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# Study conjoint application of organic amendments on yield, quality and economics of cauliflower (*Brassica oleracea var*. L. *botrytis*)

**Radhika and Savita**

**Abstract**
In India huge quantity of chemical fertilizers are used for obtained higher production. Due to unwanted use of synthetic fertilizers, it reduces the soil fertility day by day as well as spoiling the ecosystem and apart chemically produce vegetables, which we all consume enter in our food chain which cause serious disease in humans such as endocrine disruptors, respiratory disease like asthma, cancer, depression etc. Therefore, to improve the soil fertility and environmental conditions the experiment was carried at out at Agricultural research farm, Department of Horticulture, Lovely Professional University, Phagwara, during winter season of 2020-21, by using Randomized Complete Block Design with three replications. Therefore, the present study shows the positive impact of combined application of different organic amendments on yield and quality parameters of cauliflower. Result indicated that, $T_8$ performe best i.e., ($T_8$ - 3.8 t/ha vermicompost + 5 kg/ha azotobacter + 5 kg/ha VAM + 5% panchagavya) which significantly influence the yield parameters such: curd weight (703.83 g) which was at par with $T_7$ (646.25 g) followed by $T_9$ (622.08), $T_6$ (580.33 g), further followed by $T_3$ (576.41 g) in comparison to control (501.33 g). Whereas the highest curd diameter also observed under $T_8$ (11.27cm) which was at par with $T_7$ (9.28 cm), followed by $T_6$ (9.03 cm) and further followed by $T_4$ (8.76 cm). $T_8$ also gives highest curd length (16.45 cm) which was at par with $T_7$ (15.19 cm) followed by $T_6$ (14.79 cm) or $T_3$ (14.06 cm), respectively. The maximum curd yield (367.41 q/ha) was recorded under $T_8$ which was at par with $T_7$ (337.31 q/ha) followed by $T_9$ (324.37 q/ha) or followed by $T_6$ (303.13 q/ha), respectively. The minimum result observed under control. Quality parameters like ascorbic acid (54.67 mg/100g) followed by $T_7$ (51.14 mg/100g) and TSS (5.13°Brix). Also, $T_8$ was found the most profitable treatment in cauliflower with highest net return (Rs 6,95,699 /ha) with benefit cost ratio (18.55) followed by $T_7$ having net return (Rs. 6,35007) with benefit cost ration (17.02). Whereas, minimum benefit cost ration was recorded under $T_1$ . Therefore, the present study also revealed that, organic cultivation gives more profit with minimum environmental degradation with higher productivity.

**Keywords:** Azotobacter, cauliflower, curd yield, panchagavya, VAM, vermicompost

## Introduction
Cauliflower (*Brassica oleracea* L. *var. botrytis*) is one of the important cole crops grown worldwide. Before independence, in 1822 it is developed from wild cabbage with the help of mutation by east Indian company (Swarup and Chatterjee, 1972) [26]. It is annual for vegetable production and biennial for seed production, and belongs to the family *Brassicaceae*. In cauliflower, curd is an edible part which is white in colour and consists of a closed aggregating flower and developed bunchy type inflorescence. The leading cauliflower growing States in India constitutes of West Bengal, Bihar, Haryana, Uttar Pradesh, Assam, Karnataka and Tamil Nadu. In India area under cauliflower is about 435.9 thousand per hectares with production of 9235 million ton per hectares, with productivity is 281.92 thousand tonnes per hectare (NHB, 2018). Punjab state, produces about 2.6%of the total production of cauliflower in the country and 5.57% of total vegetable production in the state with productivity 17.93 MT/ha in the state. It is widely grown all over the world for its high nutritive qualities. Fresh cauliflower contains low fat and carbohydrates but is quite rich in vitamins such as A and C, thiamine, riboflavin and minerals like potassium, sodium, calcium, zinc, iron, magnesium, phosphorous, sulphur (Ogbede *et al.*, 2015) [17]. These vitamins and minerals contain antioxidant enzymes. It also a rich source of sinigrin, isothiocyanates, and glucoerucin which contains anti-carcinogenic property and cauliflower seeds also have contraceptive properties and also helps to maintain immune system.
Cauliflower is a crop which is grown all over the country and Punjab as well. Many farmers of

different districts cultivate the cauliflower in three times in one season i.e., early season, mid-season or late season varieties which further gives various opportunity of income and farmers gain more profit during cauliflower production. For higher production farmers use lots of synthetic fertilizers which reduce soil fertility, kill the beneficial micro-organisms, more over these chemicals interfere in our ecosystem (Sharma *et al*., 2020) [22]. Apart from these harmful pesticides present in fruits or vegetables which we all consume and their harmful chemicals enter in our food chain which cause serious disease in humans such as endocrine disruptors, respiratory disease like asthma, cancer, depression etc sometimes it ultimately causes death in humans (Chitale *et al*., 2012) [3]. More over price of inputs such as seeds, fertilizers, pesticides, irrigation, labour charges increase in every season. In this respect, organic farming which is an eco-friendly and natural way which sustain the production along with better economic returns and promote the higher yield as well as provide chemical free food for human consumption. Different organic sources such as biofertilizer, vermicompost and panachagavya fulfill the requirement of nutrients and give significant impact on cauliflower yield and quality at low cost. Thus, the present study is planned to study the economics of Cauliflower cultivation, in order to present the real scenario of economic Cauliflower cultivation. Keeping in view of these facts the study entitled "Study conjoint application of organic amendments on yield, quality and economics of cauliflower (*Brassica oleracea var*. L. *botrytis*)'' in Jalandhar districts Punjab, India.

## Materials and Methods

The present experiment was carried out at Agricultural research farm, Department of Horticulture, Lovely Professional University, Phagwara, Jalandhar during winter season 2020- 2021. The farm is located in the sub urban region at north latitude 31º 15' 12.99'' N and 75º 42' 13.21'' E. The experiment arranged in Randomized Block Design with three replication and 10 treatments, consisting different dose of vermicompost, biofertilizers (azotobacter & VAM) and panchagavya. The whole investigation was conducted under the scientific management practices. Seedling were raised in nursery bed and seeds were sown on 16 September 2020. For sowing firstly, prepared raised bed (3. 35 × 1.34m) and seed were sown at a depth of 1 – 1.5 cm in a line and immediately irrigate the bed. After a month, uniform and healthy seedlings are transplanted to the main field on 26 October 2020 with 45cm X 60cm plant to plant or row to row spacing and the net area of plot is 23.7 × 3.66 m². Irrigation is given at 5 to 6 days intervals. Irrigation is done according to soil moisture conditions and rainfall. Basically, three hand weeding and 1 to 2 hoeing is done. Earthing up is done on 30 days after transplanting.

### Treatments application

The different treatments were used $T_o$- control (not any nutrients), $T_1$ - 3% panchagavya, $T_2$ - vermicompost (3.8 t/has), $T_3$ - VAM (5 kg/ha) + azotobacter (5 kg/ha), $T_4$ - vermicompost (3.8 t/ha) + Azotobacter (5 kg/ha) + 3% panchagavya, $T_5$ - vermicompost (3.8 t/ha + VAM (5 kg/ha) + 3% panchagavya, $T_6$ - vermicompost (3.8 t/ha) +azotobacter (5 kg/ha) + VAM (5 kg /ha) + 3% panchagavya, $T_7$ - vermicompost (3.8 t/ha) +azotobacter (5 kg/ha) + VAM (5 kg/ha) + 4% panchagavya, $T_8$ - vermicompost (3.8 t/ha) +azotobacter (5 kg/ha) + VAM (5 kg/ha) + 5% panchagavya $T_9$ - vermicompost (3.8 t/ha) +azotobacter (5 kg/ha) + VAM (5 kg /ha) + 6% panchagavya.

The vermicompost @ 3t/ha were used and mixed thoroughly with the soil during preparation of bed as per the treatment. Vermicompost contains 2.5% nitrogen 1.5% phosphorous and 1.5% potassium which fulfil the requirements of nutrients. Apart from that, VAM were used before transplanting as seedling treatment and Azotobacter used after transplanting as broadcasting method as per the treatment. VAM slurry are prepared in the container and roots of the seedlings were dip in the solution for 30 minutes and kept it into shade. Different concentration of Panchagavya i.e., (3%, 4%, 5% or 6%) were applied to observe the variations and find out best concentration. The Panchagavya were applied after 15 days of azotobacter application and repeat this process 15 days after first application.

### Statstcal analysis

The data obtained during the experiment was analysed as per procedure described by Gomez and Gomez (1984) [6] to find out variations amongst all the characters. The statistical analysis will be carried out for each observed character by using MS-Excel, OPSTAT and TNAUSTAT packages. Check the significance difference among all the populations is the first or foremost step and it can be calculated by using following formula:

**Table 1:** ANOVA for Randomized Complete Block Design

| Source of variation | D.F | Sum of square | Mean sun of square | F value | F1 5% or 1% table value |
|---|---|---|---|---|---|
| Replication | r-1 | RSS | RMS | RMS/EMS | - |
| Treatment | t-1 | TrSS | TrMS | TrMS/EMS | - |
| Error | (r-1) (t-1) | ESS | EMS | - | - |
| Total | Rt-1 | TSS | - | - | - |

Where,

r = number of replications
t = number of treatments
D.F = degree of freedon
RSS = replication sum of square
TrSS = treatment sum of square
ESS = error sum of square
TSS = total sum of square
RMS = replication mean sum of squares
TrMS = treatment mean sum of squares
EMS = error mean sum of squares

The yield attributes and quality parameters were tested through F test at 5% and 1% level of significance. Whereas, different between the averages were calculated according to CD at 0.05% and the mean analysis was done after testing the significance of the variance ratio of error mean squares

$$C.V. = \frac{\sqrt{EMS}}{GM} \times 100$$

$$S\ E\ m\pm = \frac{\sqrt{EMS}}{GM}$$

Where, C.V means coefficient of variation, SE m± means standard error of means, S E means standard error of difference, GM means grand mean, C.D means critical difference

**Economic analysis**

The cost of cultivation and gross returns were calculated according to market prices of inputs during the period of investigation. Input cost such as seeds, vermicompost, biofertilizers, panchagavya were considered as per market price and human labour and machine labour cost for different cultural operations such as, land preparation, weeding, irrigation and harvesting etc also considered as per market price.

Gross return- it was calculated by multiplying the total volume of output by its per unit price (pc) in the harvesting period.

The following expression to calculate gross return is, GR= Pc. Qc

Where, GR means gross return, Pc means price of cauliflower and Qc means quantity of cauliflower produce.

Net return- Net return analysis was considered as a difference between gross return and total cost.

NR= GR – TC

Where, NR means net return, GR means gross return and TC means total cost

Benefit cost ration (BCR) – The BCR was calculated by using the following formula

BCR = (GR/TC)

Where, GR means gross return and TC means total cost

**Result and Discussion**

During experiment, different yield parameters or nutrient parameters have been observed and discussed with explanations or find out the best organic nutrients and its combination among different treatments at sufficient cost Table (2). The present study clearly showed that, combined application of vermicompost along with biofertilizers and panchagavya play a significant role in enhancing the reproductive parameters such as days to curd initiation and days to curd maturity. The minimum days to curd initiation (58.66 days) followed by $T_2$ (65 days), $T_4$ (67.83 days), $T_5$ (61.08 days), $T_6$ (66.91 days) was observed with the treatments $T_8$ - (3.8 t/ha vermicompost + 5 kg/ha azotobacter + 5 kg/ha VAM + 5% panchagavya). The maximum days to curd initiation was recorded under control $T_o$ (78.66 days). The probable reason for early curd initiation and curd maturity is that, the cultivar Snow Queen took minimum days to initiate because it is mid-early season variety and takes less days to germinate. Moreover, combine application of organic nutrients gives significant results because organic amendments contain some growth promoting beneficial micro-organisms, which secrets some organic acid and these organic secretion act as a growth regulator which significantly increase the growth parameters which directly leads to increase the curd weight or yield. Similar results have been investigated by Meena *et al.* (2018) [15] in cauliflower and simultaneous this type of investigation is observed in different crops by different researchers such as (Kumar *et al.*, 2017) in broccoli, who reported that organic nutrients along with inorganic fertilizers influence the early curd initiation.

Similarly, the variation in yield parameters were observed with the combined application of vermicompost along with biofertilizers and panchagavya. The results indicates that, maximum curd weight significantly influenced under $T_8$ (703.83 g) which was at par with $T_7$ (646.25 g) followed by $T_9$ (622.08), $T_6$ (580.33 g), further followed by $T_3$ (576.41 g) in comparison to control $T_o$ (501.33 g). Whereas the highest curd diameter also observed under $T_8$ (11.27cm) which was at par with $T_7$ (9.28 cm), followed by $T_6$ (9.03 cm) and further followed by $T_4$ (8.76 cm) in comparation to control $T_o$ (6.36 cm). The curd length was also significantly increased with the combined application of vermicompost along with biofertilizers and panchagavya. The results proved that, $T_8$ gives highest curd length (16.45 cm) which was at par with $T_7$ (15.19 cm) followed by $T_6$ (14.79 cm) or $T_3$ (14.06 cm), respectively, however the lowest curd length was observed under control (10.37 cm) where neither inorganic or nor organic nutrients was applied, shown in table (2). The highest curd diameter or curd length of the cauliflower might be due to secretion of growth regulators by micro-organisms.

Similarly, conjoint application of vermicompost along with the combination of biofertilizer and panchagavya showed significant effect on curd yield. The maximum curd yield (367.41 q/ha) was recorded under $T_8$ - vermicompost 3.8 t/ha + azotobacter 5 kg/ha + VAM 5 kg/ha + panchagavya 3%), which was at par with $T_7$ (337.31 q/ha) followed by $T_9$ (324.37 q/ha) or followed by $T_6$ (303.13 q/ha), respectively. The minimum yield attributes were recorded under $T_1$ (280 q/ha), $T_2$ (228 q/ha), further followed by $T_o$ control (258.33q/ha). This is might be due to different organic amendments enhanced the cell division, cell elongation which significantly increase the vegetative growth and apart from that, more number of leaves increase the photosynthetic rate which will leads to increase the curd yield in cauliflower, were reported by Singh *et al.*, (2018) or Thakur *et al.*, (2017)). Akhter *et al.*, (2011) [1] also investigates different dose of vermicompost @ 1.5t/ha or 3 t/ha also shows positive impact on curd weight or curd yield in cauliflower. Further, biofertilizers fix the small amount of atmospheric nitrogen which fulfil the requirement of nitrogen fertilizers and vermicompost or panchagavya contains some beneficial micro-organisms which secretes some organic acid and these organic acid act as a growth promoting hormones like IAA, GA, kinetin, riboflavin, and thiamine, which significantly influence the growth of the plant Kumar *et al.*, (2013) [11]. Combined application of organic nutrients gives highest curd weight (981.05 g) or curd yield (392.42 q/ha) in cauliflower, were investigated by (Thakur *et al.*, (2018) [27]. Simultaneous this type of results is observed in different crops by different researchers such as: Maheswari *et al.*, 2017 or Verma *et al.*, (2019) [14, 8] also reported that 10:3% vermiwash and panchagavya significantly influenced the highest yield on *Dolichus lablab or* Broccoli. Inoculation of biofertilizers along with the combination of vermiwash, panchagavya gives positive impact on growth or fruit yield in okra, Jadhav *et al.*, (2021) [7]. Balanced supply of nutrients or improves the soil conditions due to microbial activities and due to this improves the rooting area. The micro-organism fixes the different nutrients and make them available in soil, which directly uptake by the plants through roots directly improves the growth and yield Chongre *et al.*, (2020) [4]. Khan *et al.*, (2017) also reported that obtained highest yield when vermicompost is applied with the combination of biofertilizers. They

obtained maximum yield with the application of 4 t/ha vermicompost along with combination of PSB or rhizobium, which also resulted in net saving of 25% nitrogen fertilizers in cow pea or cauliflower. The conjoint application of @5t/ha vermicompost along with 3% panchagvaya stimulates the yield in onion, reported by Patel (2020) [18]. Similarly, Verma K *et al*., (2019) [29] or Vinnoli *et al*., (2017) investigated that, 10 t/ha vermicompost along with 20 t/ha and 3% panchagavya significantly increase the yield in okra respectively.

**Table 2:** Effect of different organic amendments on yield parameter

| Treatments | Days to curd initiation | Days to curd maturity | Curd weight (g) | Curd length (cm) | Curd diameter (cm) | Yield (q/ha) |
|---|---|---|---|---|---|---|
| $T_o$ | 78.66 | 84.66 | 501.33 | 10.37 | 6.36 | 258.33 |
| $T_1$ | 77.00 | 83.66 | 538.03 | 11.94 | 7.95 | 280.84 |
| $T_2$ | 65.05 | 79.00 | 438.33 | 12.24 | 7.76 | 228.06 |
| $T_3$ | 75.33 | 80.25 | 576.41 | 14.06 | 8.48 | 300.71 |
| $T_4$ | 67.83 | 78.75 | 509.08 | 13.86 | 8.76 | 265.68 |
| $T_5$ | 61.08 | 81.25 | 563.33 | 12.24 | 7.44 | 294.27 |
| $T_6$ | 66.91 | 80.41 | 580.83 | 14.79 | 9.03 | 303.13 |
| $T_7$ | 68.25 | 77.00 | 646.25 | 15.19 | 9.28 | 337.31 |
| $T_8$ | 58.66 | 78.91 | 703.83 | 16.45 | 11.27 | 367.41 |
| $T_9$ | 70.41 | 79.05 | 622.08 | 13.29 | 8.12 | 324.37 |
| CD (P=0.5) | 4.28 | 3.28 | 19.50 | 1.99 | 1.46 | 13.11 |
| SE (mean) | 1.43 | 1.095 | 6.51 | 0.66 | 0.48 | 4.38 |
| C.V | 3.59 | 2.36 | 9.21 | 8.54 | 10.00 | 2.56 |

**Quality parameters**

The results of present study showed significant effects on biochemical parameters such as ascorbic acid and TSS, shown in table (3). Significant variations were recorded with the combined application of vermicompost together with biofertilizers and panchagavya. Among all the treatments the maximum ascorbic acid content (54.67 mg/100g) were obtained with the treatments $T_8$ followed by $T_7$ (51.14 mg/100g). While minimum ascorbic acid content (47.56 mg/100g) was observed under $T_o$ (control). Increased ascorbic acid content and TSS content with the application of different organic nutrients because it regulates the metabolic activities and synthesis proteins which leads to increase the ascorbic content in cauliflower Chand *et al*., (2018). Similar, results were investigated by Ujjwal *et al*., (2020) [28] who reported that vermicompost and biofertilizers increase the ascorbic content in broccoli. On the other hand, the maximum TSS content (5.13°Brix) was observed under $T_8$ followed by $T_5$ (5.15°Brix), $T_7$ (4.76°Brix). While the minimum TSS content (3.48°Brix) were recorded under $T_o$ (control) followed by $T_3$ (3.87°Brix). The improvement in TSS content with the combine application of organic amendments over control, which may be due to high nutrient uptake by the plants and increase in photosynthesis rate which directly effects the physiological and biochemical activities in plants Singh *et al*., (2018). The results of present study are also correlated with the observation of Gajjela *et al*., (2019) [5] in bitter gourd.

**Table 3:** Effect of different organic amendments on quality parameters in cauliflower

| Treatments | Ascorbic acid content (mg/100g) | TSS (°Brix) |
|---|---|---|
| $T_o$ | 47.56 | 3.48 |
| $T_1$ | 50.26 | 4.37 |
| $T_2$ | 44.29 | 4.30 |
| $T_3$ | 46.78 | 3.87 |
| $T_4$ | 48.51 | 4.21 |
| $T_5$ | 45.06 | 5.07 |
| $T_6$ | 48.81 | 4.15 |
| $T_7$ | 51.14 | 4.76 |
| $T_8$ | 54.67 | 5.13 |
| $T_9$ | 49.62 | 4.31 |
| CD (P=05) | 3.86 | 0.47 |
| SE (mean) | 1.29 | 0.15 |
| C.V | 4.59 | 6.22 |




**Economics**

The adoption of organic farming can only be successful and acceptable to farmers if it gives more profit as compared to inorganic farming. The treatment wise cost and net return analysis can be explained in this paper, which is shown in table (4). The present study resulted that, the treatment $T_8$ was found the most profitable treatment in cauliflower with highest net return (Rs 76,95,699/ha) with benefit cost ratio (18.55) followed by $T_7$ having net return (Rs. 6,35007) with benefit cost ration (17.02), further followed by $T_9$ having net return (Rs. 6,09,128) with highest benefit cost (Rs. 16.36). The treatment $T_8$ were the most beneficial treatment which may be gives more profits to the farmers at cultivation on large scale. The reason of behind more profit is due to lower cost of organic inputs and higher yield. Similarly, Sharma *et al.* (2014) [21] observed highest net returns in cauliflower as well as in French bean, and okra with the combine application of organic amendments with growth regulator. Application of vermicompost @2.5 t/ha along with the biofertilizers @5kg/ha or half dose of NPK also significantly influenced the curd yield in cauliflower and moreover gives highest net return upto Rs. 157757 with benefit cost ratio 1:3:61, Singh *et al.*, (2018). Similarly, Naik *et al.*, (2012) [16] also investigated that organic inputs gives highest net returns in chilli (Rs.18227.00) as compared to inorganic chilli (Rs. 7984.00). Therefore, the present study revealed that, organic cultivation is gives more profit with minimum environmental degradation with higher productivity.

**Table 4:** Effect of different organic amendments on economics of cauliflower

| Treatments | Yield (q/ha) | Total cost (Rs) | Gross income (Rs) | Net return (Rs) | Benefit cost (Rs) |
|---|---|---|---|---|---|
| T◦ | 258.33 | 35,050 | 2,06,953.30 | 1,71,903.30 | 5.88 |
| $T_1$ | 280.84 | 35,055 | 5,61,689.30 | 5,26,634.30 | 15.81 |
| $T_2$ | 228.06 | 38,850 | 4,57,200.00 | 4,18,350.00 | 11.76 |
| $T_3$ | 300.71 | 35,800 | 5,73,780.70 | 5,37,980.70 | 16.02 |
| $T_4$ | 265.68 | 39,154 | 5,33,009.70 | 4,93,855.70 | 13.61 |
| $T_5$ | 294.27 | 39,304 | 5,88,556.70 | 5,49,252.70 | 14.84 |
| $T_6$ | 303.13 | 39,604 | 6,01,492.30 | 5,61,888.30 | 15.18 |
| $T_7$ | 337.31 | 39,619 | 6,74,626.00 | 6,35,007.00 | 17.02 |
| $T_8$ | 367.41 | 39,624 | 7,35,323.00 | 6,95,699.00 | 18.55 |
| $T_9$ | 324.37 | 39,626 | 6,48,754.00 | 6,09,128.00 | 16.36 |

## Conclusion

Now a days, different challenges facing by the nation is to provide chemical free food for the growing population. Due to use of synthetic fertilizers cauliflower yield is decline day by day Unwanted use of synthetic fertilizers reduce soil fertility, kill the beneficial micro-organisms, more over these chemicals interfere in our ecosystem. Apart from these harmful pesticides present in fruits or vegetables which we all consume and their harmful chemicals enter in our food chain which cause serious disease in humans such as endocrine disruptors, respiratory disease like asthma, cancer, depression etc sometimes it ultimately causes death in human. Therefore, the present study showed significant results of organic farming. On the basis of present study, it can be concluded that combine application of 3.8 t/ha vermicompost along with the 5 kg/ha azotobacter, 5 kg/ha VAM and 5% panchagavya, was found best in term of yield parameters and quality parameters. Maximum net return (Rs. 6,95,699) was also observed in $T_8$ with highest benefit cost ratio (Rs. 18.55). The results also indicated that, if 3% panchagvaya used alone it is not very much effective but if panchagvaya used with the combination of other organic amendments it significantly influenced the yield as well as also improves the nutrient qualities in cauliflower. Moreover, combined application of organic amendments gives more profit to the farmers with minimum environmental degradation along with higher productivity.

## References


1. Akhter S, Sen R, Akter S, da Silva JAT, Haque A, Noor S. Efficacy of vermicompost to improve soil health, yield and nutrient uptake of cauliflower in grey terrace soil of Bangladesh. Dynamic Soil Dynamic Plant 2012;6(1):103-109.
2. Chatterjee S, Chakraborty R, Banerjee H. Economic impact assessment of conservation agriculture on small and marginal farm households in eastern India. Agricultural Economics Research Review 2020,33(347-2021-802).
3. Chitale S, Bhoi SK, Tiwari A. Organic rice production technology. Model training course on rice production technology 2012,22-29.
4. Chongre S, Mondal R, Biswas S, Munshi A, Mondal R, Pramanick M. Effect of Liquid Manure on Growth and Yield of Summer Green Gram (Vigna radiata L. Wilczek). Current Journal of Applied Science and Technology 2019,1-7.
5. Gajjela S, Chatterjee R. Effect of foliar application of Panchagavya and Vermiwash on yield and quality of bitter gourd (Momordica charantia L.). International Journal of Chemical Studies 2019;7(3):218-224.
6. Gomez KA, Gomez A. Statistical Procedure for Agricultural Research—Hand Book. John Wiley & Sons, New York 1984.
7. Jadhav SD, Shinde SJ, Deshmukh KD. Influence of biofertilizer, liquid organic manures along with RDF on growth and flowering of okra (Abelmoschus esculentus L. Moench). Journal of Pharmacognosy and Phytochemistry 2021;10(1):303-306.
8. Krapal Singh Verma DS, Mishra SP, Sirothia P, Jadia M. Effect of different organic, bioenhancers and inorganic techniques on quality of okra (Abelmoschus esculantus L.). Journal of Pharmacognosy and Phytochemistry 2019;8(4):3136-3138.
9. Kumar R, Bhatia AK, Singh D. Present status of vegetable production and their impact in human nutrition. International Journal of Agriculture Sciences 2017;9:4945-4949.
10. Kumar S, Trivedi H, Sah Rahul, Verma Kumar A, Yadav A. Effect of different bio-enhancers on growth & yield of cauliflower (Brassica oleracea L. var. Botrytis). Journal of Pharmacognosy and Phytochemistry 2018;SPI:769-772.
11. Kumar M, Das B, Prasad KK, Kumar P. Effect of integrated nutrient management on growth and yield of broccoli (Brassica oleracea var. italica) under Jharkhand conditions. Vegetable science 2013;40(1):117-120.
12. Kumar R, Singh R, Singh GP, Singh HP, Choudhari MKS, Singh C. A study of the cost of cultivation and profit measures of Cauliflower grower in Varanasi District of Eastern Uttar Pradesh. Journal of Pharmacognosy and Phytochemistry 2017;6(6):1020-1023.
13. Kumar S, Thombare P, Kale P. Panchgavya: A Boon in Liquid Fertilizer for Organic Farming. Agriculture & Food 2019,104-107.
14. Maheswari VN, Srikumaran MP, Rekha GS, Elumalai D, Kaleena PK. Growth Promoting Effects of Vermiwash and Panchagavya on Dolichus Lablab under Field Experimental Conditions. International Journal of Applied Sciences and Biotechnology 2016;4(4):513-518.
15. Meena MK, Aravindakshan K, Dhayal M, Singh J, Meena SL. Effect of Biofertilizers and Growth Regulators on Growth Attributes of Cauliflower (Brassica oleracea var. botrytis L.) cv. Pusa Paushja 2018.
16. Naik VR, Kunnal LB, Patil SS, Guledgudda SS. Organic and inorganic cultivation of chilli and its marketing-an economic analysis. Karnataka Journal of Agricultural Sciences 2012,25(2).
17. Ogbede SC, Saidu AN, Kabiru AY, Busari MB. Nutrient and anti-nutrient compositions of Brassica oleracae var. capitata L. IOSR Journal of Pharmacy 2015;3:19-25.
18. Patel U. Studies on effect of integrated nutrient management and bio enhancer on productivity of Onion (Allium cepa L) 2020.
19. Rakesh S, Poonguzhali S, Saranya B, Suguna S, Jothibasu K. Effect of Panchagavya on growth and yield of abelmoschus esculentus cv. Arka Anamika. International Journal of Current Microbiology and Applied Sciences 2017;6(9):3090-3097.
20. Rao MRK, Kumar MS, Jha NK. Comparative yield analysis of chilli (*Capsicum annuum L*.) by application of vermicompost and panchagavya. Journal of Chemical and Pharmaceutical Research 2015;7(9):319-323.
21. Sharma A, Sharma RP, Sharma GD, Sankhyan NK, Sharma M. Integrated nutrient supply system for cauliflower-French bean-okra cropping sequence in humid temperate zone of north-western Himalayas. Indian Journal of Horticulture 2014;71(2):211–16.
22. Sharma M, Suryavanshi P. Growth, yield and economics of cauliflower (Brassica oleracea var. botrytis L.) as influenced by use of different combinations of biofertilizers. IJCS 2020;8(6):340-343.
23. Singh G, Singh SK. Effect of bio-fertilizer and mulching on growth, yield and quality of cauliflower (Brassica oleracea var. botrytis L.) in Punjab. Journal of Crop and Weed 2019;15(1):182-185.

24. Singh G, Singh SK. Effect of bio-fertilizer and mulching on growth, yield and quality of cauliflower (*Brassica oleracea* var. botrytis L.) in central region of Punjab. Journal of Pharmacognosy and Phytochemistry 2019;8(2):2251-2254.
25. Subedi R, Khanal A, Aryal K, Chhetri Bahadur L, Kandel Prasad B. Response of Azotobacter in cauliflower (*Brassica oleracea* L. var. botrytis) production at Lamjung, Nepal. Acta Scientifica Malaysia (ASM) 2019;3(1):17-20.
26. Swarup V, Chatterjee SS. Origin and Genetic improvement in Indian cauliflower. Economic Botany 1972;26:381-394.
27. Thakur J, Kumar P, Mohit. Studies on conjoint application of nutrient sources and PGPR on growth, yield, quality, and economics of cauliflower *(Brassica oleracea* var. botrytis L.). Journal of Plant Nutrition 2018;41(14):1862-1867.
28. Ujjwal V, Singh MK, Naresh RK, Dev P, Singh S. Effect of integrated nutrient management on quality parameters of broccoli (*Brassica oleracea* L. var. *italica*) in light textured soil of Western Uttar Pradesh 2020.
29. Verma AK, Trivedi H, Kumar S. Response of bio-enhancers on plant growth and yield of broccoli (*Brassica oleracea* L. var. *italica*) F-1 Hybrid green magic. International Journal of Chemical studies 2019;7(6):302-305.