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EFFECT OF INTEGRATED NUTRIENT MANAGEMENT FOR ENHANCING THE SUSTAINABLE PRODUCTIVITY OF CAULIFLOWER (*BRASSICA OLERACEA* VAR. *BOTRYTIS* L.)

Niteshwari Baghele[1*], Shivshankar Singh[2] and Udayabhan Nishad[1]
[1]Department of Horticulture, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh, India
[2]Department of Horticulture, Mahatma Gandhi Chitrakoot Gmamodaya Vishwavidyalaya Chitrakoot, Satna (M.P.), India
*Corresponding author E-mail: neetubaghele123@gmail.com
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ABSTRACT

A field experiment titled "Effect of Integrated Nutrient Management for Enhancing the Sustainable Productivity of Cauliflower (*Brassica oleracea* var. *botrytis* L.)'' was carried out during the Rabi season of 2020-21 at Rajaula Agricultural Farm, Department of Horticulture, Mahatma Gandhi Chitrakoot Gmamodaya Vishwavidyalaya Chitrakoot – Satna (M.P.). The study aimed to evaluate the effect of various biofertilizer and nutrient combination on cauliflower growth and yield. Where, 14th treatments were designed, including: T_1 (FYM @ 20t ha^{-1}), T_2 (Got manure @ 3.5t ha^{-1}), T_3 (Vermi compost @ 7t ha^{-1}), T_4 (Zero budget-SPNF), T_5 (Biofertilizer consortium + Panchgavya spray), T_6 (50% RDF + 50% FYM), T_7 (50% RDF + 50% Goat manure), T_8 (50% RDF + 50% Vermicompost), T_9 (50% RDF + Biofertilizer consortium + Panchagavya spray), T_{10} (25% RDF + 75% FYM), T_{11} (25% RDF + 75% Goat manure), T_{12} (25% RDF + 75% Vermicompost), T_{13} (25% RDF + Biofertilizer consortium + Panchgavya spray) and T_{14} (Farmer practices).The experiment was laid out in Randomized Block Design with three replications. The treatment T_6 (50% RDF + 50% FYM) recorded the maximum plant height (42.25cm), number of leaves (15.78), leaf length (42.77 cm), leaf width (21.72 cm), days to first curd initiation (61.45), days to 50% curd initiation (64.09), curd weight (1.32kg), yield per plot (31.15kg) and yield per hectare (49.84 tonne).These outcomes suggest that using biofertilizers combine with chemical fertilizers can boost cauliflower development and supporting sustainable practices.
***Keywords*:** Cauliflower, Organic, FYM, Vermicompost, Growth and Yield.

Introduction

Vegetables are packed with essential nutrients, providing a well-rounded diet that includes carbohydrates, proteins, fats, vitamins, minerals, and dietary fiber. As the most affordable source of supplementary nutrition, vegetables play a crucial role in ensuring nutritional security. They offer numerous health benefits, such as aiding digestion, controlling diabetes, promoting kidney function, supporting heart health and containing a powerful blend of bioflavonoids and antioxidants that help neutralize free radicals, thereby reducing the risk of cancer (Kanaujia *et al*., 2020). Among vegetables, cauliflower is one of the most significant winter crops in the cole group, classified under the genus *Brassica* of the cruciferae family, with the chromosome number of 2n = 18. The term 'cauliflower' is derived from the Latin word *caulis* (meaning - cabbage) and *floris* (meaning- flower). The edible cauliflower curd is actually a modified inflorescence. It is widely grown across the country for its tender curds, which are used in various culinary preparations, such as vegetables, soups and pickles (Chaudhari *et al*., 2003). In India, cauliflower is the fifth most important vegetable crop, primarily grown during the winter months. It is cultivated over 465 thousand hectares, yielding approximately 9,083

thousand metric tons, with a productivity rate of 19.53 metric tons per hectare (Anonymous, 2019). Cauliflower growth and productivity are closely tied to the nutrient content in the soil, which depends on the proper application of manure and fertilizers. However, excessive use of chemical fertilizers has harmful effect on soil texture, structure, colour, aeration, water retention and microbial activity (Yeasmin, 2021). Repeated and increasing use of chemical fertilizers over time can severely degrade soil fertility, as it contributes to the hardening of the soil structure and the long-term disruption of the natural nutrient balance. This leads to decline in the biological health of the soil, lowering microbial activity and soil vitality, which ultimately results in reduced land productivity and sustainability (Simarmata, 2016). Integrated nutrient management offers solution to these challenges by combining chemical fertilizers with organic manures to maintain soil health and ensure sustainable crop production (Nanjappa *et al*., 2001). Organic farming play's crucial role in producing healthy food by promoting system that sustains the well-being of soils, ecosystems and people. It relies on ecological processes, biodiversity and cycles adapted to local conditions, rather than harmful inputs. Organic farming integrates tradition, innovation and science to benefit the environment, foster equitable relationships and improve the quality of life for all participants (IFOAM). Biofertilizers are natural substances that contain living microorganisms, such as bacteria, fungi and algae, which support plant growth by enhancing nutrient availability and improving soil health. As an eco - friendly alternative to chemical fertilizers, they boost soil fertility through biological processes, reducing reliance on synthetic chemical. Biofertilizers can be applied in various agricultural practices to increase crop yield while promoting sustainability and minimizing environmental harm (Abd AL-Hseen, 2020). Compost made from cow manure is mixture of solid and liquid waste from the cow shed, which is used as an organic fertilizer for crops. The application of vermicompost and conventional compost in vegetable cultivation can help address the deficiency of organic matter in the soil (Alam *et al*., 2007).

Materials and Methods

The experiment was conducted at Rajaula Agricultural Farm, Department of Horticulture, Mahatma Gandhi Chitrakoot Gramodaya Vishwavidyalaya (MGCGV), Chitrakoot, Satna, Madhya Pradesh, India during the Rabi season of 2020-2021. The experimental site is situated at an altitude of 306 m above sea level at 24^0 31'N latitude and 81^0E15'E latitude. The climate of the region is semi-arid and sub-tropical having extreme winter and summer. During the winter months, the temperature drops down to low as 2^0C while in the summer the temperature reaches above 47^0C. The experiments was laid out in the randomize block design with 3 replications (R_1, R_2 & R_3) and 14 treatments namely T_1 (FYM @ 20t ha^{-1}), T_2 (Got manure @ 3.5t ha^{-1}), T_3 (Vermi compost @ 7t ha^{-1}), T_4 (Zero budget-SPNF), T_5 (Biofertilizer consortium + Panchgavya spray), T_6 (50% RDF + 50% FYM), T_7 (50% RDF + 50% Goat manure), T_8 (50% RDF + 50% Vermicompost), T_9 (50% RDF + Biofertilizer consortium + Panchagavya spray), T_{10} (25% RDF + 75% FYM), T_{11} (25% RDF + 75% Goat manure), T_{12} (25% RDF + 75% Vermicompost), T_{13} (25% RDF + Biofertilizer consortium + Panchgavya spray) and T_{14} (Farmer practices). Statistical analysis was performed following the Randomized Block Design method described by Panse and Sukhatme (1967). For this experiment cauliflower variety Pusa Shubhra was selected and the seeds were treated with the fungicide Thiram (@ 2.5 g kg^{-1} Seed) before being sown in the nursery bed. Treated seeds were sown in well-prepared nursery bed (5×1 m.) in 2 cm deep soil and 5 cm aprt at the 4 October 2020. The field layout was planned and the required amounts of FYM (25 t ha^{-1}) and vermicompost were applied 15 days prior, with the fields levelled using a spade. Azospirillum (10%) was used to dip the seedling roots for 30 minutes just before transplanting (Shree *et al*., 2014). Transplanting was carried out at 4 November 2020 using vigorous and 12-14 cm long seedlings, with spaced 50 x 50 cm (R×P). The full doses of phosphorus and potassium, along with half dose of nitrogen, were applied as basal application, while the remaining half dose of nitrogen were applied in two split doses at 30 and 45 days after transplanting, respectively. Data taken from four randomly selected plants from each plot.

Results and Discussion

Growth Parameters

The data provided in Table-1 demonstrate a noticeable increase in average plant height at 75 days after transplanting, as shown in figure-1. Treatment T_6 (50% RDF + 50% FYM) recorded the tallest plants height (42.25 cm) followed by treatment T_8 (50% RDF + 50% Vermicompost) with height of 42.17 cm. Whereas the shortest plants (32.21 cm) were observed in treatment T_{14} (Farmer Practices). Application of RDF along with FYM have increase in leaf number and length. Here, treatment T_6 (50% RDF + 50% FYM) recorded the maximum number of leaves (15.78) per plant at 75 DAT followed by treatment T_8 (50% RDF + 50% Vermicompost) with leaves (15.61).

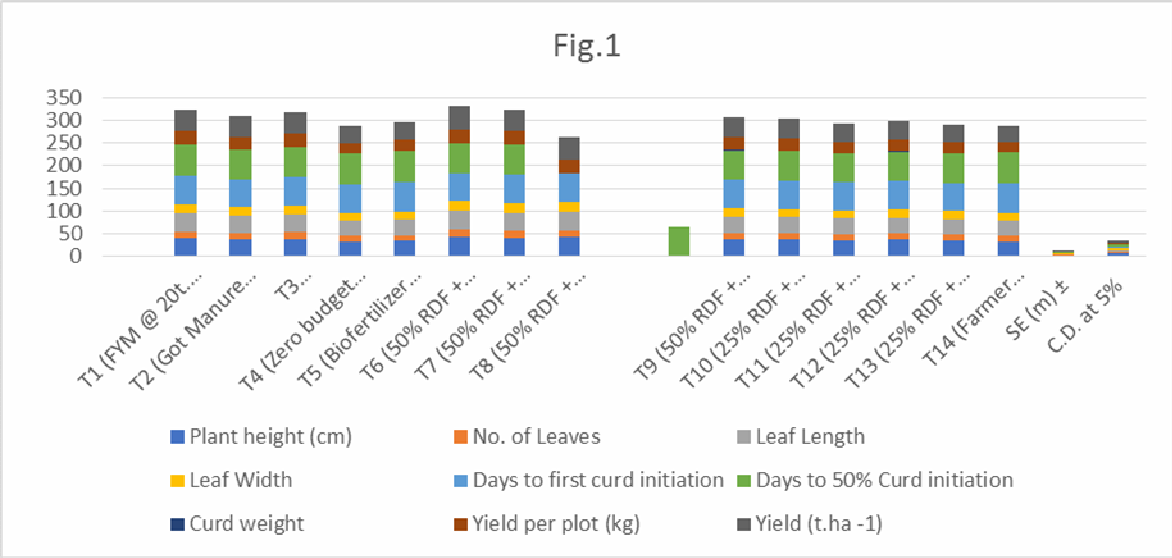
Whereas the lowest number of leaves (12.25) per plant was recorded in treatment T_{14} (Farmer Practices). Treatment T_6 (50% RDF + 50% FYM) recorded the maximum leaf length (42.77 cm) at 75 DAT followed by treatment T_8 (50% RDF + 50% Vermicompost) with leaf length (41.25 cm). Whereas the lowest leaf length (33.32 cm) was found in treatment T_{14} (Farmer Practices). Treatment T_6 (50% RDF + 50% FYM) recorded the maximum leaf width (21.72 cm) at 75 DAS followed by treatment T_8 (50% RDF + 50% Vermicompost) with leaf width (21.40 cm). Whereas the lowest leaf width (16.21 cm) was found in treatment T_{14} (Farmer Practices). Nutrient availability is critical for plant growth, as it enhances nutrient uptake, which is necessary for optimal growth and development. Nitrogen plays the key role in chlorophyll formation, which supports photosynthesis and consequently, promotes plant height, leaves number, leaf length and leaf width. These findings are consistent with those of (Singh *et al*., 2009) in cole crops.

Yield Characters

Application of organic amendment along with inorganic fertilizer they enhance the yield parameter. Treatment T_6 (50% RDF + 50% FYM) recorded the fastest curd initiation (61.45 DAT) followed by treatment T_8 (50% RDF + 50% Vermicompost) with the curd initiation (61.83). The slowest curd initiation (66.74 DAT) was observed in treatment T_{14} (Farmer practices). The studied-on cabbage shows that application of organic amendments increases higher fertility level favoured the initiation and maturity time of head (Chaubey *et al*., 2006). Treatment T_6 (50% RDF + 50% FYM) recorded the 50% curd initiation (64.09 DAT) followed by treatment T_8 (50% RDF + 50% Vermicompost) with the 50% curd initiation (65.01 DAT). Whereas the slowest 50% curd initiation (68.88 DAT) was observed in treatment T_{14} (Farmer practices). Treatment T_6 (50% RDF + 50% FYM) recorded the highest curd weight (1.32 kg) at 75 DAT followed by treatment T_8 (50% RDF + 50% Vermicompost) with the curd weight of (1.18 kg). Whereas the lowest curd weight (0.37 kg) was observed in T_{14} (Farmer practices). Curd size in cauliflower was enhanced by the combined use of organic and inorganic fertilizers (Choudhury *et al*., 2004). Treatment T_6 (50% RDF + 50% FYM) recorded the highest yield per plot (31.15 kg) followed by treatment T_8 (50% RDF + 50% Vermicompost) with yield (30.78 kg) per plot Whereas the lowest yield (22.10 kg) per plot was observed in treatment T_{14} (Farmer practices). Treatment T_6 (50% RDF + 50% FYM) recorded the highest yield (49.84 t ha^{-1}) followed by treatment T_8 (50% RDF + 50% Vermicompost) with yield (49.25 t ha^{-1}). Whereas the lowest yield (35.36 t ha^{-1}) was recorded the treatment T_{14} (Farmer practices). All growth and yield parameters are increased by combined application of organic and inorganic fertilizers that provide the different nutrient sources which enhanced the photosynthates that improve the curd initiation and maturity time, curd weight and yield. These findings are consistent with the studies in cabbage (Ghuge *et al*., 2007) and cauliflower (Kanwar *et al*., 2002).

Table 1 : Effect of integrated nutrient management on growth and yield parameters of cauliflower (*Brassica oleracea* var. *botrytis* L.)

Treatments	Plant height (cm)	No. of Leaves	Leaf Length (cm)	Leaf Width (cm)	Days to first curd initiation	Days to 50% Curd initiation	Curd weight (kg)	Yield per plot (kg)	Yield (t ha^{-1})
T_1 (FYM @ 20t ha^{-1})	40.32	14.80	38.72	20.48	63.91	66.86	0.83	29.72	47.55
T_2 (Got Manure @ 3.5 t ha^{-1})	38.08	13.87	36.67	19.56	62.19	64.42	0.71	28.31	45.30
T_3 (Vermicompost @ 7t ha^{-1})	38.66	14.42	38.27	19.68	63.44	66.09	0.75	28.96	46.33
T_4 (Zero budget (SPNF)	32.66	12.92	33.63	16.29	63.48	67.73	0.41	22.72	36.34
T_5 (Biofertilizer consortium + Panchgavya spray)	33.63	13.19	34.23	16.75	66.74	68.68	0.45	23.86	38.14
T_6 (50% RDF + 50% FYM)	42.25	15.78	42.77	21.72	61.45	64.09	1.32	31.15	49.84
T_7 (50% RDF + 50% Goat manure)	40.63	15.10	39.84	20.59	63.51	65.26	0.84	29.87	47.79
T_8 (50% RDF + 50% Vermicompost)	42.17	15.61	41.25	21.40	61.83	65.01	1.18	30.78	49.25
T_9 (50% RDF + Biofertilizer consortium+ Panchagavya spray)	37.45	13.81	36.25	19.08	62.58	64.30	0.67	27.64	44.22
T_{10} (25% RDF + 75% FYM)	36.69	13.23	35.74	18.78	62.88	64.97	0.63	27.02	43.23
T_{11} (25% RDF + 75% Goat manure)	35.36	13.42	34.69	17.65	62.36	64.15	0.50	24.87	39.78
T_{12} (25% RDF + 75% Vermicompost)	36.07	13.82	35.25	18.14	62.77	64.53	0.58	25.62	40.99
T_{13} (25% RDF + Biofertilizer consortium + Panchgavya spray)	34.27	13.23	34.52	17.31	62.19	64.39	0.47	24.22	38.75
T_{14} (Farmer practices)	32.21	12.25	33.32	16.21	66.74	68.88	0.37	22.10	35.36
SE (m) ±	2.21	1.04	1.36	1.19	1.76	1.60	0.05	0.89	1.42
C.D. at 5%	6.46	3.02	3.96	3.49	5.14	4.67	0.15	2.59	4.14



Conclusion

The experiment indicates that the integration of organic and inorganic fertilizers contributed to maximum plant height (cm), number of leaves, leaf length (cm), leaf width (cm), days to first curd initiation, days to 50% curd initiation, curd weight (kg), yield per plot (kg), yield (t ha $^{-1}$). The variation in plant growth and yield is likely result of RDF and FYM, which stimulate plant growth and overall yield.

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