

Original Research Article**Impact of Vermi-compost and Hydrogel (Pusa) on Soil Dynamics, Nutrient uptake & Water Productivity of through Wheat Crop****Abstract**

A field experiment was conducted during winter (*Rabi*) season of 2015-16 and 2016-17 at the Crop Research Centre of the Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut, Uttar Pradesh, India to study the Impact of different irrigation levels and moisture conservation practices on wheat crop. Three irrigation levels were three viz., I₁ (at CRI stage), I₂ (at CRI, Booting and Milking) and I₃ (at CRI, Late tillering, Late jointing, Flowering and Milking stage) and moisture conservation practices (Application of pusa hydrogel @ 5 kg/ha, Vermi-compost @ 1t/ha, pusa hydrogel @ 5 kg/ha+Vermicompost @ 1t/ha and no application) were tested in split plot design (SPD) with three replications. Results revealed that the highest total nitrogen (105.22 and 97.48 kg/ha), phosphorus (23.05 and 20.94 kg/ha) and potassium (141.96 and 138.41kg/ha) uptake was recorded with five irrigations followed by three irrigations during first and second years, respectively. Besides, this treatment also gave highest nutrient uptake by crop along with maintaining the soil fertility and moisture status. Thus, in wheat application of 5 kg pusa hydrogel+1t Vermi-compost/ha with five irrigations (~~at CRI, Late tillering, Late jointing, Flowering and Milking stage~~) seems to more effective best under in the sandy loam soils of North Western Plain Zones of Western Uttar Pradesh.

Keywords: Soil nutrients, Moisture conservation, Vermi_compost, Pusa Hydrogel & Protein.

Introduction

Wheat (*Triticum aestivum L.*) is the most important cereal crop in the world. Wheat covered more land for cultivation as compare to the other crops worldwide than any other; it's

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Comment [CM1]: According to Zoehl, D. (2006). the term productivity is not appropriate and has to be reserved for genuine production factors such as labour, land and capital.

Zoehl, D. (2006). Is water productivity a useful concept in agricultural water management?. *Agricultural Water Management*, 84(3), 265-273.

Comment [CM2]:

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31 contribution to provide human diet for fulfill the demand of daily required protein and more
 32 calories than any other crops. The total area under wheat in the world was 216.64 million hectares
 33 with an annual production of 674.88 million tones and an average productivity of 3115 kg ha⁻¹
 34 (FAO- 2015). In India, wheat is the second most important food crop, next only to rice, with an
 35 area of 29.65 million hectares production of 92.46 million tones and the average productivity of
 36 3118 kg ha⁻¹ (Anonymous, 2015). It occupies 25 per cent of the area under food grains and
 37 contributes 36 per cent to the total food grain production of the country. Water is an important
 38 lifesaving natural resource for the crop. Due to improper irrigation in the country, it is important
 39 to increase irrigation efficiency and water productivity of crop and to exploit the existing water
 40 potential by reducing the losses of water ~~and also~~ and ensuring better atmospheric condition for
 41 crop growth. Super absorbent polymer has capability to store extra water in the soil that enables
 42 crops to utilize the water over an extended ~~period of time~~ period. Hydrogel (Super absorbent
 43 polymer) is a water retaining, cross-linked hydrophilic, biodegradable amorphous ~~polymer~~
 44 ~~which polymer, which~~ can absorb and retain water at least 400 times of its original weight and
 45 make at least 95 percent of stored water available for crop absorption (Johnson and Veltkamp,
 46 1985).

47 Hydrogel is three-dimensional, hydrophilic polymer, loosely cross-linked networks
 48 capable of imbibing large amounts of water or biological fluids. These synthetic polymers found
 49 in form of crystals and available under several trade names viz., Super Absorbent, Pusa Hydrogel
 50 ~~etc.~~, are collectively called hydrogel. "Pusa Hydrogel" ~~is~~ is a novel semi-synthetic super
 51 absorbent polymer developed by the Indian Agricultural Research Institute (IARI) has shown the
 52 potential to realize more yield per unit of input. This product displayed a swelling potential of
 53 minimum 350 times, often exceeding 500 times its weight in pure water. Notably, its swelling

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54 | ratio increased with the rise in temperature up to 50 °C, without any adverse effect on the
 55 | polymer matrix structure. It enhances the crop productivity per unit available water and nutrients,
 56 | particularly in moisture stress condition. It improves physical properties of soil, seed
 57 | germination, seedling emergence rate, root growth and density that help plants to prolonged
 58 | moisture stress (**Ekebafeet et al., 2011**). Hydrogel reduces the leaching of herbicide, fertilizer and
 59 | requirements of irrigation for crops. Applications of Hydrogel in the soil forms an amorphous
 60 | gelatinous mass on hydration and is capable of absorption and desorption over a long period
 61 | of timeperiod, hence acts as a slow-release source of water in soil. However, Hydrogel particles
 62 | may be taken as “miniature water reservoir” in the soil and water will be removed from these
 63 | reservoirs upon the root demand through osmotic pressuredifference.

64 | Vermicompost (VC) which is produced by the fragmentation of organic wastes by
 65 | earthworms, it contains nutrients in forms that are readily available for plant uptake (**Atiyeh et**
 66 | **al., 2002**). There is good evidence that VC application promotes growth of plants, and it has been
 67 | found to have a positive effect on growth and productivity of cereals and legumes. There is an
 68 | increasing interest in the potential use of VC as soil amendment, where the addition of VC
 69 | improves the soil physical and chemical properties (Arancon et al., 2006; ~~and~~ Edwards and
 70 | Burrows, 1988). Integration of organic and inorganic fertilizers is being advocated as one of the
 71 | strategic solutions to maintain soil fertility and to increase production in Ethiopia and has been
 72 | highly emphasized for the Growth and Transformation Plan (GTP), in which the Agricultural
 73 | Growth Program (AGP) is an essential component (**Gezahegn et al., 2014**). This is because the
 74 | carbon pool of most Ethiopian soils has been depleted due to continuous cultivation and removal
 75 | of crop residues from crop fields as well as little addition of manures to the land (**Girmay et al.,**
 76 | **2008**). In this regard, vermicompost VC is a potential organic nutrient source which source.

Comment [CM6]: Missing Reference

77 | [which](#) provides additional plant nutrients that are not found in chemical NP fertilizers. **Simsek-**
 78 | **Ersahin (2011)** revealed that vermi compost was ~~ere~~ effective organic fertilizers and bio-control
 79 | agents ~~that's that is~~ improved food quality, increases soil porosity, aeration and water holding
 80 | capacity and thus increases the surface area, provides strong absorbability and retention of
 81 | nutrients for a longer period of time. Manure, compost or ~~vermi-compost~~ [VC](#) applications
 82 | increase the contents of organic C, P and N in the soil. The soil pH decreases slightly, and the
 83 | electrical conductivity increases without salinity effect. The information on the above study is
 84 | meager and fragmented under this region, thus the investigation is planned and executed in
 85 | western [U.P.](#) conditions.

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86 | **Materials and Methods**

87 | The experiment was carried out in pots at [the](#) Crop Research Centre, Sardar Vallabhbhai
 88 | Patel University of Agriculture and Technology, Meerut (U.P.), ~~having semi-arid to sub-tropical~~
 89 | ~~climate and~~ geographically situated at a latitude of 29° 40' North, longitude of 77° 42' East with
 90 | an altitude of 237 meters above mean sea level.

91 | **Climate and Weather**

92 | The climate of this region is ~~semi-arid and sub-tropical with extreme hot weather in~~
 93 | ~~summer~~ [semi-arid, sub-tropical with extreme hot weather in summer](#) and cold in [the](#) winter
 94 | season. There is a gradual decrease in mean daily temperature in December reaching as low as
 95 | 3.2 °C and further a gradual increase is registered reaching as high as 45.0 °C in the month of
 96 | May. Occasionally, frost does occur during the months of December and January. The total
 97 | annual rainfall of the region is about 665 & 787mm. Winter ~~showers-precipitations~~ sometimes
 98 | are accompanied by high wind velocity and hail storms. Mean relative humidity is found to be
 99 | maximum in August and minimum in May.

100 | The mean data ~~on~~ weekly weather such as rainfall, temperature, wind velocity and
 101 | relative humidity for the crop period of 2015-16 & 2016-17 was recorded from the
 102 | Meteorological observatory in the University. However, daily pan evaporation and Sun shine
 103 | duration have been collected from Indian Institute of Farming Systems Research (IIFSR), ICAR
 104 | Modipuram Meerut.

105 | During ~~the crop development period~~ the minimum mean temperature was recorded
 106 | 4.8°C in the 4th week of January in 2015-16 ~~and~~ 4.3°C in the 2nd week of January in 2016-17.
 107 | The mean maximum temperature was recorded (40.2°C) in the 3rd week of April in 2015-16 and
 108 | ~~40.3°C~~ in the 3rd week of April in 2016-17 (40.3°C). ~~During crop period~~ A minimum mean
 109 | evaporation was recorded (0.7 mm) in the 4th week of January and maximum (10.6 mm) was
 110 | recorded ~~o~~ in the 4th week of April in 2014-15 and minimum mean evaporation was recorded (1.2
 111 | mm) in the 1st week of January and maximum (42.3 mm) was recorded ~~o~~ in the 4th week of April
 112 | in 2016-17. The total rainfall 38.7 and 123.3 mm was received during ~~the~~ crop period 2015-16
 113 | and 2016-17, respectively. The minimum mean Humidity was recorded 21.4 % in the 4th week of
 114 | April in 2015-16 and 18.5 % in the 1st week of May in 2016-17. The maximum Humidity mean
 115 | was recorded 99.2% in the 4th week of January in 2015-16 and 97.7% in the 4th week of April in
 116 | 2016-17.

117 | **Soil of the Experiment Field**

118 | The sampling of soil was done to a depth of 0-15 cm from 10 spots before sowing of
 119 | wheat crop in the research field. The samples collected were mixed homogenously, and a
 120 | composite soil sample was air dried, powdered and allowed to pass through (2 mm) sieve and
 121 | analysed ~~for~~ physico-chemical properties. The values obtained are ~~given shown~~ in Table -1. The

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122 soil of experimental site was sandy loam in texture, low in nitrogen and OC, medium in available
123 phosphorus, available potassium and alkaline in reaction.

124 **Soil analysis**

125 **Soil Moisture Content (%)**

126 Soil samples were drawn with the help of post auger from 0-15 and 15-30 cm of soil
127 depth. In all the treatments, soil samples for moisture determination were collected initially and
128 after harvest of the crop. We adopted [the](#) gravimetric method for determination of soil moisture
129 content and the average moisture percentage from different soil depths were used to calculate [the](#)
130 consumptive use of water and moisture productivity during twice the years.

131 **Organic Carbon (%)**

132 OC of the soil was estimated by the procedure given by Walkley and Black (1934) rapid
133 titration method ([Jackson, 1973](#)).

Comment [CM9]: Not listed in the References

134 **Available Nitrogen (kg ha⁻¹)**

135 Available N determined by alkaline potassium permanganate method given by
136 [Subbiah and Asija \(1956\)](#). In this method, OM in the soil is oxidized with [a](#) warm alkaline
137 KMnO₄ solution followed by release of ammonia which is distilled and trapped in boric acid
138 mixed indicator solution. The amount of NH₃ trapped is estimated by titrating with standard
139 acid. [A S](#)soil sample of 5g was taken and transferred to digestion tube. [The S](#)sample was
140 distilled with 0.32% KMnO₄ and 2.5% NaOH followed by heating of sample by passing
141 steady steam and collection of liberated NH₃ in [a](#) conical flask containing 20 ml of 2% boric
142 acid with mixed indicator. Colour changed from pink to green. Thereby, distillate was titrated
143 against 0.02 N H₂SO₄ and [the](#) colour changed to original pink.

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144 **Available Phosphorus (kg ha⁻¹)**

145 Before estimation of available phosphorous, the pH of soil sample was determined
 146 using the glass electrode pH meter. The pH of soil sample was 7.9 alkaline ranges, so 0.5M
 147 NaHCO₃ extractable method was used given by Olsen's *et al.* (1954). 2.5 g of soil sample
 148 was weighed and a pinch of activated charcoal was added and mixed with an extraction
 149 solution (50 ml of 0.5M NaHCO₃ pH 8.5) with continuous shaking the solution for half an
 150 hour followed by a filtrate collection (5 ml) in 25 ml volumetric flask. 2-3 drops of p- Nitro
 151 phenol indicator was added to the filtrate resulting in the yellow color development, thereby,
 152 addition of 5N H₂SO₄ drop by drop, until yellow the color disappears to acidify upto pH 5.
 153 Thereafter, 4 ml solution of ascorbic acid was added to the flask resulting in blue color
 154 development. The intensity of blue color which is proportional to phosphate was read on the
 155 spectrophotometer at a wavelength of 660 nm. A blank was also prepared with all chemicals
 156 and no soil. The concentration of available phosphorus in the soil was expressed in kg ha⁻¹.

157 Available phosphorus (kg ha⁻¹) = ppm of P calculated from standard curve × dilution
 158 factor × 2.24.

159 Available Potassium (kg ha⁻¹)

160 Available K in the soil extracted by 1N ammonium acetate as an extractant (Hanway &
 161 Heidel, 1952) and K in the extract were determined by Flame photometer.

162 Plant analysis

163 Preparation of plant sample

164 Nutrient content was analyzed in crop grains and straw at harvested and estimated
 165 separately from the randomly selected plants of each plot. The plant samples for estimating the
 166 dry matter production (grain and straw) and nutrient uptake from each plot at harvest were
 167 thoroughly washed with distilled water and dried in hot air oven at 65 ± 2°C as dry matter

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168 accumulation. Dried samples were powdered in a Willey mill to considerable fineness before
169 storing them in polythene bags for further analysis.

170 **Nutrient content and uptake studies**

171 Nutrient content in wheat (grains & straw) at harvest~~ed~~ and estimated separately from the
172 selected plants of each plot. Oven dried plant samples were ground with the help of the Willy
173 mill grinder. Total N, P & K contents were estimated by micro-Kjeldahl,
174 vanadomolybdophosphoricacid ~~vanadomolybdo phosphoric acid~~ yellow color and flame
175 photometric method, respectively (Jackson, 1973).

Comment [CM13]: Not listed in the References

176 The nutrient uptake by grains and straw of wheat was calculated as follows:

$$\text{Nutrient uptake (kg/ha)} = \frac{\text{Nutrient content (\%)} \times \text{Yield of grains or straw (kg/ha)}}{100}$$

177 Finally, NPK uptake by grains and straw were added to work out the total N, P and K
178 nutrient uptake by wheat, respectively.

179 **Protein content in grains**

180 Nitrogen content of grains as determined by modified micro-Kjeldahl method was
181 multiplied by 5.73 conservation factor to get total crude protein content (AOAC, 1960).

Comment [CM14]: Not listed in the References

$$\text{Grains-protein content (\%)} = \text{Nitrogen content in grains (\%)} \times 5.73$$

183

184

185 **Results and Discussion**

186 **Nutrient content and their uptake**

187 Nutrient content and uptake *viz.*, nitrogen content uptake in grains and straw,
188 phosphorous content uptake in grains and straw potassium content uptake in grains and straw as
189 well as their total uptake did reveal a significant effect of irrigation level and moisture

190 | conservation practices during both of the years. ~~And~~ the interaction between irrigation level and
 191 | moisture conservation practices was insignificant.

192 | **Nitrogen content in grains and straw**

193 | Nitrogen content in grains and straw was significantly higher~~st~~ under the crop received
 194 | ~~5~~five irrigations over ~~4~~one irrigation, followed by ~~3~~three irrigations during both the years. Crop
 195 | supply by ~~4~~one time irrigation was inferior over all other treatments. The mean percent of
 196 | nitrogen in grains and straw less than 1 irrigation was 1.63 and 0.37 % as against 1.73 and 0.47
 197 | %, respectively, over 5 irrigations 2015-16 and 2016-17, respectively. Control lead~~ed~~
 198 | reduction in N content in grains and straw than ~~the~~ rest of the treatments. ~~Though~~However, the
 199 | effect was significant~~ly~~ during both the years. Moreover, Crop fertilized with pusa hydrogel @ 5
 200 | kg ha⁻¹ and vermin-compost @ 1 t ha⁻¹ obtained high nitrogen content in crop grains and straw
 201 | followed by vermin-compost @ 1 t ha⁻¹. However, vermin-compost @ 10 q ha⁻¹ did also differ
 202 | significantly over pusa hydrogel @ 5 kg ha⁻¹ and control.

203 | **Nitrogen uptake in grains and straw as well as their total uptake**

204 | Nitrogen uptake in grain and straw was significantly lowest under the application of ~~4~~one
 205 | irrigation as against ~~3~~three and ~~5~~five irrigations during both the years (Table 2). Crop received 5-
 206 | time irrigation was superior over other irrigation levels. Moreover, in total uptake, crop receiving
 207 | 5 irrigations had removed 4.39% and 3.42% more nitrogen over 3 irrigations, while 19.59% and
 208 | 16.78% over 1 irrigation during 2015-16 and 2016-17, respectively. Crop grown under pusa
 209 | hydrogel @ 5 kg ha⁻¹ along with vermi compost @ 1 t ha⁻¹ did show ~~a~~ significant increment in
 210 | nitrogen uptake in grains and straw than ~~the~~ rest of the treatments during both the years.
 211 | Moreover, Crop grown under unfertilized condition had recorded lowest nitrogen uptake in
 212 | grains and straw. Furthermore, application of pusa hydrogel @ 5 kg ha⁻¹ recorded higher

213 nitrogen uptake in grains and straw against control, whereas lowest over vermi-compost @ 1 t
 214 ha⁻¹. However, vermi compost @ 1 t ha⁻¹ did also differ significantly over pusa hydrogel @ 5 kg
 215 ha⁻¹ and control. Though, as above control did remain lowest in respect to nitrogen uptake in
 216 grains and straw over the rest of its counterparts, irrespective of the years. Alike trends were also
 217 noted in total N uptake during both the years of experimentation.

218 **Table 1: Nitrogen content uptake by wheat crop as affected by irrigation levels and**
 219 **moisture conservation practices**

Treatment	Nitrogen content (%)				Nitrogen uptake (kg ha ⁻¹)					
	Grains		Straw		Grains		Straw		Total	
	015-16	016-17	015-16	016-17	015-16	016-17	015-16	016-17	015-16	016-17
Irrigation levels										
I ₁ (at CRI stage)	.64	.62	.39	.35	8.02	5.97	9.96	7.50	7.98	3.47
I ₂ (at CRI, Booting and Milking)	.68	.65	.44	.40	5.08	1.86	5.72	2.38	00.79	4.25
I ₃ (at CRI, tillering, jointing, Flowering and Milking stage)	.76	.72	.48	.45	8.68	3.38	6.54	4.09	05.22	7.48
S. Em. ±	.008	.007	.005	.001	.26	.39	.26	.33	.45	.13
C. D.	.032	.031	.023	.005	.01	.53	.01	.31	.78	.52

(P=0.05)										
Moisture conservation practices										
Control	.57	.53	.36	.31	2.10	9.15	6.80	5.11	8.90	4.26
Pusa hydrogel @5 kg ha ⁻¹	.67	.63	.42	.37	6.50	2.57	1.44	9.14	7.94	1.70
Vermi compost @ 1 t ha ⁻¹	.75	.71	.47	.43	1.13	7.81	6.32	3.39	07.46	01.20
Pusa hydrogel @5 kg ha ⁻¹ + Vermi compost @ 1 t ha ⁻¹	.81	.78	.51	.48	5.97	2.09	1.70	7.66	17.68	09.75
S.E.m. ±	.006	.005	.005	.003	.21	.37	.33	.32	.34	.40
C.D. (P=0.05)	.020	.019	.014	.008	.62	.09	.98	.94	.02	.18

220

221

222 Phosphorous content in grains and straw

223 Application of [five](#) irrigations significantly resulted into maximum phosphorous content
 224 in grains (0.35 and 0.33 %) as against all other treatments during 2015-16 and 2016-17,
 225 respectively (Table2). Whereas, crop receiving 1 irrigation at CRI had recorded maximum
 226 phosphorous content in straw (0.22 %) during 2015-16 only, while supplying of 1 and 3

227 irrigations had obtained maximum and alike phosphorous content in straw (0.20 %) during 2016-
 228 17 as against 5 irrigations. ~~Though~~However, the differences among them were significantly
 229 during both the years. Control did measure least phosphorous content in grain (0.30 and 0.28 %)
 230 and straw (0.17 and 0.15 %) during both the years. Though, the effect was more significant than
 231 the rest of the treatments. Moreover, Crop fertilized with pusa hydrogel @ 5 kg ha⁻¹ and vermi
 232 compost @ 1 t ha⁻¹ did obtain maximum phosphorous content in grain and straw followed by
 233 vermi compost @ 1 t ha⁻¹. However, pusa hydrogel @ 5 kg ha⁻¹ did record significantly
 234 maximum phosphorous content in grain and straw over control, while remaininged lower over
 235 vermi compost @ 1 t ha⁻¹.

236 **Phosphorous uptake in grain and straw as well as their total uptake**

237 Phosphorous uptake in grains and straw was significantly lowest under the application of
 238 one irrigation as against three irrigation and five irrigations during both the years (Table
 239 ~~No:~~2). Crop receiving 5-time irrigation was superior over other irrigation levels during both ~~the~~
 240 years. Moreover, in total uptake, crop receiving one irrigation had removed 4.39% and 0.43 %
 241 lowest phosphorous over 3 irrigations, while 14.05% and 11.91% over 5 irrigations during 2015-
 242 16 and 2016-17, respectively. Integrated incorporation of pusa hydrogel @ 5 kg ha⁻¹ and vermi
 243 compost @ 1 t ha⁻¹ did showeda significant increment in phosphorous uptake in grains and straw
 244 than the rest of the treatments during both the years. Moreover, Crop grown under unfertilized
 245 condition had recorded lowest phosphorous uptake in grains and straw. Furthermore, application
 246 of pusa hydrogel @ 5 kg ha⁻¹ did record higher phosphorous uptake in grains and straw against
 247 control, whereas lowest over vermi compost @ 1 t ha⁻¹. However, vermi compost @ 1 t ha⁻¹ did
 248 also differ significantly over pusa hydrogel @ 5 kg ha⁻¹ and control. ~~Though~~However, the control
 249 did remain inferior in respect to phosphorous uptake in grains and straw over the rest of its

250 counterparts, irrespective of the years. Similar trends were noted in total phosphorous uptake
 251 during both the years.

252 **Table2: Phosphorus content and uptake by wheat as influenced by irrigation levels and**
 253 **moisture conservation practices**

Treatment	P content (%)				P uptake (kg ha ⁻¹)					
	Grains		Straw		Grains		Straw		Total	
	015-16	016-17	015-16	016-17	015-16	016-17	015-16	016-17	015-16	016-17
Irrigation levels										
I ₁ (at CRI stage)	.32	.31	.19	.17	2.17	1.47	.04	.24	0.21	8.71
I ₂ (at CRI, Booting and Milking)	.33	.32	.21	.19	3.18	2.82	.62	.62	2.08	0.85
I ₃ (at CRI, Late tillering, Late jointing, Flowering and Milking stage)	.35	.33	.22	.20	4.43	3.22	.90	.11	3.05	0.94
S. Em. ±	.001	.002	.002	.001	.18	.08	.06	.05	.21	.10
C. D.	.006	.009	.007	.006	.72	.31	.23	.23	.81	.39

(P=0.05)										
Moisture conservation practices										
Control	.30	.28	.17	.15	.98	.85	.69	.82	5.66	4.67
Pusa hydrogel @ 5 kg ha ⁻¹	.31	.30	.19	.17	2.72	2.02	.10	.23	0.82	9.25
Vermi compost @ 1 t ha ⁻¹	.34	.33	.22	.20	3.46	2.66	.74	.88	2.21	0.55
Pusa hydrogel @ 5 kg ha ⁻¹ + Vermi compost @ 1 t ha ⁻¹	.38	.36	.25	.23	6.87	5.49	1.55	0.68	8.42	6.18
S.E.m. ±	.002	.002	.001	.002	.19	.19	.25	.24	.38	.38
C.D. (P=0.05)	.005	.006	.005	.005	.57	.58	.75	.72	.14	.13

254

(Table No:2)

255 **Potassium content in grains and straw**

256 The content of K in grains and straw was significantly higher under the crop received
 257 five irrigations over one irrigation, followed by three irrigations during both the years (Table
 258 3). Crop supply by one time irrigation was inferior over all other treatments. The mean percent
 259 of potassium content in grains and straw under the 5 irrigation was 0.45 and 1.70 % as against

260 | 0.39 and 1.41 %, respectively, over the ~~one~~ irrigation during both the years. Control did let to a
 261 | reduction in potassium content in grains and straw than other treatments. Though, the effect was
 262 | ~~significansignificantly~~ during both the years. Moreover, Crop fertilized with pusa hydrogel @ 5
 263 | kg ha⁻¹ and vermi compost @ 1 t ha⁻¹ did obtain maximum potassium content in grains and straw
 264 | followed by vermi compost @ 10 q ha⁻¹. However, vermi compost @ 1 t ha⁻¹ did also differ
 265 | significantly over pusa hydrogel @ 5 kg ha⁻¹ and control, while recorded maximum potassium
 266 | content in grains and straw as against both moisture conservation practices.

267 | **Potassium uptake in grains and straw as well as their total uptake**

268 | Potassium uptake in grains and straw was significantly lowest under the application of
 269 | ~~one~~ irrigation as against ~~three~~ and ~~five~~ irrigations during both the years. Crop supply by 5-
 270 | time irrigation was significantly recorded highest potassium uptake in grains and straw over
 271 | other irrigation levels (Table ~~No.~~3). Moreover, in total uptake, crop receiving ~~five~~ irrigations
 272 | had removed 6.03% and 6.36 % more potassium over ~~three~~ irrigations, while 9.38% and 9.24 %
 273 | over ~~one~~ irrigation during 2015-16 and 2016-17, respectively. Crop grown under pusa
 274 | hydrogel @ 5 kg ha⁻¹ along with vermi compost @ 1 t ha⁻¹ did show a significant increment in
 275 | potassium uptake in grains and straw than ~~the~~ rest of the treatments during both the years.
 276 | Moreover, Crop grown under unfertilized condition had recorded lowest potassium uptake in
 277 | grains and straw. Furthermore, application of pusa hydrogel @ 5 kg ha⁻¹ did record higher
 278 | potassium uptake in grains and straw against control, whereas lowest over vermi compost @ 1 t
 279 | ha⁻¹. Though, as above control did remain lowest in respect to potassium uptake in grains and
 280 | straw over ~~the~~ rest of its counterparts, irrespective of the years. Alike trends were also noted in
 281 | the total nitrogen uptake during both years of experiments.

282 | **Table3: Potassium content and uptake by wheat crop ~~a~~affected by irrigation levels and**
 283 | **moisture conservation practices**

Treatment	Potassium content (%)				Potassium uptake (kg ha ⁻¹)					
	Grains		Straw		Grains		Straw		Total	
	015-16	016-17	015-16	016-17	015-16	016-17	015-16	016-17	015-16	016-17
Irrigation levels										
I ₁ (at CRI stage)	.40	.38	.49	.42	7.33	6.23	12.44	10.47	29.78	26.70
I ₂ (at CRI, Booting and Milking)	.43	.41	.60	.55	8.82	7.97	15.06	12.16	33.88	30.13
I ₃ (at CRI, tillering, jointing, Flowering and Milking stage)	.46	.44	.74	.66	1.64	0.34	20.32	18.07	41.96	38.41
S. Em. ±	.001	.002	.007	.008	.08	.08	.15	.16	.08	.18
C. D. (P=0.05)	.006	.009	.027	.033	.33	.32	.56	.62	.31	.70
Moisture conservation practices										
Control	.39	.38	.47	.41	5.76	4.71	09.81	08.03	25.58	22.74

Pusa hydrogel @ 5 kg ha ⁻¹	.41	.39	.53	.48	7.84	6.96	14.56	12.54	32.40	29.50
Vermi compost @ 1 t ha ⁻¹	.44	.42	.66	.59	0.66	8.89	17.94	15.34	38.61	34.23
Pusa hydrogel @ 5 kg ha ⁻¹ + Vermi compost @ 1 t ha ⁻¹	.47	.45	.77	.69	2.80	2.17	21.44	18.34	44.24	40.52
S.E.M. ±	.002	.002	.007	.008	.19	.15	.16	.19	.24	.24
C.D. (P=0.05)	.005	.006	.021	.024	.56	.44	.48	.56	.71	.72

(Table No:3)

284
285**286 NPK contents and their uptake by crop**

287 Implement of different irrigation levels treatments increased N, P and K content and their
 288 uptake and total uptake by wheat grain and straw significantly over control during both years
 289 with few exceptions. Among different irrigation levels treatments, the highest value for NPK
 290 content and uptake was recorded with 05 irrigation levels. An increment of 7.32 and 6.17, 9.38
 291 and 6.45 and 15.00 and 15.78% in N, P and K content in grain and 23.08 and 28.57, 15.78 and
 292 17.64 and 16.77 and 16.90% in straw was recorded with 5 irrigation levels over 1 irrigation
 293 levels during 2015-16 and 2016-17 respectively. The NPK contents increase might be due to the

294 solubilization effect of organic manures on native nutrients solubilization and releasing of
 295 nutrients for a longer duration might be the reason for greater availability. Arancon *et al.* (2004)
 296 reported that organic sources had a longer and greater efficiency as compared to inorganic source
 297 that might be responsible for higher uptake ~~of by~~ building material. Application different
 298 irrigation levels treatments increased significantly the uptake of NPK in grain and straw over
 299 ~~one~~ irrigation levels. The uptake of these nutrients was more in 2015-16 as compared to 2016-
 300 17 because the yield was more during the first year of ~~the~~ experiment. Among irrigation levels
 301 treatments, ~~five~~ irrigation levels and ~~one~~ irrigation levels recorded maximum and minimum
 302 NPK uptake, respectively. Application different moisture conservation treatments increased
 303 nitrogen, phosphorus and potassium content and their uptake and total uptake by wheat grain and
 304 straw significantly over control during both years with few exceptions. Among different
 305 moisture conservation treatments, highest value for NPK content and uptake was recorded with
 306 Pusa hydrogel @ 5 kg ha⁻¹ + Vermi-compost @ 1 t ha⁻¹. An increment of 15.28 and 16.34, 26.66
 307 and 28.57 and 20.51 and 18.42 per cent in N, P and K content in grain and 41.66 and 54.84,
 308 47.06 and 53.33 and 20.41 and 19.86 per cent in straw was recorded with Pusa hydrogel @ 5 kg
 309 ha⁻¹ + Vermi compost @ 1 t ha⁻¹ over control plot during 2015-16 and 2016-17, respectively.
 310 Application of different irrigation levels treatments increased nitrogen, phosphorus and
 311 potassium content and their uptake and total uptake by wheat grain and straw significantly over
 312 control during both years with few exceptions. Among different moisture conservation
 313 treatments, highest value for NPK content and uptake ~~was~~ recorded with 05 irrigation levels.
 314 An increment of 15.67 and 11.23, 18.57 and 15.25 and 24.87 and 25.32 per cent in N, P and K
 315 uptake in grain and 32.96 and 37.65, 10.70 and 12.02 and 7.00 and 6.88 per cent in straw ~~were~~
 316 recorded with ~~five~~ irrigation levels over ~~one~~ irrigation levels during 2015-16 and

317 2016-17 respectively. Application different moisture conservation treatments increased nitrogen,
 318 phosphorus and potassium content and their uptake and total uptake by wheat grain and straw
 319 significantly over control during both years with few exceptions. Among different moisture
 320 conservation treatments, highest value for NPK content and uptake was recorded with Pusa
 321 hydrogel @5 kg ha⁻¹+ Vermi compost @1 t ha⁻¹. An increment of 65.00 and 67.01, 69.04 and
 322 57.26 and 44.67 and 50.71 per cent in N, P and K uptake in grain and 88.69 and 83.06, 102.98
 323 and 121.57 and 10.59 and 9.54 per cent in straw whereas recorded with Pusa hydrogel @5 kg ha⁻¹
 324 + Vermi compost @1 t ha⁻¹ followed by Vermi compost @1 t ha⁻¹ over control during 2015-16
 325 and 2016-17, respectively. Higher uptake of nutrients by the crop under the influence of
 326 moisture conservation treatments was due to the fact that moisture conservation treatments
 327 controlled the moisture conservation effectively and consequently made more nutrient available
 328 to wheat resulting in enhanced nutrient concentration and yield and thereby higher uptake of
 329 nutrients. Similar findings have been reported by Nehra *et al.* (2000), Akhteret *et al.* (2004) and
 330 Yadav *et al.* (2010). Higher NPK uptake by crop in Pusa hydrogel @5 kg ha⁻¹+ Vermi
 331 compost @1 t ha⁻¹ has also been reported by El-Hady and Abosedera (2006).

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332 Protein content in grains

333 Protein content exhibited significantly with irrigation levels and moisture conservation
 334 practices during both the years (Table 4). Moreover, the interaction between irrigation level and
 335 moisture conservation practices was non-significant. Significantly maximum protein content was
 336 recorded with the application of five irrigations as compared with the rest of the treatments.
 337 Moreover, three irrigations did also differ over one irrigation. Though, least protein content
 338 was noted with 1 irrigation. The mean protein content in five irrigations was 10.72 and 10.18 %
 339 against 9.91 and 9.41 % under one irrigation during 2015-16 and 2016-17,

340 | respectively. Among the different moisture conservation practice, combine application of pusa
 341 | hydrogel @ 5 kg ha⁻¹ and vermi compost @ 1 t ha⁻¹ did recorded maximum protein content which
 342 | was significantly differ over the rest of the treatments, irrespective of the years.
 343 | ~~Though~~ However, application of pusa hydrogel @ 5 kg ha⁻¹ did significantly result higher protein
 344 | content over control while lower as against vermi compost @ 1 t ha⁻¹ during both the
 345 | years. Moreover, significantly lower protein content (9.20 and 8.74 %) was recorded under
 346 | the control during 2015-16 and 2016-17, respectively.

347 | **Table4: Protein content of wheat grains as influenced by irrigation levels and moisture**
 348 | **conservation practices**

Treatment	Protein content (%)	
	2015-16	2016-17
Irrigation levels		
I ₁ (at CRI stage)	9.91	9.41
I ₂ (at CRI, Booting and Milking)	10.24	9.73
I ₃ (at CRI, Late tillering, Late jointing, Flowering and Milking stage)	10.72	10.18
S. Em. ±	0.07	0.06
C.D. (P=0.05)	0.26	0.25
Moisture conservation practices		
Control	9.20	8.74
Pusa hydrogel @5 kg ha ⁻¹	9.90	9.40
Vermi compost @ 1 t ha ⁻¹	10.72	10.18
Pusa hydrogel @5 kg ha ⁻¹ + Vermi compost @ 1 t ha ⁻¹	11.35	10.78
S. Em. ±	0.05	0.04
C.D. (P=0.05)	0.14	0.13

(Table 4)

349 | **Soil studies**

351 | **Soil available nutrients**

352 Soil available nutrients (nitrogen, phosphorous and potassium) and organic carbon did
 353 reveal a significant effect of irrigation level and moisture conservation practices during both the
 354 years (Table5) Moreover, the interaction between irrigation level and moisture conservation
 355 practices was insignificant. Further, slight variations were noted in soil available nutrients at
 356 harvest as against initial nutrients during both the years.

357 Available nitrogen

358 Available nitrogen was increaseds with broadening the irrigation level where crop
 359 receiving five times irrigation did showed its superiority to record maximum available nitrogen
 360 as compared to three irrigation and +one irrigation. The increment under Sfive irrigations was to
 361 the tune of was 7.3 % (2015-16) and 7.7 % (2016-17) as against one irrigation. ThoughHowever,
 362 one irrigation did showed inferiority over other treatments to record least grains yield,
 363 irrespective of the years. Crop grown without fertilization did obtain lowest available nitrogen of
 364 212.22 kg ha⁻¹ (2015-16) and 214.34 kg ha⁻¹ (2016-17) as compared with all other treatments.
 365 Although, incorporation of pusa hydrogel @ 5 kg ha⁻¹ along with vermi compost @ +one t ha⁻¹
 366 was significantly recorded highest available nitrogen over its individual component, irrespective
 367 of the years. ThoughHowever, application of pusa hydrogel @ 5 kg ha⁻¹ did significantly result
 368 higher available nitrogen over control while lower as against vermi compost @ 1 t ha⁻¹during
 369 both the years.

370 Available phosphorous

371 Significantly application of +one irrigation did record 8.8 and 6.8 % lower available
 372 phosphorous as against crop received Sfive irrigations during 2015-16 and 2016-17, respectively.
 373 The next in order was 3-time irrigation which irrigation, which was significantly higher over +one
 374 time irrigation and minimum over 5-time irrigation, irrespective of the years. Crop fertilized with

375 pusa hydrogel @ 5 kg ha⁻¹ and vermi-compost @ 1 t ha⁻¹ obtained 14.61 kg ha⁻¹ (2015-16) and
 376 15.05 kg ha⁻¹(2016-17) available phosphorous which was significantly higher than other
 377 treatments. Although, incorporation of pusa hydrogel @ 5 kg ha⁻¹ did superior than over control
 378 and inferior over vermi-compost @ 1 t ha⁻¹ in order to recorded available phosphorous.
 379 Moreover, control did remain inferior over [the](#) rest of its counterparts during both the years.

380 Available potassium

381 Irrigation level [has](#) also [result](#) significant difference among them during both the
 382 year. However, considerable improvement was noted in available potassium with the increasing
 383 irrigation frequency. Though, application of 5-time irrigation in wheat significantly recorded
 384 maximum available potassium (177.18 and 179.10 kg ha⁻¹), while lowest available potassium
 385 (165.84 and 167.12 kg ha⁻¹) was found under the crop received 1 irrigation as compared with
 386 other irrigation levels during 2015-16 and 2016-17, respectively. Crop grown without [pusa](#)
 387 [hydrogel @ 5 kg ha⁻¹ and vermi compost @ 1 t ha⁻¹](#) (control) did significantly obtain lower
 388 available potassium as compared with all other treatments. Moreover, combine application of
 389 pusa hydrogel @ 5 kg ha⁻¹ alongwith vermi compost @ 1 t ha⁻¹ had recorded significantly highest
 390 available potassium as compared with control, pusa hydrogel @ 5 kg ha⁻¹ and vermi compost @
 391 1 t ha⁻¹, irrespective of the years.

392 Organic carbon

393 Application of [5](#) irrigations brought significant improvement in organic carbon over
 394 [3](#) and [4](#) irrigation during twice the years. Moreover, lowest organic carbon noted under
 395 crop obtained only irrigation at CRI stage, irrespective of the years. Crop receiving pusa
 396 hydrogel @ 5 kg ha⁻¹ + vermi compost @ 1 t ha⁻¹ had significantly maximum organic carbon as
 397 compared to the other treatments irrespective of the years. However, application of vermi

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398 compost @ 1 t ha⁻¹ did also significantly result higher organic carbon as against pusa hydrogel @
 399 5 kg ha⁻¹ and control during twice the years.

400 **Table5: Available N, P, K and organic carbon content of the soil as influenced irrigation**
 401 **levels and moisture conservation practices at harvesting time**

Treatment	N (kg ha ⁻¹)		P (kg ha ⁻¹)		K (kg ha ⁻¹)		OC (%)	
	015-16	016-17	015-16	016-17	015-16	016-17	015-16	016-17
Irrigation levels								
I ₁ (at CRI stage)	13.4	15.6	2.8	3.1	65.8	67.1	.46	.48
I ₂ (at CRI, Booting and Milking)	22.3	24.5	3.0	3.9	71.3	74.3	.47	.49
I ₃ (at CRI, Late tillering, Late jointing, Flowering and Milking stage)	29.9	32.2	4.0	4.1	77.2	79.1	.48	.50
S. Em. ±	.3	.2	.19	.08	.2	.2	.003	.003
C.D. (P=0.05)	.9	.0	.74	.31	.6	.6	.008	.007
Moisture conservation practices								
Control	12.2	14.3	2.0	2.3	67.3	68.9	.46	.46
Pusa hydrogel @5 kg ha ⁻¹	19.4	21.6	2.9	3.4	70.2	72.6	.47	.47
Vermi compost @ 1 t ha ⁻¹	25.0	27.2	3.6	4.0	72.7	74.8	.48	.48
Pusa hydrogel @5 kg ha ⁻¹ + Vermi compost @1 t ha ⁻¹	31.0	33.3	4.6	5.1	75.5	77.8	.49	.51
S. Em. ±	.5	.5	.15	.12	.2	.2	.003	.003
C.D. (P=0.05)	.5	.4	.43	.35	.7	.6	.008	.008
Initial value	22.0	24.6	4.2	4.6	72.1	75.3	.48	.49

402 (Table:5)

403

404

405 **Soil moisture content studies**

406 The effect of moisture conservation under different irrigation schedule on average profile,
 407 soil moisture content in wheat during 2015-16 and 2016-17. In general, the profile moisture
 408 content was the highest at the time of sowing (21%) and it was lowest at the time of crop
 409 maturity in all the treatments during both 2015-16 and 2016-17, successive increase in irrigation
 410 levels has been increased moisture content at harvest, being the highest at five irrigation
 411 levels (17.3 and 17.3%, respectively). ~~Though~~ However, the respective mean values were 15.7
 412 and 15.1%. Similarly, combined application of 5 kg Pusa hydrogel + 1 t vermi-compost ha⁻¹
 413 stored the highest moisture content of 16.1 and 14.4% during 2015-16 and 2016-17, respectively.
 414 The next in the order was VC @ 1 t ha⁻¹ and Pusa hydrogel @ 5 kg ha⁻¹ of treatments.

415 **Table6: Impact of irrigation levels and moisture conservation practices on soil at the**
 416 **harvesting and water productivity (kg m⁻³) of wheat:**
 417

Water productivity						
Treatments	Soil moisture content (%)		Total water applied (cm)		Water productivity (kg grain m ⁻³)	
	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17
Irrigation levels						
I ₁ (at CRI stage)	14.3	12.0	10.48	10.25	2.60	2.58
I ₂ (at CRI, Booting and Milking)	15.4	16.0	34.21	33.45	1.25	1.23
I ₃ (at CRI, Late tillering, jointing, Flowering and Milking stage)	17.3	17.3	44.28	43.58	1.04	1.03
Mean	15.7	15.1	29.65	29.10	1.63	1.61
Moisture conservation practices						
Control	13.8	13.3	18.63	17.95	1.65	1.57
Pusa hydrogel @ 5 kg ha ⁻¹	14.2	13.5	32.56	31.29	1.30	1.32
Vermi compost @ 1 t ha ⁻¹	15.6	14.0	35.69	34.69	1.25	1.24
Pusa hydrogel @ 5 kg ha ⁻¹ + Vermi compost @ 1 t ha ⁻¹	16.1	14.4	38.56	37.54	1.22	1.20

Mean	14.9	13.8	31.36	30.37	1.36	1.33
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418

419 **Water productivity**

420 The crop water productivity during 2015-16 was slightly higher than 2016-17 (Table6).

421 The crop water use increased under plots where more irrigation scheduling was adopted during

422 twice ~~in~~ the year of experimentation. The crop water use increased markedly in five irrigation

423 levels than three irrigation levels and one irrigation levels during twice of the year of study.

424 Water productivity varied inversely with irrigation levels. Maximum water productivity was

425 recorded under one irrigation levels followed by three irrigation levels and five irrigation levels

426 during both the years. Although mean water productivity during 2015-16 and 2016-17 was 1.63

427 and 1.61 kg grains/m³, respectively. Among moisture conservation practices, water productivity428 varied from 1.22 to 1.33 and 1.20 to 1.32 kg grams/m³, being highest under treatment ~~receiving~~429 ~~of~~ Pusa hydrogel @ 5 kg ha⁻¹ during first and second years, respectively.430 **Table7: Effect of irrigation levels and moisture conservation practices on soil moisture**
431 **content at harvest and water productivity (kg m⁻³) of wheat**

Water productivity						
Treatments	Soil moisture content (%)		Total water applied (cm)		Water productivity (kg grain m ⁻³)	
	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17
Irrigation levels						
I ₁ (at CRI stage)	14.3	12.0	10.48	10.25	2.60	2.58
I ₂ (at CRI, Booting and Milking)	15.4	16.0	34.21	33.45	1.25	1.23
I ₃ (at CRI, Late tillering, Late jointing, Flowering and Milking stage)	17.3	17.3	44.28	43.58	1.04	1.03
Mean	15.7	15.1	29.65	29.10	1.63	1.61
Moisture conservation practices						
Control	13.8	13.3	18.63	17.95	1.65	1.57
Pusa hydrogel @5 kg ha ⁻¹	14.2	13.5	32.56	31.29	1.30	1.32

Vermi compost @ 1 t ha ⁻¹	15.6	14.0	35.69	34.69	1.25	1.24
Pusa hydrogel @5 kg ha ⁻¹ + Vermicompost @1 t ha ⁻¹	16.1	14.4	38.56	37.54	1.22	1.20
Mean	14.9	13.8	31.36	30.37	1.36	1.33

(Table:7)

432
433

434 Impact of Available NPK and Organic Carbon in Soil

435 Alliance of organic manures and chemical fertilizers generally affects physical, chemical
436 and biological properties of soil. During this study available N, P and K organic carbon were
437 measured during 2015-16 and 2016-17 after harvesting of crop from various treatments
438 during twice years. Provided N, P and K increased in soil with the application of different
439 irrigation levels treatments during twice years.

440 All various treatments maximum value for available N, P and K in soils was recorded
441 with five irrigation levels during the years of study. The application of manures has been
442 reported not only to improve the nutrient content in the soil but also helps to bring native
443 irrigation into the available forms thus increasing the available nutrient contents in the soil.
444 Moreover, organic manures create better environment for biological activity in the soil, which
445 which results into more fixation of N and more solubilizing effect on another fixed form of
446 irrigation. In the present study N, P and K content in the soil after harvesting were 7.73 and 7.70,
447 9.64 and 7.25 and 6.87 and 7.18 percent higher than five irrigation levels during 2015-16 and
448 2016-17, respectively. Increase in nutrients in soil by the application of organic manures was
449 also reported by Ahmadabadi *et al.* (2011) and Islam *et al.* (2011).

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450 Maximum carbon content was recorded in five irrigation levels (0.485 and 0.502)
451 followed by three irrigation levels during twice the years which were significantly higher than
452 one irrigation levels. Studies conducted by various workers have established the fact of
453 maintenance of soil fertility in terms of improved organic content and available nutrients in then

454 soil through the applications of organic manures in combination with chemical fertilizers in
 455 different ratio (Gupta and Seth, 1996 and Bulluck *et al.* (2002).

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456 | **Table 8-8: Impact of different irrigation levels and moisture conservation practices at**
 457 **various stages of crop growth grains, straw and biological yield (q ha⁻¹) and**
 458 **harvest index of wheat**

Treatment	Yields (q ha ⁻¹)							
	Grain		Straw		Biological Yield		Harvest index (%)	
	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17
Irrigation levels								
I ₁	2	2	5	5	7	7	3	3
(at CRI stage)	7.25	6.58	1.74	0.37	8.99	6.95	8.46	8.48
I ₂	4	4	5	5	1	9	4	4
(at CRI, Booting and Milking)	2.75	1.63	7.72	6.21	00.48	7.84	2.54	2.55
I ₃	4	4	7	7	1	1	4	4
(at CRI, Late tillering, jointing, Flowering and Milking stage)	6.01	5.02	3.62	2.02	19.62	17.03	4.43	4.44
S	0	0	0	0	0	1	0	0
Em ±	.30	.47	.59	.68	.87	.12	.12	.18
C.D	1	1	2	2	3	4	0	0
(P=0.05)	.28	.82	.32	.67	.62	.58	.45	.59

Moisture conservation practices									
Con	3	2	5	5	8	8	4	4	
trol	0.71	8.12	6.11	5.01	6.82	3.13	1.50	1.43	
Pus	4	4	5	5	1	9	4	4	
a hydro gel	2.30	1.42	9.53	8.35	01.83	9.77	1.54	1.51	
@5 kg ha ⁻¹									
Ver	4	4	6	6	1	1	4	4	
mi compost	4.46	3.17	2.47	0.68	06.93	03.85	1.57	1.56	
@ 1 t ha ⁻¹									
Pus	4	4	6	6	1	1	4	4	
a hydro gel	6.97	5.62	5.98	4.09	12.95	09.71	1.58	1.57	
@5 kg ha ⁻¹									
¹⁺									
Ver									
mi compost									
@1 t ha ⁻¹									
S	0	0	1	1	2	2	0	0	
Em ±	.88	.68	.47	.52	.48	.52	.27	.12	
C.D	2	3	4	4	7	7	N	N	
(P=0.05)	.97	.00	.38	.50	.46	.60	S	S	

459 Different moisture conservation treatments had a significant effect on the available NPK
 460 status of soil during twice the years of investigation. This might be due to more removal of
 461 nutrients by the crop under the integration of Pusa hydrogel @5 kg ha⁻¹+ vermi compost @1 t ha⁻¹
 462 ¹. Organic carbon was significantly higher in the treatment receiving Pusa hydrogel @5 kg ha⁻¹
 463 ¹⁺ Vermicompost @1 t ha⁻¹ followed by Vermicompost @1 t ha⁻¹ which was significantly higher
 464 to Pusa hydrogel @5 kg ha⁻¹+ Vermicompost @1 t ha⁻¹. These results are closely related to the
 465 findings of Arguello *et al.* (2006) which observed that soil nutrient status was unaffected by
 466 various cultural and chemical moisture conservation treatments. On the contrary, Mahmood *et*

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468 | *al.*(2004) reported ~~that an~~ increase in the fertility levels and conservation of moisture by either
 469 | mechanical or chemical method increased the available NPK status of soil after crop harvest.

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470 | **Conclusion**

471 | After doing two years of study and research, it can be concluded that the increased
 472 | irrigation levels enhanced the growth, yield attributing characters, yield and productivity of
 473 | wheat crop significantly, being highest with the adoption of five irrigations (at CRI, Late
 474 | tillering, jointing, Flowering and Milking stage). All the moisture conservation practices and
 475 | applications of pusa hydrogel @ 5 kg/ha+Vermi compost @ 1 t/ha performed best with the
 476 | highest yield and quality. Thus, in wheat application of 5 kg pusa hydrogel+1 t/ha vermi-
 477 | compost with five irrigations (at CRI, Late tillering, jointing, Flowering and Milking stage)
 478 | seems to be best under the sandy loam soil of North Western Plain Zones of Western Uttar Pradesh.

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