IJNRD.ORG ISSN : 2456-4184
INTERNATIONAL JOURNAL OF NOVEL RESEARCH AND DEVELOPMENT (IJNRD) | IJNRD.ORG
An International Open Access, Peer-reviewed, Refereed Journal

"STUDY ON THE EFFECT OF BIO-FERTILIZERS ON THE GROWTH AND YIELD OF CAULIFLOWER (Brassica oleracea L. var. botrytis)"

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ABSTRACT

The field experiment was conducted at Agricultural Research Farm, AIOA Amity University Noida U.P. during rabi season of 2022-2023. The experiment was deliberated in ramdomized block design with six treatments replicated thrice. Results revealed that application of combination of the biofertilizers i.e. T5 (Vermicompost + Azotobater + Azospirillum) produced the highest yield of cauliflower (115.60 q ha-1). T5 (Vermicompost + Aztobacter + Azospirillum), T4 (Azotobacter + Vermicompost), and T3 (Azospirillum) biofertilizer combinations are more effective and advised for use in commercial cultivation of cauliflower PusaSnow Ball-16 for growth, yield, and quality. Best growth characteristics (plant height 32.47cm, green leaves per plant 18.95, longest leaf length 28.90cm, widest leaf width 25.06 cm, stem girth 4.54 cm).

Key words: Cauliflower, biofertilizer, growth, yield, organic manure.

INTRODUCTION

Cauliflower (Brassica oleracea var. Botrytis L.) is an important representative of the cabbage crop. Cauliflower contains significant protein content and exceptional vitamin C stability after cooking. Cauliflower is largely nutritional as rich in health salutary antioxidant composites similar as glucosinolates, vitamins, phenolic, composites and carotenoids. It can delay the onset of numerous types of cancer and habitual conditions similar as coronary roadway complaint. Cauliflower has place to family Brassicaceae has diploid (2n = 18) chromosome number. Raw cauliflower curd is mostly nutrient-dense, with 90800 mg of water, 2600 mg of protein, 400 mg of fat, 1000 mg of minerals, 1200 mg of beneficial fibre, 30 kcal of calories, 4.0 g of carbohydrates, 33 mg of calcium, 57 mg of phosphorus, and 1.5 mg of magnesium. It began on the island of Cyprus and has spread to Turkey, Italy, Spain, Egypt, Syria and the northwest region of Europe. Global product of cauliflower (broccoli combined for product reporting) was 25.5 million tonnes in 2020, led by China and India, together counting for 72 of the global aggregate. Rural generation has expanded in later decades due to the utilize of high yielding assortments and expanded utilization of chemical fertilizers. In any case, with this comes an exponential

increment within the utilization of non-renewable shapes of vitality in the confront of raising vitality costs. The improvement and selection of natural fertilizer use strategies is fundamental to their utilize. Natural fertilizers make strides soil wellbeing by converting on reasonable sources of settled natural nitrogen, phosphate, and deteriorated plant residues into usable shapes to encourage supplement take-up by plants. Progresses richness and crop yield. In expansion, the disproportionate synthetic fertiliser use by agriculturists has deteriorate soil wellbeing and diminish soil natural carbon levels. Farm Yard Manuring is utilized as the initial source of natural fertilizer for crops. Additional resources such as vermin-compost, poultry-manure and neem cakes have been supported as excellent natural fertilizers. Chemical-based horticulture is not viable today because of numerous issues such as misfortune of soil efficiency from intemperate disintegration and related plant supplement losses, surface and ground water defect from pesticide, fertilizers and silt looming deficiencies of unable to be renewed assets and less cultivate wage from increased production expenses. On an outcome of this, mindfulness of the require for elective farming frameworks is expanding. In spite of the fact that, fertilizers made from chemicals have a significant function to fulfill the supplement necessity of the crops, determined supplement consumption is posturing a more prominent danger to agriculture that is environmentally friendly. In this manner, there's an urgent ought to decrease the utilization of chemical fertilizers and in turn increase the utilization of organics. Utilize of natural fertilizer unaccompanied or in mixture with chemical fertilizers, makes a difference in progressing physio-chemical properties of the soil, and improves the productive exploitation of connected fertilizers brought about in superior seed yield and quality. Natural fertilizers viz. FYM, vermin-compost (VC), poultry-manure (PM) and oil cakes assist in the enhancement of soil composition, oxygenation, and retention of water capacity. A variety of nitrogen-fixing organisms, including Rhizobium, Azotobacter, Azospirillum, Cyanobacteria, and Azolla, are included in natural fertilisers. The importance of Azotobacter and Azospirillum for vegetable crops is organised well among them (Kachari et al, in 2009), and there are a few information that highlight the advantages of Azotobacter and Azospirillum concern with nitrogen. In protected plants, expansion of low amounts of nitrogen increases air nitrogen fixation and availability. Important plant nutrients like nitrogen and phosphorus can be supplied more affordably by using organic fertilizers. In any event, natural fertilizers don't take the place of essential nutrients; instead, they work in grouping with chemical fertilizers to increase yields and agricultural biological systems. Based on the above facts the current study was aimed to evaluate the role of different combination of bio-fertilizers and organic fertilizers to growth and yield of cauliflower.

MATERIALS and METHODS

A field experiment was carried out during 2022-2023 at Amity Institute of Organic Agriculture research farm in Noida, UP, which is located at 280 53′ N latitude, 770 39′ E longitude, and 200 m above mean sea level the pH of the soil was slightly alkaline.

Field preparation

Beyond the coming of the monsoon, the agricultural land was tilled and planked with a tractor-drawn disc harrow. The samples were taken from the field soil to figure out certain aspects of the physical and chemical properties of the soil, as shown in table number 1. The rows were excavated and the field was separated into experimental

sections alongside an area of 4.0 m x 3.5 m, where an overall of 18 plots were created with the one row distant from the other being 45cm, the plant to plant distance being 30cm, and the plots made being 0.5m apart.

During the testing phase,the following climatic observations were taken:

- Relative humidity (Rh): 32-43%
- Wind speed: 6km/h
- Rainfall: Nil
- Minimum temp: 14°c
- Maximum temp: 38°c

During the Rabi season, six organic fertilizer and bio-fertilizer treatments were administered to Cauliflower T_1 (Vermicompost @2 t/ha), T_2 (Farm Yard Manure @25 t/ha), T_3 (Azospirillum @ (100 g/kg of the seed), T_4 (Azotobacter @ 2 kg/ha + Vermi compost @ 2t/ha), T_5 (Azotobacter @ 2kg/ha + Verni compost @ 2t/ha + Azospirillum @ 100 g/kg of seeds) and T_6 (Control).

On November 15, 2022, seeds were sterilized with Thiram at a rate of 2g kg-1 of seeds prior being sowed in distinct rows at a depth of 2-3 cm. Watering is done weeding, and protection for plants activities were performed on a regular schedule. Transplanting takes place on December 8, 2022, with 40cm spacing among rows and 30cm flanked by plants. Light irrigation was applied in the evening and immediately after transplanting. Hoeing, Weeding took place 20 days after cultivating to limit weed competitiveness. To help in dispersion and weed suppression, pruning and hoeing took place by hand 30 and 45 days following seeding. On December 25/2022, gaps were filled to maintain the optimal plant population per plot. After that, the gap-filled plants were softly irrigated. To manage insect pests, such as aphids and pod borer, the crop was sprayed with 5% Neem oil. In total, three sprays were performed when early insect signs were detected. At the end of the experiment, the growth indices and yield from the randomly selected plants from each plot were recorded using different measurement techniques. On March 25, 2023, the crop was harvested. The fully matured white cauliflower should be ready for harvest and selling right away.

Table 1. Some chemical, physical and fertility properties of the study soil before planting

Particulars	Values	Units
Sand percentage (%)	61.20	g kg^{-1}
Silt percentage(%)	12.00	g kg^{-1}
Clay percentage (%)	26.80	g kg^{-1}
Tectile Class	Sand Loamy	
Organic C percentage (%)	0.52	mg kg^{-1}
Total N (%)	0.43	mg kg^{-1}
Available N	178.40	mg kg^{-1}
Available P	20.70	mg kg^{-1}
Available K	265.90	mg kg^{-1}
pH (1:2.5) soil to water	8.1	
Electrical conductivity EC at 25 ^{0}C	0.95	ds m^{-1}

RESULT and DISCUSSION

Growth parameters

The resultants are shown in table number 2.

The treatment T5 having Vermicompost + Azotobacter + Azospirillum resulted in significantly highest seed germination over all other treatments. The second most effective treatment was T4 having Vermicompost + Azotobacter. The third best treatment was T3 having Azospirillum. The treatment T6 (control) recorded lower seed germination, closely followed by T1 and treatment T2. The significantly maximum plant height (21.28, 28.09 and 32.47) of cauliflower was recorded in treatment T5 (Vermicompost + Azotobacter + Azospirillum) at 30, 45 and 60 DAT stagesin comparison to alternative treatments. This closely followed by the T4 (21.05, 27.00 and 31.89 cm) and T3 (20.78, 26.97 and 30.45 cm). The treatment T6 (control) resulted in extensively lowest plant height at different level of growth. The no. of leaves as per plant was, in general increased steadily involving 30, 45 and 60 DAT in all the treatments. At 30 days ranged from 6.21 to 7.39 leaves, at 45 days range from 10.06 to 11.35 leaves and at 60 days range from 15.89 to 18.95 leaves per plant in different treatments. The highest leaves per plant of cauliflower was recorded in treatment T5 (Vermicompost + Azotobacter + Azospirillum) 7.39, 11.35 and 18.95 leaves and the lowest found in T6 (Control) 6.21, 10.06 and 15.89 leaves at 30, 45 and 60 DAT of cauliflower. These findings are also consistent with the findings of Badaway and Imam (1975), Mohandas (1987), Kalyani et al in 1996), Patel et al in 1998), Mengistu and Singh (1999), Nanthakumar and Veeraragavathatham (2000), Vivek et al in 2001), Kanwar et. Al in 2002), Yadev et al in 2003), Choudhary et al in 2004), Kashyap et al (2005), Moniruzzaman et al in 2007), Kachari and Korla (2009) and Singh et al in 2015). The length of cauliflower leaves per plant rose substantially when using varied treatments containing Vermicompost, Azotobacter, Azospirillum, and each of their combinations. The highest possible length of the leaves was notably noticed under the treatments T5 having (Vermicompost + Azotobacter + Azoapirillum) 15.30, 25.67 and 28.90 cm, T4 having (Azotobacter + Vermicompost) 14.70, 24.72 and 27.68 cm and T3 having (Azospirillum) 13.70, 24.02 and 27.52 cm as compared to the other treatments at 30, 45 and 60 DAT. The minimum length of leaves found in Control treatment T6 (12.98, 23.07 and 26.97 cm) at 30,45 and 60 DAT. In terms of cauliflower leaf width, the crop performed strongly to diverse treatments. Application of Vermicompost, Azotobacter, Azospirillumseperately and the combination of these biofertilizers, the highest width of leaves were found in T5 (Vermicompost + Azotobacter + Azospirillum), T4 (Azotobacter + Vermicompost) and T3 (Azospirillum) i.e. (15.58 to 25.06 cm, 14.65 to 24.98 cm and 14.07 to 24.35 cm). The significantly lowest leaves width (13.42, 17.98 and 23.93cm) was noted from the control treatment T6 at 30, 45 and 60 DAT correspondingly. The results obtained are steady with those of Iswaran (1975), Vijay and Mangal (1997), Bhagavantagoudra and Rokhade (2001), Raghav and Shashi (2007) and Velmurugan et al in (2008). The girth of stem of cauliflower increase significantly with different treatments having Vermicompost, Azotobacter and Azospirillum. The significantly maximum leaf ares was observed under the treatment T5 (4.54 cm), followed by T4 (4.37 cm) and then T3 (4.28 cm) treatments, while it was significantly lowest in control T6 treatment (4.01 cm). The maximum leaf area (184.11, 351.53 and 527.16 cm2) was recorded from T5 having Vermicompost + Azotobacter +

Azospirillum followed bt T4 (161.76, 341.22 and 507.22 cm2) and T3 (150.41, 338.26 and 500.39 cm2). The minimum leaf area (130.02, 290.92 and 444.92 cm2) was noted from the control treatment T6 at 30, 45 and 60 DAT respectively. The results reported are consistent with the ones from Parvatham et al, (1989), Gamo (1991), Olsen et al (1996), Bambal et al (1998), Bhagavantagoudra and Rokhade (2001), Anbhurani and Manivannan (2002), Velmurugan et al (2008) and Singh et al, (2015).

Table 2: Cauliflower growth characteristics as impacted by organic manures and bio-fertilizers at peak stage.

Treatment	Treatment details	Plant height (cm) at 60 DAT	Number of leaves/plant at 60 DAT	Length of leaves (cm) at 60 DAT	Width of leaves (cm) at 60 DAT	Leaf area (cm2) at 60 DAT	Girth of stem (cm)
T1	Vermicompost	31.40	16.98	27.25	24.68	475.45	4.12
T2	Azotobacter	29.97	16.55	27.55	24.12	485.68	4.24
T3	*Azospirillum*	30.45	17.07	27.52	24.35	500.39	4.28
T4	Azotobacter + Vermicompost	31.89	17.00	27.68	24.98	507.22	4.37
T5	Azotobacter + Vermicompost + *Azospirillum*	32.47	18.95	28.90	25.06	527.16	4.54
T6	Control	28.52	15.89	26.97	23.93	444.92	4.01
	Total	30.78	17.07	27.65	24.52	490.14	4.26
	SEm±	0.04	0.03	0.03	0.02	0.03	0.02
	CD at (P=0.05)	0.11	0.08	0.07	0.05	0.08	0.04

Yield parameters

Different fertility treatments had extensive contact on the yield attributed to characteristics such as curd diameter, fresh weight of curd, yield plot (kilograms plot-1), and yield per hectare (quintals ha-1) shown in table number 3. The treatments T5, T4 and T3 having (Vermicompost + Azotobacter + Azospirillum) equally maximum curd diameter separately or with combination of these different biofertilizers (17.16, 16.44 and 16.02 cm0, while the control treatment T6 recorded the minimum curd diameter 914.38 cm). The fertility treatment T5 comprising sources of biofertilizers registered significantly maximum yield per hectare (115.60 q) and plot (7.106 kilograms) as compared to the remaining treatments. Similarly the fruit weight was also significantly higher upto 0.70 kg. The second best fertility treatment was T4recorded yield 110.56 q/ha and 6.601 kg/plot with fruit weight 0.55 kg and the T3 recorded yield 107.00 q/ha and 6.408 kg/plot with fruit weight 0.51 kg. The control treatment (T6)

recorded the minimum curf yield 102.62 q/ha and 6.016 kg/plot with fruit weight 0.36 kg followed by T1 and T2 (104.21 to 105.74 q/ha, 6.104 to 6.203 kg/plot, with fruit weight 0.46 to 0.52 kg). These findings are also in agreement with those of Lehri and Mehrota (1972), County et al, (1974), Kucey (1987), Mahendra and Kumar (1990), Subbiah (1990), Subbiah (1991), Jothi et al, (1993), Wange et al, (1995), Warade et al, (1996), Chatto et al, (1997), Nanthakumar and Veeraraghvathatham (1999),Selvarajan and Chezhiyan (2001), Nanthakumar and Veeraraghavathatham (2001), Naidu et al, (2002), Shalini et al, (2002), Bhattarai et al, (2003), Bahadur et al, (2004), Narayanamma et al, (20040, Chaterjee et al, (2005), Pandey et al, (2008), Kumar and Singh (2009), Khan et al, (2010), Gorakh and Keshav (2011)and Singh et al, (2014).

Amongst the combined application of biofertilizers, T5 continued to be the best with respect to quality also. The significantly highest dry matter content (11.98%) and maximum number of "A" grade curds (52.67%) were recorded from the fertility treatment T5. The second best fertility treatment was T4 (Azotobacter + Vermi-compost). On the further, the lowest values of dry matter (6.71%) and "A" grade curds (45.59%) were recorded under T6 (Control).

These conclusion are also in agreement with those of Bagyaraj et al (1979), Kumaraswamy and Madalageri (1990), Mahendran and Kumar (1990), Gaikwad and Wani (2001), Kumutha et al (2001), Shalini et al (2002), Tyagi et al (2003), Pandey et al (2007), Bashyal (2001), Upadhyay et al (2012) and Kumar and Seema (2016).

Table 3: Yield and yield attributes of cauliflower as influenced by organic manures and bio-fertilizers.

Treatment	Treatment details	Fresh weight of curd (kg)	Curd diameter (cm)	Yield per plot (kg/ha)	Yield per hectare (q/ha)
T1	Vermicompost	0.52	15.24	6.104	104.21
T2	Azotobacter	0.46	15.32	6.203	105.74
T3	*Azospirillum*	0.51	16.02	6.408	107.00
T4	Azotobacter + Vermicompost	0.55	16.44	6.601	110.56
T5	Azotobacter + Vermicompost + *Azospirillum*	0.70	17.16	7.106	115.60
T6	Control	0.36	14.38	6.016	102.62
	Total	0.52	15.76	6.418	107.62
	SEm±	0.02	0.02	0.005	0.03

	CD at (P=0.05)	0.04	0.04	0.01	0.06

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