5	I_2N_1	I_2N_2	I_2N_3	I_2N_4	I_2N_5	I_3N_1	I_3N_2	I_3N_3	I_3N_4	I_3N_5
F_1	267	299	279	288	285	271	304	283	292	289	253	289	290	298	296
F_2	269	306	285	294	291	273	311	289	299	295	229	332	297	307	304
SEm±	8.0														
CD (P=0.05)	22.6														

from vermicompost during the first year and on the pooled basis, respectively. This treatment showed significantly higher potassium levels, though it remained comparable with all treatments except N1. In the pooled analysis, treatment N2 was comparable to treatments N4 & N5. Conversely, the lowest available potassium levels were observed with treatment N1 during the individual years and on the pooled basis. A 4.5% increase in available potassium was observed in the highest treatment compared to the initial status. The increased potassium availability in the N2 treatment was attributed to enhanced mineralization after the mustard crop. Potassium is recognized for being excessively absorbed by crop beyond their normal requirement, leading to negative nutrient balance. The decomposition of mustard contributed to the increase in available potassium in the soil, both due to the direct addition from decomposed mustard and the higher nutrient release during the decomposition process. These results align with reports from Mitra and Mandal (2012) in a mustard-green gram cropping- sequence. Direct fertilizer treatments showed significant effect on available potassium in the soil after the second year and in the pooled analysis. The highest available potassium was recorded under treatment with 100% RDF during the second year & on the pooled basis, respectively. These results remain consistent with the conclusions of Gorade *et al.* (2014) and Barkha *et al.* (2020).

Additionally, significant outcome of residual irrigation scheduling, nitrogen management, & direct fertilizer treatments for available potassium was observed on a pooled basis (Table 1f). The interaction effect between residual irrigation scheduling, nitrogen management, and direct fertilizer treatments was also significant on the pooled basis (Table). The highest available potassium was observed under the treatment combination I3N2F2. In contrast, the lowest available potassium was found under the treatment combination I1N1F1.

Organic carbon

The soil organic values somewhat increased due to nutrient management practices in second year of experimentation as compared to first year and to intial values. Among, Nitrogen management treatments. About 5.88% hike in soil organic carbon was orded by application of vermicompost. The vermicompost enhanced soil organic matter, microbial activity ther by biomass in the soil further enhancing soil organic carbon. The findings of Gour *et al*. (2017), Konsotia *et al*. (2015) and Manojkumar *et al.* (2018) showed that vermicompost helped in enhancing soil organic carbon than chemical fertilization.

Microbial Count (x10^7 cfu/g)

In the pooled analysis, significantly highest microbial counts in soil after harvest (118 x 10^7 cfu/g) were recorded with treatment I3 (1.0 IW:CPE ratio) (Table 2). The lowest microbial count (111 x 10^7 cfu/g) was observed under treatment I1 (0.6 IW:CPE ratio). In the second year and pooled analysis, significantly higher microbial counts (123 and 119 x 10^7 cfu/g) were recorded with residual effect of 100% RDN from vermicompost, which was comparable to treatments N4 and N5. The microbial population increased by 14.4% over the initial status with vermicompost application. Lowest microbial count (109 and 108 x 10^7 cfu/g) was recorded under treatment N1 during the second year and on the pooled basis, respectively. The data also revealed that direct fertilizer treatments significantly influenced microbial count during the first year and on the pooled basis. Significantly higher microbial counts (114 and 116 x 10^7 cfu/g) were shown under treatment 100% RDF.

Treatment combinations significantly affected microbial count during individual years and on the pooled basis (Table 2a, b and c). The microbial count was significantly influenced by the residual effects of irrigation scheduling & nitrogen management during the first year and on the pooled basis. The highest microbial count in

Table 2 : OC and microbial count in soil after harvest of summer green gram as influenced by different treatments.

Treatment	OC (%)			Microbial count (x 107 cfu/g)		
	2020	2021	Pooled	2020	2021	Pooled
Initial	0.34			104		
(A) Main plot treatment: Irrigation levels (I)						
I_1:	0.34	0.36	0.35	109	113	111
I_2:	0.34	0.36	0.35	112	115	113
I_3:	0.35	0.37	0.36	116	120	118
SEm±	0.005	0.006	0.004	1.95	2.10	1.43
CD (P=0.05)	NS	NS	NS	NS	NS	4.13
(B) Sub plot treatment: Nitrogen management (N)						
N_1:	0.34	0.36	0.35	106	109	108
N_2:	0.35	0.37	0.36	115	123	119
$N_{3:}$	0.34	0.36	0.35	112	112	112
N_4:	0.35	0.37	0.36	112	119	116
N_5:	0.34	0.36	0.35	115	116	116
SEm±	0.006	0.007	0.005	2.16	2.30	1.58
CD (P=0.05)	NS	NS	NS	NS	6.71	4.49
C) Sub sub plot: RDF levels (F)						
F_1 :	0.344	0.36	0.35	111	114	112
F_2:	0.344	0.36	0.35	114	117	116
SEm±	0.003	0.004	0.003	1.13	1.16	0.81
CD (P=0.05)	NS	NS	NS	3.28	NS	2.3
Significant interaction	NS	NS	NS	I x N	I x N x F	I x N, I x N x F

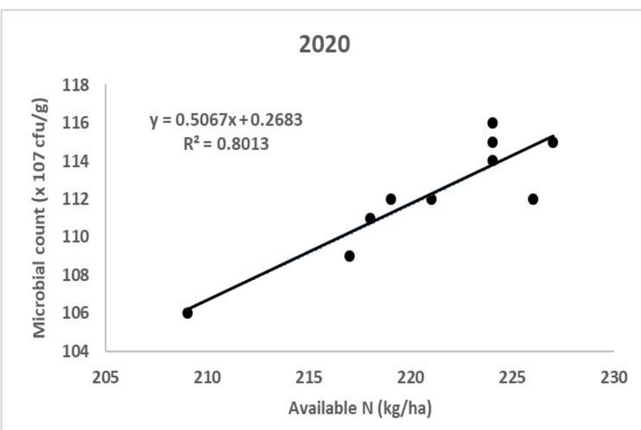

Fig. 1a : Correlation soil available N with microbial count due to different treatments during 2020.

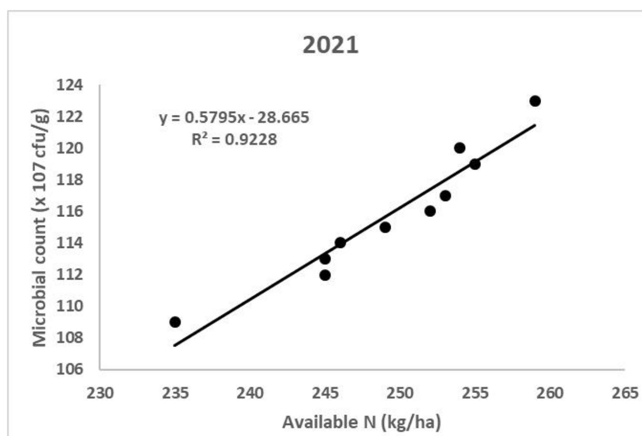

Fig. 1b : Correlation soil available N with microbial count due to different treatments during 2021.

soil after harvest (121 and 119 x 10^7 cfu/g) was observed under the treatment combination I3N4. The lowest microbial count (96 and 97 x 10^7 cfu/g) was recorded under the treatment combination I1N1 (0.6 IW:CPE ratio + No RDF) on the pooled basis.

The interaction effects between residual irrigation scheduling, nitrogen management and direct fertilizer treatments for microbial count were significant during

Table 2a : Interaction effect of residual irrigation & nitrogen management and direct fertilizer treatment on microbial count (x 10^7 cfu/g) in soil after harvest of summer green gram during 2020 and pooled basis.

2020	**Microbial count (x 10^7 cfu/g)**				
	Nitrogen management (N)				
Irrigation levels (I)	**N_1**	**N_2**	**N_3**	**N_4**	**N_5**
I_1	96	117	114	102	116
I_2	110	112	109	116	112
I_3	114	117	113	121	116
SEm ±	4				
CD (P=0.05)	11				
Pooled	**Microbial count (x 10^7 cfu/g)**				
	Nitrogen management (N)				
Irrigation levels (I)	N_1	N_2	N_3	N_4	N_5
I_1	97	120	113	111	112
I_2	111	116	109	116	116
I_3	117	118	113	119	117
SEm±	3				
CD (P=0.05)	8				

Table 2b : Interaction effect of residual irrigation and nitrogen management and direct fertilizer treatment on microbial count (x 10^7 cfu/g) in soil after harvest of summer green gram during 2021.

Irrigation treatment	**Nitrogen management (N) x Fertilizer treatment (F)**									
	N_1F_1	**N_1F_2**	**N_2F_1**	**N_2F_2**	**N_3F_1**	**N_3F_2**	**N_4F_1**	**N_4F_2**	**N_5F_1**	**N_5F_2**
I_1	89	110	121	128	109	117	116	124	99	115
I_2	114	110	119	120	108	111	114	117	116	122
I_3	120	114	123	126	116	115	118	122	120	120
SEm±	3									
CD (P=0.05)	9									

Table 2c : Interaction effect of residual irrigation scheduling and nitrogen management and direct fertilizer treatment on microbial count of summer green gram on pooled basis.

Fertilizer treatment (F)	**Microbial count (x 10^7 cfu/g)**														
	Irrigation levels (I) x Nitrogen management (N)														
	I_1N_1	**I_1N_2**	**I_1N_3**	**I_1N_4**	**I_1N_5**	**I_2N_1**	**I_2N_2**	**I_2N_3**	**I_2N_4**	**I_2N_5**	**I_3N_1**	**I_3N_2**	**I_3N_3**	**I_3N_4**	**I_3N_5**
F_1	87	117	110	113	114	113	115	107	114	113	112	114	111	118	117
F_2	108	124	117	109	110	109	112	110	117	118	114	122	115	112	113
SEm±	3														
CD (P=0.05)	9														

the second year and on the pooled basis. The highest microbial count (126 and 122 x 10^7 cfu/g) was observed under the treatment combination I3N2F2 during the second year and on the pooled basis, respectively. The lowest microbial count (89 and 87 x 10^7 cfu/g) was found by the treatment combination I1N1F1.

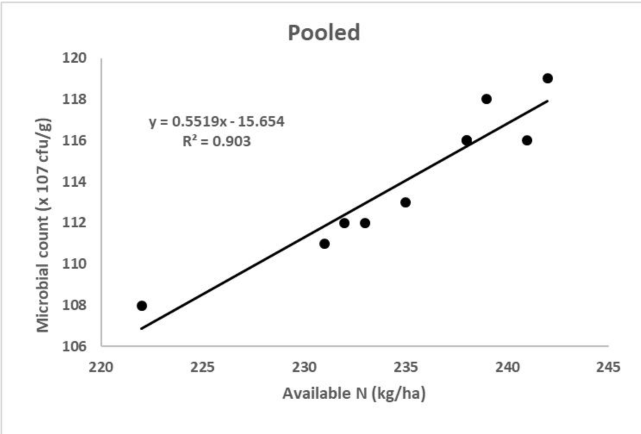

Fig. 1c : Correlation soil available N with microbial count due to different treatments (average values).

Correlation of soil available N with microbial count

Microbial count after the harvest of green gram was positively correlated with available nitrogen content in the soil. About 80.13%, 92.28% and 90.3% microbial population growth was dependant on soil available N during first year, second year, on an average basis respectively. (Fig. 1 a, b and c). Soil nitrogen acted as source to enhance nitrifying bacteria and even had enhanced other phosphorus and potassium solubilizing bacteria by influencing other soil chemical reactions. The significant influence of vermicompost on microbial count was due to the adequate nutrient supply in crop root zone. The higher availability of the nutrients in crop root zone coupled increased metabolic activity at cellular levels hence enhanced microbial population in soil (Sharma *et al.*, 2017) and also due to higher by mass produced as litter fall of mustard crop throughout growth period which acts as source to soil microfauna.

The residual effect of nitrogen treatments, particularly 100% RDN through vermicompost, significantly improved soil organic carbon, available nitrogen, phosphorus, potassium and microbial activity. The immediate impact of 100% RDF was observed in enhanced soil chemical properties. Over the long term, the residual effect of vermicompost plays a crucial role in sustaining and improving soil fertility and productivity in cropping systems. The treatments applied during the preceding crop are key to maintaining soil fertility and productivity. Therefore, applying vermicompost in rabi mustard crop can help to achieve higher yields in green gram, even without additional fertilizers, resulting in better yields compared to traditional summer-grown green gram in semi-arid regions.

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