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# Optimizing bio-organic preparations and *Sharbati* wheat varieties for higher organic wheat productivity and profitability

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**Keywords:**
Bio-dynamic preparations, vermicompost, Panchgavya, Sharbati wheat, organic nutrient management

**ABSTRACT**

In JNKVV, Jabalpur, a research was conducted to examine the effects of biodynamic preparations in the context of comparisons of conventional, organic, and biodynamic systems and varied varieties of wheat. Seven BOP (bio-organic preparations) served as the treatments of main plot for the experiment's split plot design, while four different wheat varieties served as the sub plot treatments, each of which was replicated thrice. Observations based on plant population, various crop's growth studies were noted at the 30, 60, 90 DAS and at the harvest. However, the crop growth rate (CGR), relative growth rate (RGR) and net assimilation rate (NAR) was computed at 30-60 and 60-90 days intervals. The yield attributing characteristics viz., length of ear head, number of effective tillers per meter square, no. of grains per ear head, weight of grains per ear head, and the test weight and finally grain and straw's yield were recorded at harvest. Finally, the economic viability of treatments were determined in the terms of gross monetary returns, cost cultivation, net monetary returns and benefit- cost BC ratio on the per hectare area basis. Data pertaining to the various parameters subjected to the statistical analysis for the interpretation of the results. The combined application of BD500+BD501+P+VC was succeeded by P+VC and BD500+BD501+VC, gave a notable increase of 22.29, 18.26, and 6.38 per cent on grain yield of wheat over the sole application of BD500, BD501, and P each with VC. Considerably higher grain (2462.18 kg per ha) and straw yields (3149.88 kg per ha), including harvest index (HI) (43.73). In terms of profitability, BD500+BD501+P+VC was superior to

BD: 500+BD: 501+VC and P+VC. Aside from that, it was noted that the use of BD-500+BD-501 or P+VC in JW-3020 and HW-2004 as well as BD500+BD-01+P or P+VC in C-306 and Sujata stood more lucrative.



## 1. INTRODUCTION

Cereals are essential for supplying the world's expanding population with food, especially in undeveloped countries where the production system is centred on cereals which is the sole significant source of nutrition and caloric intake [37], [53]. In terms of calories and caloric consumption, wheat (*Triticum aestivum* L.) ranks second to rice as a major source of protein in developing and middle-income countries, feeding almost 2.5 billion people worldwide [62]. It is cultivated on more than 220 million acres of

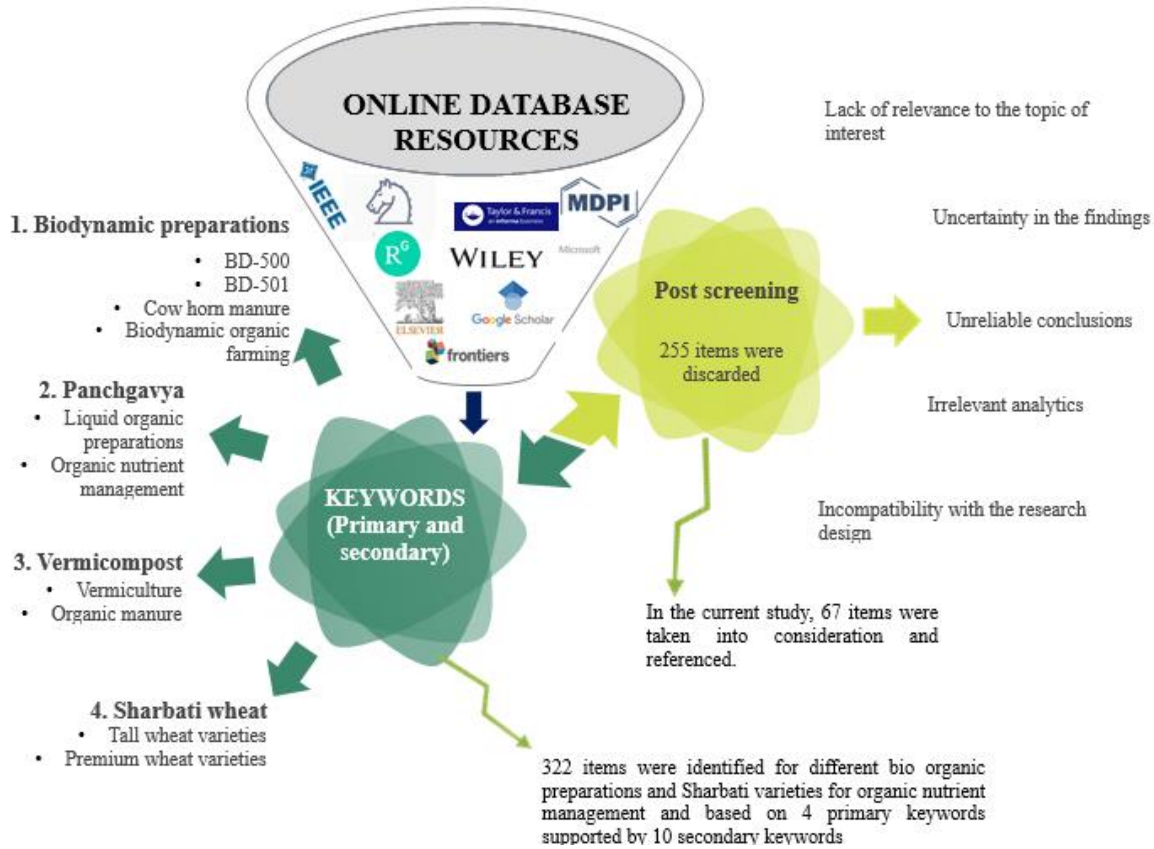


**Fig 1:** Accessed online data base

land in 43 different countries, yielding 780, 59 million metric tonnes annually [19]. With the production and the productivity of around 111.32 MT and 3424 kg per ha, respectively, while considering India it is grown on an area of around 31.67 Mha after rice [31]. With 9.75 million hectares, Uttar Pradesh has the largest area share (32%), succeeded by Madhya Pradesh (approx 18.75%) [50]. Nevertheless, states such as Madhya Pradesh (27%), Jharkhand (51%), and simultaneously Rajasthan (13%), had a substantial increase in the wheat area [48]. Madhya Pradesh and Jharkhand experienced the largest quantum growth, nearly doubling their production from 9.45 to 16.32 million tonnes to 0.22 to 0.38 million tonnes. In Madhya Pradesh, the average production increased by 6.87 million tonnes [48].

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In India, food production was insufficient from 1947 to 1960 due to an increasing population, which even lead to the fear of famine [35]. (GR) Green revolution began in the 1960s and contributed to rise in domestic food production. High-yielding grain was introduced including cereal varieties (HYVs) which was main objective of green revolution to reduce poverty and hunger [35]. After green revolution, cereal crop production tripled but cultivable acreage only increased by 30%. The overall food security in India has unquestionably improved. The green revolution had a good effect, and there is useful and thorough evidence to support this. But after a while, several unforeseen but detrimental impacts of green revolution were visible. Green revolution helped to ensure food security, but it also had unanticipated, detrimental effects on agricultural and public health [1], [36] (Fig 2). Micro-scale information on how diffusion of MVs (modern crop varieties) affects people wellbeing, specifically health, is strikingly rare despite the general consensus that Green Revolution contributed a lot to the world whole supply of food [29]. Following the Green Revolution, a lot of chemical fertilisers were used for crop cultivation (Fig 3), which explains the sharp rise in fertiliser consumption between 1981 to 1982.

The cropping system was repeated in order to boost crop yield and decrease the crop failure, and replenish available nutrients in the soil, [56]. Similarly, organic matter and crop residues aren't returned to soil, practices of intensive cropping led to loss/decline of the soil organic matter [55]. In response farmers applied more fertiliser when the soil's condition declined in order to fulfil the demands of high yielding varieties [10]. Heavy metals, specifically Pb (lead), Cd (cadmium), and As (arsenic), due to the use of fertilisers and pesticides, are found in the soil in higher amounts. With the green revolution, soil pH increased as a result of the application of these alkaline substances [51]. Consequently, the soil microbes that are crucial for maintaining soil health were reduced due to the presence of heavy metals and toxic substances.

The yield has dropped as a result of the decline in soil fertility. Tractor utilization and the mechanisation also degraded soil's physicochemical quality, had an impact on biological activity in soil. In conventional techniques, soil recovers in presence of any of the stresses [56]. The Green Revolution had the following significant ecological effects, including the extinction of native landraces in our country, the soil is losing nutrients and becoming unproductive, overconsumption of pesticides that results in an increase in pesticide residues in the food and environment, and particularly shift by farmers to unsustainable practises in order to increase yield [16], [67].

| Fungicides | Effect on body |
|---|---|
| Benomyl | Cirrhosis |
| Metiram | Thyroid gland |
| Zineb | Diarrhoea |
| Nabam | Nerve damage |
| Dichloram | Kidney |

| Herbicides | Effect on body |
|---|---|
| Trifluralin | Dermal irritation |
| Dacthal | Liver damage |
| Glyphosate | Nervous system |
| Mtribuzin | Organ weight |
| Sethoxydim | Tremors |

| Insecticides | Effect on body |
|---|---|
| Methoxychlor | Nervous system |
| Dicofol | Headache |
| DDT | Carcinogenic |
| Dieldrin | Dizziness |
| Endosulfan | Diarrhoea |

**Fig 2:** Effects of using chemical fertilizers on public wellbeing [2], [36]

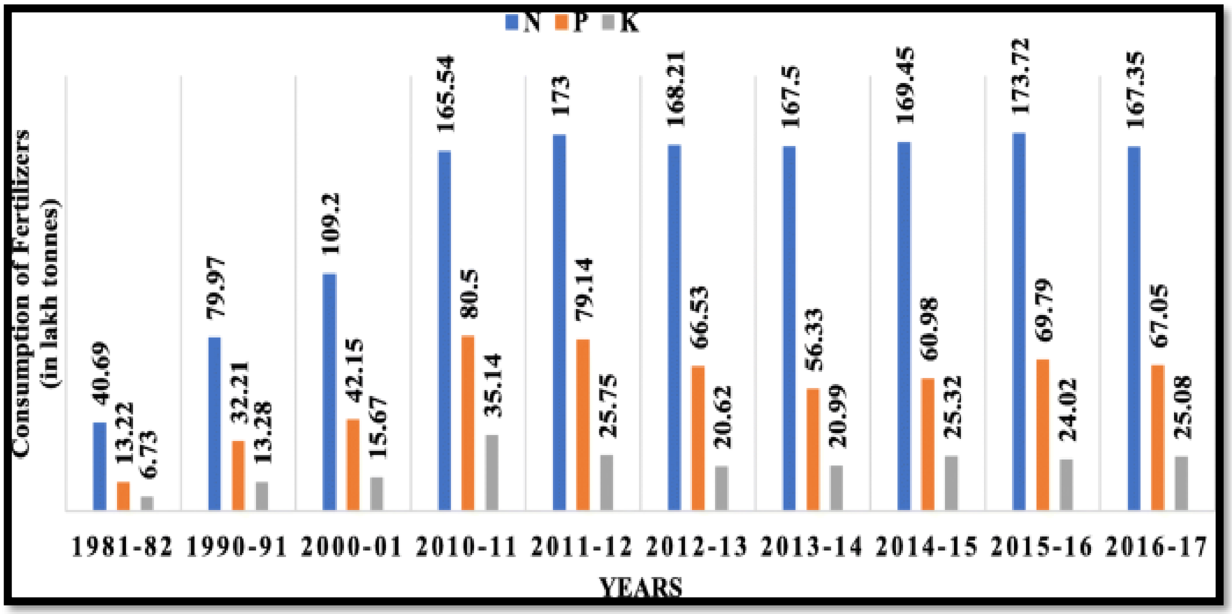


**Fig 3:** Post-Green Revolution (N, P, and K) fertiliser consumption [15]

Since agri-food production systems overly rely on agrochemicals, that has hastened the loss of ecosystem services that regulates, supports ecosystem health and impaired environmental sustainability, it is increasingly challenging to accomplish sustainable development goals (SDGs) [57]. On the other hand, it's important to lessen the negative impact chemical fertilizer have on the ecosystem and peoples health [18]. Chemical fertilizer usage and exposure can be decreased in areas with high consumption by using organic and/or integrated agricultural systems [24], [27]. The organic crop management, which describes the A farm's use of natural farming methods that incorporate tradition, creativity, and science might be the answer. The widespread application of beneficial soil bacteria, animal manures, bio-agents, bio-pesticides, and the indigenous technical know-how based on the scientific and technical concepts of the agricultural systems is the simplest description of organic crop management as opposed to the extensive use of genetically engineered plants, plant growth regulators (PGRs), pesticides, fungicides, and herbicides that are synthetic chemicals [41]. Since the introduction of artificial nitrogen fertilisers, biodynamic agriculture, the first certified organic farming system, has sought out alternative methods [7], [60]. The environment's negative consequences of conventional agriculture may be mitigated in part by using biodynamic farming techniques. Biodynamic-farming is comparable to the organic farming in which no chemically synthesized fertiliser or insecticides are employed (Fig 4). Contrary to organic farmers, biodynamic farmers supplement their soil with eight unique preparations (out of cow manure, silica, and other herbs) to improve plant development and growth. Organic farming practises use no synthetic inputs in an effort to food production with little negative affect on people, animals, and biodiversity [3]. According to two recent meta-analyses, switching from traditional high-input systems to organic systems will result in a yield loss of 19 to 34% [49], [13], which might be disastrous given that the current issue of producing food for 9 billion people by 2050 [20], [61]. When compared to conventional farms, the biodynamic farms had soils that were of superior biological and physical quality, had a considerable increase in microbial activity and organic matter(OC) content, and had improved structure of the soil, reduced bulk-density(BD), easy penetrability, and a deeper top-soil depth [42]. Bibliometric analysis which is a useful tool to evaluate research trends and patterns in a specific area of interest was utilised in the current situation. Some studies have focused on analyzing the effect of bio-organic preparations and Sharbati wheat varieties for higher organic wheat productivity and profitability. Analysis from 322 research documents on organic agriculture was performed and eventually 255 research documents were discarded (Fig 1).

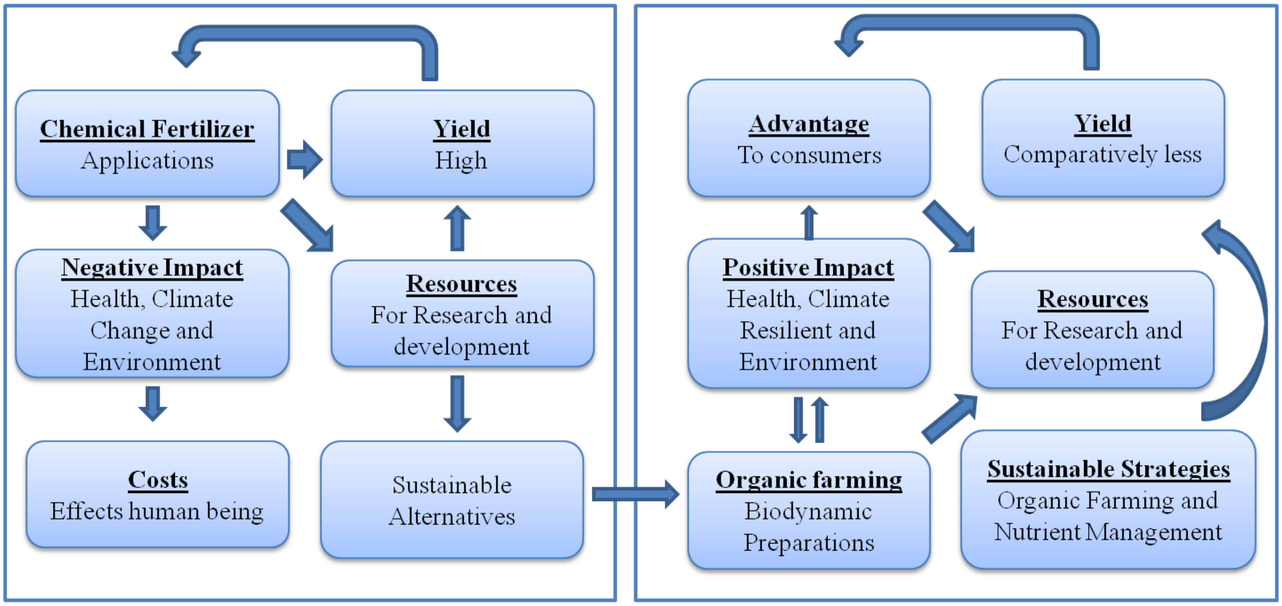


**Fig 4:** Shifting from Chemical Fertilizer to Organic Practice

## 2. Material and methods

### *2.1 Experimental setup and location*

During the rabi seasons of 2018–19 and 2019–20, a field experiment was done on 'Vertisol' at the Adhartal farm unit, JNKVV, Jabalpur, Madhya Pradesh, India (Fig 5). The experimental location in Jabalpur is comprised of wheat-rice cropping- system covered with the Kymore plateau including the Satpura hills Agro-climatic zone of the Madhya Pradesh, India. Hot, dry summers and dry winters are characteristics of this region's sub humid, tropical climate. Over two consecutive years (2015-16 and 2016-17), all weekly meteorological data on various weather parameters (i.e. temperature (max. & min.), rainfall, relative humidity, sunshine hr, and wind velocity) were collected at meteorological observatory at College of Agricultural Engg. (CoAE), J.N.K.V.V, JBP (Fig 6(a) and 6(b)).

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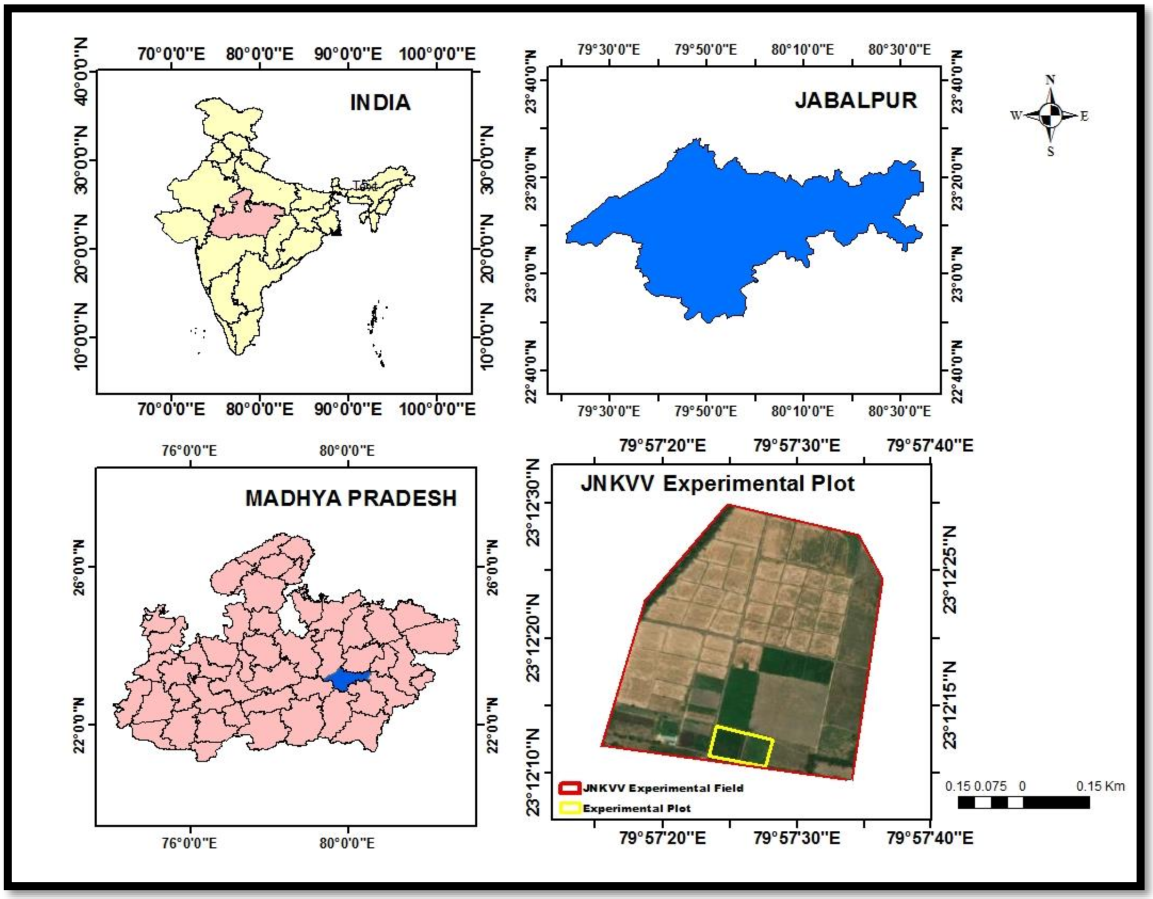


**Fig 5:** Index Map of Study Area

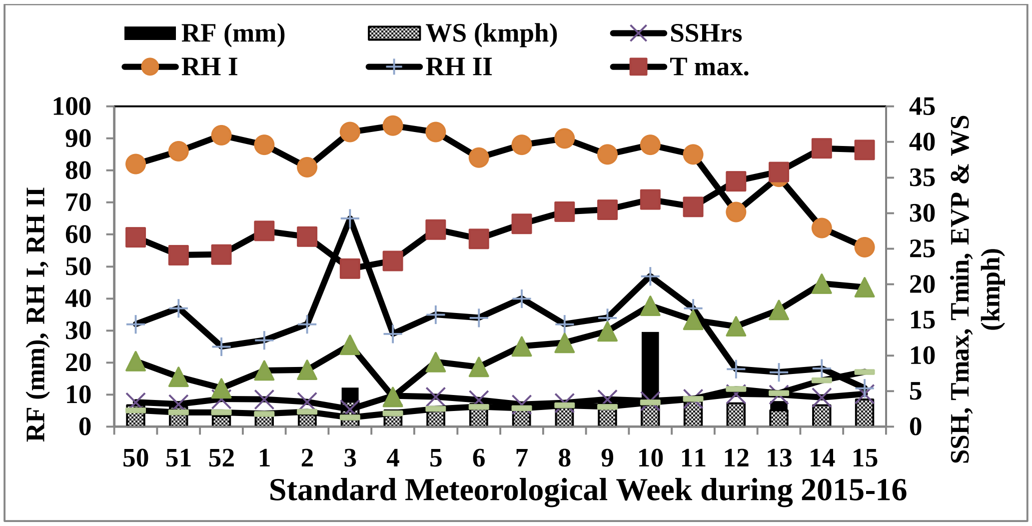


**Fig 6** (a): Meteorological data during rabi 2015-16

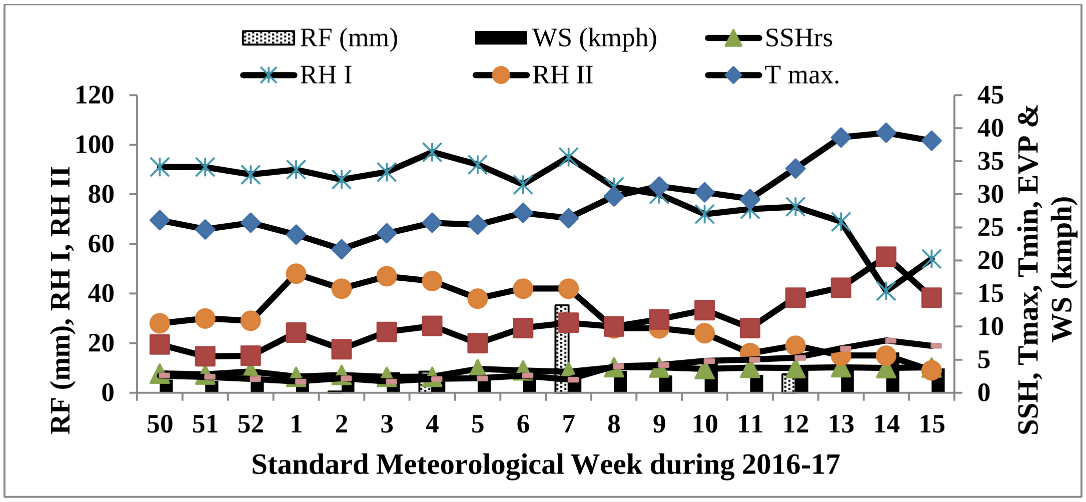


**Fig 6**(b): Meteorological data during rabi 2016-17

### *2.2 Soil characteristics: Physical and Chemical*

Before the field experiment began, soil samples were taken using a soil auger at random depths of 0–15 cm from different patches around the experimental site to get a sense of texture and the inherent soil fertility of field. The soil-sample was thoroughly combined to create a typical soil sample. A representative soil sample was produced once the soil samples were well mixed. Next, physico-chemical analyses were performed in the Deptt. of Agronomy, main laboratory at College of Agriculture (CoA), J.N.K.V.V, JBP, according to recognised protocols. Soil samples were found to be neutral in the reaction and electrical conductivity, with medium available phosphorus (P), low available nitrogen (N), potassium (K), and organic carbon content (Table 1).

**Table 1:** Physical and chemical features of soil

| Parameter | Calculated Value | Class /groups /status | Adopted technique |
|---|---|---|---|
| **A. Mechanical-composition** | | | |
| Sand(%) | 28.15 | Sandy clay loam | Method of International pipette [40] |
| Silt(%) | 23.6 | | |
| Clay(%) | 44.7 | | |
| Bulk-density(BD, $Mgm^{-3}$) | 1.36 | | Method of Core sampler [6] |
| **B. Chemical composition** | | | |
| Organic carbon(OC, %) | 0.64 | Medium | Method of Rapid titration [64] |
| Available nitrogen(kg per ha) | 290.84 | Medium | Method of Alkaline permanganate [58] |
| $P_2O_5$ Available(kg per ha) | 16.78 | Medium | Calorimeteric method [38] |
| $K_2O$ Available (kg per ha) | 325.62 | High | Flame photometer method [25] |
| pH of Soil (1:2.5 soil- | 7.1 | Neutral | Glass-electric pH meter method |

| | | | |
|---|---|---|---|
| water suspension) | | | [40] |
| Electrical Conductivity (EC) (dS/m) | 0.38 | Normal | Solu-bridge method [5] |

### *2.3 Adopted treatment*

Seven BD (bio-organic preparations) served as the treatments of main plot for the experiment's split plot design, while four different wheat varieties served as the sub plot treatments, each of which was replicated thrice (Table 2).

**Table 2:** Adopted treatments their characteristics in the experiment

| **Description** | | |
|---|---|---|
| **Main-plot treatments** | | |
| $P_1$ | VC*+BD-500 | |
| $P_2$ | VC+BD-501 | |
| $P_3$ | VC+P** | |
| $P_4$ | VC+BD-500+BD-501 | |
| $P_5$ | VC+BD-500+BD-501+P | |
| $P_6$ | VC(control) | |
| $P_7$ | Absolute control | |
| **Sub-plot treatments** | | |
| $V_1$ | C-306 | |
| $V_2$ | Sujata | |
| $V_3$ | HW-2004 (Amar) | |
| $V_4$ | JW-3020 | |
| BD-500: 75g /ha, BD-501: 2.5g /ha *Vermicompost: 4t/ha, **Panchgavya: 3% spray at CRI, tillering and jointing | | |
| **Varietal characteristics of different *Sharbati* wheat varieties**<br>The most expensive variety of wheat sold in the nation is called *Sharbati*. It thrives best in excellent black and alluvial soil that is ideal for growing *Sharbati* wheat. Because of its golden hue, weighty appearance on the palm, and sweet flavour, *Sharbati* wheat is however known as "*The Golden Grain*". According to its name, *Sharbati* type wheat is a little bit sweeter than other wheat varieties in tests. This is most likely because it contains a little bit more glucose and sucrose than other wheat varieties. | | |
| **Variety** | **Average yield** | **Plant, Grain and Quality Characteristic** |
| **C-306** | 26-30 q $ha^{-1}$ | The awn color of the variety is white, amber colour grain, hardy texture (hardness index: 90), oblong and bold in shape and size. The germ width is medium with shallow grain crease in nature. The test weight is 40-45 g [45]. Its sedimentation value is 30-60 ml. |
| **Sujata** | 16-18 q $ha^{-1}$ | The color of coleoptiles is green. It attains a plant height of 120-130 cm, matures in 135-140 days, the color of stem is green and foliage is moderately waxy stem, grain holds amber color, hardy in texture, and bold in size. 1000 kernel weight is 42-45 gm. The variety is very good for chapatti making [21], [46]. |

| | | |
|---|---|---|
| **HW-2004 (Amar)** | 15-20 q ha$^{-1}$ | The variety is intermediate, takes medium (91-100 days) to heading. [23]. The amber coloured grain, hardy texture (hardness index: 89), oblong and bold in shape and size. Medium germ width with shallow grain crease, 40-45 g test weight. Its reaction to phenol is medium and sedimentation value (SV) is 30-60 ml. |
| **JW-3020** | 35-38 q ha$^{-1}$ | An intermediate variety, takes 125-130 days [27]. The grain is amber color, bears bold grain and long ears. 1000 kernel weight of this variety is 40-45 gm and sedimentation value is found to be 30-60 ml. |

### *2.4 Biodynamic spray: preparation and its application*

Two different biodynamic forms from SUPA Biotech (P) Ltd., namely BD-500 and BD-501 were included in this studyBD-500, also known as "prime starter of BD," is fermented cow dung that is made by filling cow horn with lactating dung of cow, burying cow's dung in the ground during southward equinox (September equinox ), and thereafter removing it at the time of the march equinox (March).As during cooler months, the propensity of growth energies is higher in the soil, which due to the receptiveness of the horns gets absorbed in to the horns [44]. Thereafter, the humidified cow dung from the buried horns are stored in dark, inside an earthen pot. Its application is done by dissolving 75g of cow horn manure in to 500 liters of warm water and stirring it continuously for the 1 h in clockwise as well as anti-clockwise way). The prepared solution is spread using broom stick over the soil surface as big droplets during evening prior to the sowing of seeds. Another biodynamic preparation utilised was BD-501 which is "cow horn silica" containing silica as the major content from, quartz crystals with powdery texture is stuffed in cow horns and placed similarly like cow horn manure but buried during spring equinox (March) till autumn equinox (September). The application of BD-501 is done by dissolving 2.5g in 500 l of warm water, stirred for 1 hr. and was sprayed as mist using knap sack sprayer on the plant foliage during early morning periods (i.e. before 9.00 a.m.).

Thereafter, *Panchgavya* as an organic preparation was used which was made by using the basic five ingredients derived from cow [i.e. milk of Cow (2 litres), curd of cow's milk (3 litres), dung of cow (7 kg), urine of cow (3 litres), and the clarified ghee of cow (4 litres) (1 kg)]. Fresh cow's dung and clarified ghee was first combined on day one and let to stand for two days in a small container while being stirred as least once every day [39]. Then, on the third day cow's urine (3 l) + water (10 l) were added and left for fermentation for 12 days. Later, cow's curd (3 l) + cow's milk (2 l) were added and again kept for fifteen days. The container lid was kept covered with a mesh (wired mesh) under shade and was mixed timely during morning and evening for about 20 minutes, as it promotes aerobic microbial growth, aeration and to enhance its storage capacity [4]. Afterwards, in an earthen pot all of the mixture is transferred and preserved in shade, 10 days later, *Panchgavya* stock gets fully fermented and is ready to use. For its application 3% solution was prepared by mixing 3 l of *Panchagvya* in to 100 l of water. A hand sprayer was used to apply 15 l of the solution after mixing it with 500 l of water.

### *2.5 Observations and Statistical Analysis*

Observations based on plant population, crop's growth studies (*viz*. plant height, plant population, no. of tiller and plant weight (dry) of wheat) were noted at the 30, 60, 90 DAS and at the harvest). Data pertaining to LAI and chlorophyll content were also recorded at 30, 60 and 90 DAS. However, the crop growth rate (CGR), relative growth rate(RGR) and net assimilation rate(NAR) were computed at 30-60 and 60-90 days intervals. The yield attributing characteristics *viz*., length of ear head, number of effective tillers per meter square, no. of grains per ear head, weight of grains per ear head, and the test weight and finally grain and straw's yield were recorded at harvest. Finally, the economic viability of treatments were determined in the terms of gross monetary returns, cost cultivation, net monetary returns and benefit- cost BC ratio on the per hectare area basis.

Using SAS 9.3 software, all the parameters were subjected to analysis using the analysis of variance (ANOVA) approach (Gomez and Gomez, 1984). (SAS Institute, Cary, NC). In every instance, the 5% level of significance (P0.05) was utilised to calculate the main and interaction effects among the treatments using the least significant test. As a post-hoc means separation test, Tukey's honest significant difference (HSD) test is employed (p 0.05).

## 3. Results and discussion

### *3.1 Effect on plant growth related parameters*

The lowest values of the growth parameters viz., plant height, the number of tillers and the leaf area index (LAI), the plant dry weight, the crop growth rate (CGR), the relative growth (RGR) rate along with the chlorophyll content; were recorded in absolute control treatments. However, values of the growth parameter was appreciably increased in the plots receiving BD-500+BD-501+P+ VC at different time intervals followed by plots receiving P+VC and BD-500+ BD-501+ VC. The variety JW-3020 produced significantly superior growth parameters at all-time intervals over C-306 and HW-2004. Chlorophyll content was maximum in the leaves of JW-3020 during all time intervals indicating healthy and productive plants in comparison to C-306 and HW-2004 (Table 3). The positive effect of vermicompost combined with biodynamic remedies and Panchgavya as compared to absolute control may be attributable to higher photosynthetic efficiency in leaves and awns, according to results on the dry matter production (DMA) and the distribution. The application of the bio-organics, which in turn was in charge of upholding higher chlorophyll and consequently was responsible for leading to the higher photosynthesis and the dry matter production by the plants, may also be related to this. This would improve the mineral status of the soil. Similar observations were also made by [8] in wheat, [9], [34], [12] when VC was applied to wheat, plant height and dry weight greatly increased, and all other growth measures and wheat yield features also increased in similar manner.

**Table 3:** Impact of various treatments applied at sequential time intervals on plant growth parameters (2-year average data)

| Treatments | Plant height (ht) (in cm) | | | | Dry matter accumulation (DMA) ($g/m^2$) | | | | Number of tillers per square metre | | | | Leaf-area index (LAI) | | | Chlorophyll- Index (by SPAD values) | | | (CGR) Crop growth rate ($gm^{-2}$ $day^{-1}$) | | (RGR) Relative growth rate ($g$ $g^{-1}$ $day^{-1}$) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 30 D-A-S | 60 D-A-S | 90 D-A-S | At the harvest | 30 D-A-S | 60 D-A-S | 90 D-A-S | At the harvest | 30 D-A-S | 60 D-A-S | 90 D-A-S | At the harvest | 30 D-A-S | 60 D-A-S | 90 D-A-S | 30 D-A-S | 60 D-A-S | 90 D-A-S | 30 D-A-S | 60 D-A-S | 30 D-A-S | 60 D-A-S |
| **Bio-organic (BO) preparations** | | | | | | | | | | | | | | | | | | | | | | |
| P1:VC+ BD–500 | 18.66 | 53.04$^{de}$ | 92.36$^{g}$ | 93.90$^{f}$ | 45.10 | 765.39$^{bc}$ | 1211.49$^{cd}$ | 1324.49$^{de}$ | 91.17$^{d}$ | 197.86$^{d}$ | 296.01$^{d}$ | 292.27$^{d}$ | 0.44 | 2.22$^{cd}$ | 4.13$^{de}$ | 34.09 | 38.49$^{de}$ | 31.28$^{cd}$ | 24.01$^{cd}$ | 14.87$^{de}$ | 41.61$^{bc}$ | 7.73$^{bc}$ |
| P2:VC+ BD–501 | 20.07 | 54.92$^{d}$ | 95.84$^{d}$ | 98.71$^{d}$ | 50.04 | 760.43$^{cd}$ | 1210.32$^{de}$ | 1323.32$^{cd}$ | 90.55$^{de}$ | 196.52$^{de}$ | 294.00$^{de}$ | 289.84$^{de}$ | 0.45 | 2.20$^{de}$ | 4.16$^{cd}$ | 34.72 | 38.94$^{cd}$ | 31.82$^{bc}$ | 23.68$^{de}$ | 15.30$^{cd}$ | 39.74$^{ef}$ | 6.74$^{cd}$ |
| P3: VC+ P | 19.90 | 56.83$^{b}$ | 100.61$^{b}$ | 103.29$^{b}$ | 53.91 | 806.98$^{ab}$ | 1382.28$^{a}$ | 1488.78$^{a}$ | 100.19$^{b}$ | 217.44$^{b}$ | 325.30$^{b}$ | 319.41$^{b}$ | 0.51 | 2.41$^{b}$ | 4.30$^{b}$ | 34.92 | 39.78$^{b}$ | 32.31$^{b}$ | 25.10$^{ab}$ | 19.18$^{a}$ | 40.50$^{cd}$ | 6.68$^{de}$ |
| P4:VC+ BD-500 +BD–501 | 19.73 | 56.00$^{bc}$ | 99.22$^{c}$ | 100.22$^{c}$ | 47.64 | 771.98 | 1230.99$^{c}$ | 1343.99$^{bc}$ | 97.52$^{bc}$ | 211.65$^{c}$ | 316.65$^{c}$ | 310.52$^{bc}$ | 0.48 | 2.25$^{c}$ | 4.21$^{bc}$ | 34.01 | 39.60$^{bc}$ | 31.22$^{de}$ | 24.14$^{bc}$ | 15.00$^{bc}$ | 39.85$^{de}$ | 7.67$^{ab}$ |
| P5:VC+ BD-500+BD-501+ P | 21.01 | 60.96$^{a}$ | 108.28$^{a}$ | 110.01$^{a}$ | 45.75 | 816.45$^{a}$ | 1353.56$^{ab}$ | 1465.06$^{ab}$ | 106.07$^{a}$ | 230.20$^{a}$ | 344.39$^{a}$ | 343.25$^{a}$ | 0.57 | 2.83$^{a}$ | 4.54$^{a}$ | 34.48 | 41.88$^{a}$ | 34.70$^{a}$ | 25.69$^{a}$ | 17.90$^{ab}$ | 42.30$^{a}$ | 8.15$^{a}$ |
| P6:VC (control) | 19.05 | 51.33$^{f}$ | 94.39$^{df}$ | 96.77$^{e}$ | 42.75 | 705.00$^{de}$ | 918.01$^{f}$ | 1029.51$^{f}$ | 82.34$^{f}$ | 178.69$^{f}$ | 267.34$^{f}$ | 262.57$^{f}$ | 0.41 | 2.19$^{de}$ | 3.49$^{f}$ | 33.67 | 38.43$^{ef}$ | 30.42$^{f}$ | 22.08$^{f}$ | 7.53$^{f}$ | 41.10$^{ab}$ | 3.28$^{g}$ |
| P7:Absolute control | 19.57 | 41.54$^{g}$ | 82.70$^{h}$ | 85.48$^{g}$ | 48.33 | 679.68$^{ef}$ | 905.64$^{fg}$ | 1017.14$^{fg}$ | 67.00$^{g}$ | 145.40$^{g}$ | 217.53$^{g}$ | 212.14$^{g}$ | 0.39 | 1.89$^{f}$ | 2.38$^{g}$ | 31.62 | 35.91$^{g}$ | 26.83$^{g}$ | 21.05$^{fg}$ | 7.10$^{fg}$ | 38.24$^{fg}$ | 4.14$^{ef}$ |
| **SEm ±** | 0.62 | 0.69 | 2.05 | 0.56 | 2.81 | 23.02 | 50.91 | 48.2 | 1.03 | 2.23 | 3.33 | 3.29 | 0.01 | 0.04 | 0.06 | 0.40 | 0.54 | 0.46 | 0.69 | 1.02 | 0.51 | 0.40 |
| **CD (p=0.05)** | NS | 2.12 | 6.30 | 1.72 | NS | 70.93 | 156.88 | 146.22 | 3.16 | 6.86 | 10.26 | 10.15 | NS | 0.13 | 0.19 | NS | 1.65 | 1.40 | 2.11 | 3.13 | 1.57 | 1.24 |
| **Varieties** | | | | | | | | | | | | | | | | | | | | | | |
| $V_1$: C-306 | 19.39$^{c}$ | 51.85$^{c}$ | 96.28bc | 96.94$^{c}$ | 45.92 | 786.22$^{b}$ | 1201.21$^{ab}$ | 1313.57$^{ab}$ | 97.86$^{b}$ | 212.39$^{b}$ | 317.75$^{b}$ | 312.22$^{b}$ | 0.47$^{ab}$ | 2.28$^{b}$ | 3.94$^{b}$ | 34.54$^{a}$ | 39.97$^{b}$ | 31.15$^{b}$ | 24.68$^{b}$ | 13.83$^{b}$ | 41.67$^{a}$ | 6.50$^{bc}$ |
| $V_2$: Sujata | 17.84$^{d}$ | 55.61$^{ab}$ | 96.70b | 100.54$^{ab}$ | 46.21 | 683.05$^{d}$ | 1090.88$^{d}$ | 1203.23$^{cd}$ | 76.21$^{d}$ | 165.40$^{d}$ | 247.46$^{d}$ | 240.80$^{d}$ | 0.44$^{cd}$ | 2.16$^{d}$ | 3.67$^{d}$ | 33.09$^{cd}$ | 37.75$^{c}$ | 30.63$^{d}$ | 21.23$^{d}$ | 12.79$^{d}$ | 39.27$^{cd}$ | 5.03$^{d}$ |
| $V_3$: HW-2004 | 20.78$^{ab}$ | 56.97$^{a}$ | 107.06a | 108.10$^{a}$ | 46.80 | 732.61$^{c}$ | 1116.21$^{c}$ | 1226.71$^{c}$ | 86.15$^{c}$ | 186.98$^{c}$ | 279.74$^{c}$ | 270.97$^{c}$ | 0.45$^{bc}$ | 2.26$^{bc}$ | 3.81$^{bc}$ | 33.61$^{c}$ | 37.48$^{cd}$ | 31.08$^{bc}$ | 22.86$^{c}$ | 13.59$^{c}$ | 40.14$^{bc}$ | 6.12$^{ab}$ |
| $V_4$: JW-3020 | 20.83$^{a}$ | 49.61$^{d}$ | 84.75d | 87.78$^{d}$ | 51.64 | 830.07$^{a}$ | 1284.45$^{a}$ | 1394.95$^{a}$ | 102.53$^{a}$ | 222.52$^{a}$ | 332.90$^{a}$ | 326.87$^{a}$ | 0.49$^{a}$ | 2.41$^{a}$ | 4.13$^{a}$ | 34.48$^{ab}$ | 40.23$^{a}$ | 32.05$^{a}$ | 25.95$^{a}$ | 15.15$^{a}$ | 40.83$^{b}$ | 6.72$^{a}$ |
| **SEm ±** | 0.31 | 0.52 | 0.92 | 0.46 | 1.94 | 16.51 | 32.94 | 33.92 | 0.69 | 1.50 | 2.24 | 2.24 | 0.01 | 0.03 | 0.04 | 0.25 | 0.36 | 0.27 | 0.50 | 0.71 | 0.41 | 0.37 |
| **CD (p=0.05)** | 0.89 | 1.49 | 2.64 | 1.32 | NS | 47.12 | 94.02 | 100.2 | 1.97 | 4.27 | 6.39 | 6.39 | 0.02 | 0.09 | 0.12 | 0.72 | 1.02 | 0.76 | 1.43 | 2.03 | 1.18 | 1.05 |

### *3.2 Effect on yield attributing parameters*

Characteristics that influence yield, such as ear head length, (no.) number of the active tillers, and number of the grains in per ear head were recorded under absolute control treatments (Table 4 and Table 5). The combination application of BD500+BD501+P+VC was then followed by P+VC and BD500+BD501+VC, which produced the notable increase of 22.29, 18.26, and 6.38 per cent on the grain yield of the wheat over single application of the BD500, BD501, and P. each along with VC. In comparison to C-306 and HW-2004, JW-3020 was shown to provide much better grain yield and yield qualities.

**Table 4:** Impact of the bio-organic preparations and the *Sharbati* varieties of wheat on effective tillers/m2 and no. of grains per ear (2-year average data)

| Treatments | Effective tillers/m$^2$ | | | | | | | | Grains per ear head | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Bio-organic preparations | | | | | | | | | | | | | | | |
| **Varieties** | **$P_1$** | **$P_2$** | **$P_3$** | **$P_4$** | **$P_5$** | **$P_6$** | **$P_7$** | **Mean** | **$P_1$** | **$P_2$** | **$P_3$** | **$P_4$** | **$P_5$** | **$P_6$** | **$P_7$** | **Mean** |
| **C-306 ($V_1$)** | 246.68 | 246.68 | 279.87 | 269.65 | 300.56 | 229.37 | 200.57 | **253.34** | 26.80 | 26.57 | 29.06 | 27.65 | 30.16 | 24.10 | 18.49 | **182.82** |
| **Sujata ($V_2$)** | 204.24 | 197.83 | 222.29 | 210.65 | 234.17 | 189.89 | 122.00 | **197.30** | 17.19 | 17.38 | 18.96 | 18.40 | 20.48 | 16.56 | 15.47 | **124.43** |
| **HW-2004 ($V_3$)** | 228.65 | 226.31 | 240.62 | 237.24 | 260.52 | 195.86 | 172.03 | **223.03** | 25.75 | 25.82 | 27.29 | 26.49 | 27.80 | 23.70 | 17.85 | **174.68** |
| **JW-3020 ($V_4$)** | 264.47 | 266.82 | 294.66 | 292.30 | 303.08 | 237.48 | 199.15 | **265.42** | 29.63 | 29.60 | 31.99 | 30.38 | 32.15 | 26.78 | 20.49 | **200.99** |
| **Mean** | **236.01** | **234.41** | **259.36** | **252.46** | **274.58** | **213.15** | **173.44** | | **24.84** | **24.84** | **25.73** | **26.82** | **27.65** | **22.78** | **18.07** | |
| | **SEm ±** | | | | **CD (P=0.05)** | | | | **SEm ±** | | | | **CD (P=0.05)** | | | |
| **P x V at same P** | 11.25 | | | | 3.75 | | | | 0.94 | | | | 2.83 | | | |
| **P x V at same V** | 2.53 | | | | 7.60 | | | | 1.28 | | | | 3.85 | | | |

**Table 5:** Sharbati wheat yield attributes as influenced by the different treatments (2 years average data)

| **Treatments** | **Ear length (cm)** | **Test weight (g)** |
|---|---|---|
| **Bio-organic preparations** | | |
| $P_1$: VC+ BD–500 | 7.35$^{e}$ | 33.76$^{de}$ |
| $P_2$: VC+ BD–501 | 7.43$^{cd}$ | 33.92$^{cd}$ |
| $P_3$: VC+ P | 7.51$^{b}$ | 35.44$^{bc}$ |
| $P_4$: VC+ BD-500 +BD–501 | 7.48$^{bc}$ | 35.48$^{b}$ |
| $P_5$:VC+BD-500+BD-501+P | 7.77$^{a}$ | 36.90$^{a}$ |
| $P_6$: VC (control) | 6.80$^{f}$ | 30.83$^{f}$ |
| $P_7$: Absolute control | 5.17$^{g}$ | 29.23$^{g}$ |
| **SEm ±** | 0.079 | 0.14 |
| **CD ( p=0.05)** | 0.24 | 0.42 |
| **Varieties** | | |
| $V_1$: C-306 | 7.14$^{b}$ | 35.35$^{b}$ |
| $V_2$: Sujata | 6.79$^{d}$ | 30.61$^{d}$ |
| $V_3$: HW-2004 | 6.97$^{c}$ | 33.05$^{c}$ |
| $V_4$: JW-3020 | 7.40$^{a}$ | 35.6$^{a}$ |
| **SEm ±** | 0.04 | 0.08 |
| **CD ( p=0.05)** | 0.12 | 0.24 |

Grain yields in plots treated with BD-500+BD-501+ P and P+VC over both years were noticeably higher. Spraying of BD500+BD501+ P with the VC provided significantly higher grain yield 2438.14 and 2684.92

kg ha$^{-1}$ than other bio-organic treatments during 2015-16 and 2016-17, respectively followed by the application of P+VC (2272.00 and 2489.33 kg per ha) and BD500+BD501 with VC (2214.25 and 2370.92 kg per ha). However, poor grain-yield (1747.00 and 1911.83 kg per ha) was recorded under control and absolute control treatment (1289.17 and 1197.33 kg per ha) respectively in the years 2015–16 and 2016–17 (**Table 6**). Between all the varieties JW-3020 gave the highest (2984.79 and 3259.29 kg per ha) grain yield during the both years followed by C-306 (1999.33 and 2102.19 kg per ha) and HW-2004 (1532.67 and 1667.29 kg per ha). Nevertheless, during the years 2015–16 and 2016–17, it was concluded that the variety Sujata had a low grain yield (1477.47 and 1604.43 kg per ha). The grain yield of wheat crop in both years was influenced by interactions between distinct bio-organic preparations and different *Sharbati* wheat cultivars. Wheat varieties outperformed each other when fed with BD-500+ BD-501+ P and VC, with P application being higher under JW-3020, followed by C-306, HW-2004, and Sujata. The grain production of all the varieties also was boosted by the other bio-organic (BO) preparations, BD500+BD501+ P each with VC, and these demonstrated to be superior to combinations. When the bio-organic (BO) preparations (BD500+, BD501, and P) were utilised alone with VC, presence of the growth hormones (GA and IAA) may had favoured faster division of cells and the cell elongation in the crop plants, which eventually stimulated the crop growth and also development and may have contributed to the development of superior yield-attributing traits in Sharbati wheat. The group of biodynamic preparations examined in BD, according to [22], showed a yield-stabilizing impact on wheat and maize performance. Ultimately, higher grain production was produced by the BD system than by the organic system. According to their findings, these preparations significantly boosted root development in maize, and the biodynamic treatment that got the most preparations showed the largest degree of the impact in the overall yield performance of both the crops. Further, According to [52], application of the BD500 and BD501 with the FYM or VC and in fact, under an organic production system, the combined application of the (OM) organic manure together with biodynamic treatments (BD500 and BD501) increased cumin yield and yield characteristics to their full potential.

Significantly highest (3386.32 and 3532.15 kg ha$^{-1}$) straw yield was noted with application of BD500+BD501+ P +VC during both years followed by P+VC (3186.65 and 3431.27 kg ha$^{-1}$) being at par to BD-500+BD-501 with VC (3177.93 kg ha$^{-1}$) during 2015-16. However, lowest straw yield was registered under the sole application of VC (2699.60 and 2549.60 kg per ha) and absolute control (2197.17 and 2100.50 kg per ha) for both years.

Genetic makeup of each variety accounted for the majority of the variations in straw yield. The straw yield with the variety JW-3020 was significantly higher (3644.25 and 3731.87 kg ha$^{-1}$) followed by C-306 (3036.39 and 3019.24 kg ha$^{-1}$) and HW-2004 (2578.37 and 2687.18 kg ha$^{-1}$) being the lowest under Sujata was (2197.17 and 2100.50 kg ha$^{-1}$) respectively, for both years.

Interactions between various bio-organic preparations have a substantial impact on the straw yield and various Sharbati wheat varieties during both the years (Table 7). Spray of BD-500+BD-501+P+VC in all the *Sharbati* wheat varieties recorded higher straw yield throughout the two years of experimentation which proved much better than other combinations of the bio-organic (BO) preparations and the *Sharbati* varieties of wheat except application of Panchgavya along with VC in case of C-306 variety which proved better than N5V1 and N4V1 during 2015-16.

Genetic traits are responsible for varietal variations in yields, but bio-organic preparations in addition to VC can lead to superior yield-attributing features and better records. [32] reported that cultivars differed significantly with respect to grain yield under the similar sowing windows [11] observed that C-306 consistently had better performance nonetheless, it is a very tall cultivar that is prone to lodging across all cropping systems.

A higher harvest index value implies that the plant is more effective at providing a profitable crop. A very close perusal of data clearly manifests marked the effect of bio-organic preparations on harvest index (HI) of the crop as it was higher (41.08 and 42.56 per cent) with BD-500+BD-501+ P+ VC and performed noticeably better than P+VC (40.99 and 41.08%) during both the years. However, BD-500+BD-501 with VC was also found superior (40.44 and 41.31 per cent) over control (38.38 and 40.12 per cent) and absolute control treatments (36.53 and 35.77 per cent) in both the consecutive years. Amongst the varieties, JW-3020 exhibited significantly higher harvest index (44.72 and 46.17 per cent) in comparison to varieties however, the variety C-306 also registered superiority (39.49 and 40.76 per cent) over other varieties being the lowest (37.31 and 38.15 per cent) under *Sujata* (37.19 and 37.51 per cent) during *rabi* 2015-2016 and 2016-17 (Table 8).

The highest cost of cultivation was incurred under BD500+BD501+P+Vermi Compost following that BD500+BD501+VC and P+VC being the lowest under absolute control plots where none of the bio-organic preparations or VC was applied (Fig 7). Nonetheless, the cost of cultivation was the same for all types. Among the bio-organic preparations, the highest GMR and NMR were noted under BD-500+BD-501+P+VC that are found better than all the other treatments. BD-500+BD-50+P stood first in terms of profitability and was superior to BD-500+BD–501 with VC and P+VC (Table 9). However, the least profitability was obtained from the absolute control plots. The profitability was highest with JW-3020 followed by C-306, HW-3020 being the least in case of Sujata. Organic manure has been found to have a beneficial effect on net returns, with [65] reporting higher net returns for wheat, [54] for soybean, [66] for Panchagavya spray [66]. [59] observed maximum net return from spray of BD-501 being lowest under untreated control plots. It was also reported that maximum BC ratio (2.24) was significantly obtained in case of spraying of silicon BD compared to untreated control (1.55). The BC ratio was greater with the combined application of the RDF and Panchagavya (2.28) than RDN through the organics +Panchagavya spray in case of rice, according to [54].

**Table 6:** Effect of the bio-organic (BO) preparations on the grain yield of *Sharbati* wheat varieties during *rabi* of 2015-16 and the 2016-17

| 1st year | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Grain yield (kg/ha)** | | | | | | | | |
| **Treatment** | **Bio-organic preparations** | | | | | | | |
| **Varieties** | **P1** | **P2** | **P3** | **P4** | **P5** | **P6** | **P7** | **Mean** |
| **C-306 (V1)** | 1927.33 | 2039.67 | 2367.33 | 2187.67 | 2536.67 | 1600.00 | 1336.67 | **1999.33** |
| **Sujata (V2)** | 1521.00 | 1532.00 | 1613.33 | 1655.33 | 1856.67 | 1234.00 | 930.00 | **1477.48** |
| **HW-2004 (V3)** | 1480.33 | 1564.33 | 1774.00 | 1744.33 | 1767.67 | 1341.33 | 1056.67 | **1532.67** |
| **JW-3020 (V4)** | 3006.67 | 3046.33 | 3333.33 | 3269.67 | 3591.56 | 2812.67 | 1833.33 | **2984.79** |
| **Mean** | **1983.83** | **2045.58** | **2272.00** | **2214.25** | **2438.14** | **1747.00** | **1289.17** | |
| | **Bio-organic prep. (P)** | **Varieties (V)** | | **P x V at same P** | | **P x V at same V** | | |
| **SEm ±** | 10.59 | 9.34 | | 34.94 | | 45.34 | | |
| **CD (P=0.05)** | 32.63 | 26.65 | | 105.82 | | 137.02 | | |
| **2nd year** | | | | | | | | |
| **Treatments** | **Bio-organic preparations** | | | | | | | |
| **Varieties** | **P1** | **P2** | **P3** | **P4** | **P5** | **P6** | **P7** | **Mean** |
| **C-306 (V1)** | 2086.67 | 2114.33 | 2468.00 | 2286.67 | 2766.67 | 1723.00 | 1270.00 | **2102.19** |
| **Sujata (V2)** | 1618.67 | 1646.00 | 1840.33 | 1770.00 | 2160.00 | 1336.00 | 860.00 | **1604.43** |
| **HW-2004 (V3)** | 1681.00 | 1728.33 | 1985.67 | 1863.67 | 2019.67 | 1453.33 | 939.33 | **1667.29** |
| **JW-3020 (V4)** | 3453.33 | 3486.67 | 3663.33 | 3563.33 | 3793.33 | 3135.00 | 1720.00 | **3259.29** |
| **Mean** | **2209.92** | **2243.83** | **2489.33** | **2370.92** | **2684.92** | **1911.83** | **1197.33** | |
| | **Bio-organic prep. (P)** | **Varieties (V)** | | **P x V at same P** | | **P x V at same V** | | |
| **SEm ±** | 17.28 | 13.47 | | 50.41 | | 66.40 | | |
| **CD (P=0.05)** | 53.23 | 38.45 | | 151.74 | | 199.45 | | |

**Table 7:** Effect of the bio-organic (BO) preparations and the varieties on the straw yield of the *Sharbati* wheat varieties

| 1st year | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Straw yield (kg/ha)** | | | | | | | | |
| **Treatment** | **Bio-organic preparations** | | | | | | | |
| **Varieties** | **$P_1$** | **$P_2$** | **$P_3$** | **$P_4$** | **$P_5$** | **$P_6$** | **$P_7$** | **Mean** |
| **C-306 ($V_1$)** | 2970.98 | 3071.40 | 3545.80 | 3354.53 | 3439.33 | 2640.00 | 2232.67 | **3036.39** |
| **Sujata ($V_2$)** | 2441.80 | 2437.60 | 2602.93 | 2644.00 | 2926.00 | 2294.53 | 1834.00 | **2454.41** |
| **HW-2004 ($V_3$)** | 2490.93 | 2540.47 | 2853.20 | 2752.47 | 3141.80 | 2341.07 | 1928.67 | **2578.37** |
| **JW-3020 ($V_4$)** | 3688.00 | 3762.07 | 3845.40 | 3860.00 | 4038.14 | 3522.80 | 2793.33 | **3644.25** |
| **Mean** | **2897.93** | **2952.88** | **3186.65** | **3177.93** | **3386.32** | **2699.60** | **2197.17** | |
| | **Bio-organic prep. (P)** | **Varieties (P)** | | **P x V at same P** | | **P x V at same V** | | |
| **SEm ±** | 8.26 | 6.85 | | 17.63 | | 22.50 | | |
| **CD (p=0.05)** | 25.46 | 19.55 | | 51.73 | | 68.26 | | |
| **2nd year** | | | | | | | | |
| **Treatments** | **Bio-organic preparations** | | | | | | | |
| **Varieties** | **$P_1$** | **$P_2$** | **$P_3$** | **$P_4$** | **$P_5$** | **$P_6$** | **$P_7$** | **Mean** |
| **C-306 ($V_1$)** | 3054.31 | 3114.73 | 3437.87 | 3355.80 | 3559.33 | 2460.00 | 2152.67 | **3019.24** |
| **Sujata ($V_2$)** | 2711.80 | 2724.27 | 3064.00 | 2866.27 | 3226.00 | 2101.20 | 1754.00 | **2635.36** |
| **HW-2004 ($V_3$)** | 2784.60 | 2795.13 | 3173.20 | 2985.80 | 3228.47 | 1994.40 | 1848.67 | **2687.18** |
| **JW-3020 ($V_4$)** | 3841.33 | 3842.07 | 4050.00 | 3985.40 | 4114.81 | 3642.80 | 2646.67 | **3731.87** |
| **Mean** | **3098.01** | **3119.05** | **3431.27** | **3298.32** | **3532.15** | **2549.60** | **2100.50** | |
| | **Bio-organic prep. (P)** | **Varieties (V)** | | **P x V at same P** | | **P x V at same V** | | |
| **SEm ±** | 8.61 | 5.71 | | 14.36 | | 19.86 | | |
| **CD (p=0.05)** | 26.54 | 16.29 | | 43.10 | | 59.06 | | |

**Table 8:** Harvest index (HI) of *Sharbati* wheat varieties as affected by the different bio-organic preparations

| **Treatments** | **Harvest index (HI) (%)** | | |
|---|---|---|---|
| | **1st year** | **2nd year** | **Mean** |
| **Bio-organic preparations** | | | |
| **$N_1$**:VC+BD500 | $39.98^{e}$ | $40.74^{de}$ | $40.36^{de}$ |
| **$N_2$**:VC+BD501 | $40.34^{cd}$ | $40.97^{d}$ | $40.65^{cd}$ |
| **$N_3$**:VC+P | $40.99^{b}$ | $41.08^{c}$ | $41.15^{b}$ |
| **$N_4$**:VC+BD-500+BD-501 | $40.44^{c}$ | $41.31^{b}$ | $40.76^{c}$ |
| **$N_5$**:VC+BD-500+BD-501+P | $41.08^{a}$ | $42.56^{a}$ | $41.82^{a}$ |
| **$N_6$**:VC(control) | $38.38^{f}$ | $40.12^{f}$ | $40.25^{ef}$ |
| **$N_7$**:Absolute control | $36.53^{g}$ | $35.77^{g}$ | $36.15^{g}$ |
| **SEm ±** | 0.13 | 0.21 | 0.14 |
| **CD (p=0.05)** | 0.39 | 0.64 | 0.43 |
| **Variety** | | | |
| **$V_1$**:C-306 | $39.49^{b}$ | $40.76^{b}$ | $40.12^{b}$ |
| **$V_2$**:Sujata | $37.19^{cd}$ | $37.51^{d}$ | $37.41^{cd}$ |
| **$V_3$**:HW-2004 | $37.31^{c}$ | $38.15^{c}$ | $37.67^{c}$ |
| **$V_4$**:JW-3020 | $44.72^{a}$ | $46.17^{a}$ | $45.45^{a}$ |
| **SEm ±** | 0.13 | 0.15 | 0.12 |
| **CD (p=0.05)** | 0.38 | 0.44 | 0.36 |

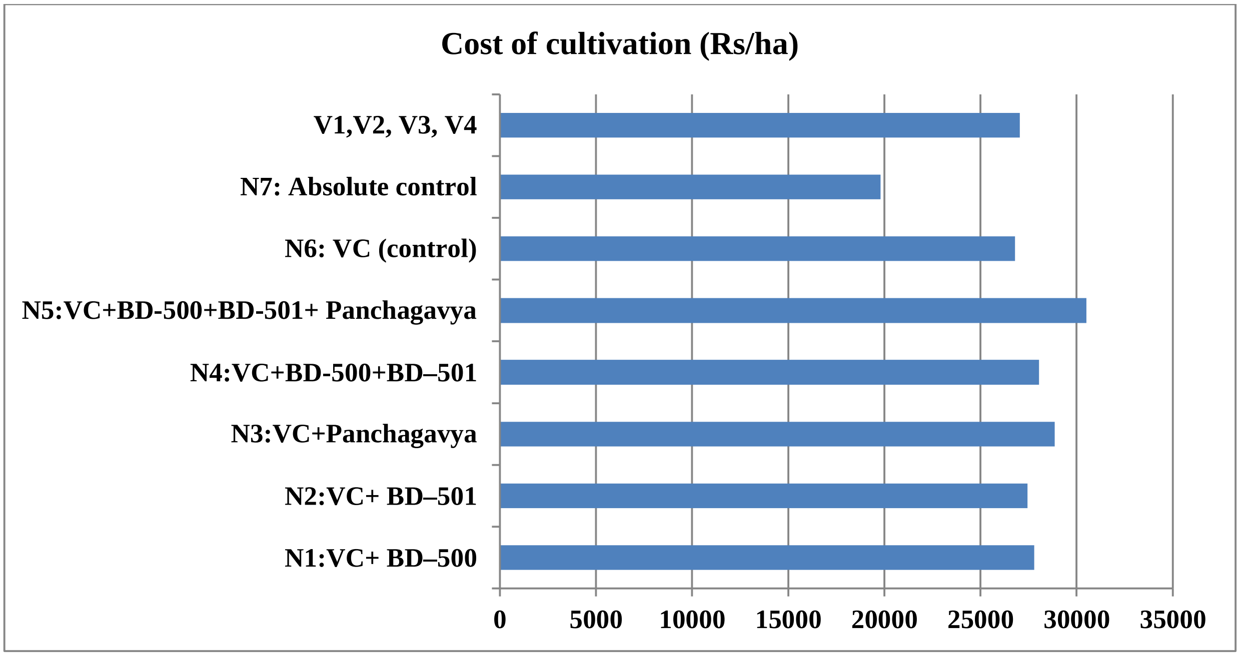


**Fig 7:** Cost of cultivation as affected by the different bio-organic (BO) preparations and the *Sharbati* wheat varieties (2-year average data)

**Table 9:** Effect of bio-organic preparations on the net monetary returns(NMR), gross monetary returns(GMR), and the benefit- cost (BC) ratio of Sharbati wheat varieties (2-year average data)

| Treatments | Gross monetary returns (GMR) (Rs./ha) | | | | | | | | Net monetary returns (NMR) (Rs/ha) | | | | | | | | Benefit- cost (BC) ratio | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Bio-organic preparations | | | | | | | | Bio-organic preparations | | | | | | | | Bio-organic preparations | | | | | | | |
| **Varieties** | **$N_1$** | **$N_2$** | **$N_3$** | **$N_4$** | **$N_5$** | **$N_6$** | **$N_7$** | **Mean** | **$N_1$** | **$N_2$** | **$N_3$** | **$N_4$** | **$N_5$** | **$N_6$** | **$N_7$** | **Mean** | **$N_1$** | **$N_2$** | **$N_3$** | **$N_4$** | **$N_5$** | **$N_6$** | **$N_7$** | **Mean** |
| **C-306 ($V_1$)** | 68246 | 70528 | 81279 | 76444 | 88244 | 56722 | 45264 | **69533** | 40446 | 43078 | 53229 | 47584 | 57734 | 29922 | 25464 | **42494** | 2.45 | 2.57 | 2.82 | 2.73 | 2.89 | 2.12 | 2.29 | **2.55** |
| **Sujata ($V_2$)** | 54262 | 54815 | 59767 | 58893 | 65763 | 44771 | 20196 | **51606** | 26462 | 27365 | 31717 | 30033 | 35253 | 17971 | 13396 | **24567** | 1.95 | 2.00 | 2.07 | 2.10 | 2.25 | 1.67 | 1.02 | **1.87** |
| **HW-2004 ($V_3$)** | 54808 | 56768 | 64688 | 61988 | 68537 | 47796 | 35499 | **55330** | 27010 | 29318 | 36638 | 33128 | 38027 | 20996 | 15699 | **28291** | 1.97 | 2.07 | 2.24 | 2.21 | 2.16 | 1.78 | 1.79 | **2.03** |
| **JW-3020($V_4$)** | 105499 | 106670 | 113773 | 111324 | 119694 | 97598 | 36546 | **98729** | 77699 | 79220 | 85723 | 82463 | 89184 | 70798 | 16747 | **71690** | 3.79 | 3.89 | 3.94 | 3.97 | 3.92 | 3.64 | 1.85 | **3.57** |
| **Mean** | **70705** | **72196** | **77163** | **79878** | **85560** | **61722** | **34377** | | **42904** | **44746** | **51827** | **48302** | **55050** | **34922** | **14576** | | **2.54** | **2.63** | **2.74** | **2.78** | **2.80** | **2.30** | **1.74** | |

## 4. Conclusion

The application of biodynamic remedies was recognised as they had an impact on soil characteristics and productivity. The lowest values of growth parameters [viz., the plant height (ht), no. of the tillers, dry-matter accumulation (DMA), relative growth rate(RGR) crop growth rate(CGR), and the chlorophyll content]; yield attributed parameters [(viz., no. of the effective tillers, length of the ear head, no. of grains/ head)] were recorded under absolute control treatments. However, the values of growth measures were appreciably increased in plots treated with BD500+BD501+P+VC at different time intervals followed by plots receiving P+VC and BD500+BD501+VC. Spraying of BD500+BD501+ P+VC followed by P+VC in Sharbati wheat varieties were found more productive than other combinations. The combined application of BD500+BD501+ P+VC was succeeded by P+VC and BD500+BD501 +VC, gave a notable increase of 22.29, 18.26, and 6.38 per cent on grain yield of wheat over the sole application of BD500, BD501, and P each with VC. Considerably higher grain (2462.18 kg per ha) and straw yields (3149.88 kg per ha), including harvest index (HI) (43.73). The variety JW-3020 produced significantly superior growth parameters at all-time intervals over C-306 and HW-2004. Chlorophyll content was maximum in the leaves of JW-3020 during all time intervals indicating healthy and productive plants in comparison to C-306 and HW-2004. The variety JW-3020 was concluded significantly superior in producing superior yield attributes, and grain yield than C-306 and HW-2004. Sharbati variety JW-3020 followed by C-306 and HW-3020 were found superior in terms of productivity for organic production system. In comparison to all other treatments, BD500+BD501+P+VC had the greatest GMR and NMR among all bio-organic preparations. In terms of profitability, BD500+BD501+P+VC was superior to BD-500+BD-501+VC and P+VC. Aside from that, it was noted that the use of BD-500+BD-501 or P+VC in JW-3020 and HW-2004 as well as BD-500+BD-501+P or P+VC in C-306 and Sujata stood more lucrative.

**Declaration of interests**

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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