Study the Effect of Integrated Nutrient Management on Growth and Yield of Cauliflower

Alka Choudhary[1*]; Dr. Mahesh Kumar[2]; Mukesh Jakhar[3]; Ram Narayan Bhateshwar[4]

[*1]M.Sc. (Ag.) Horticulture Maharaja Agrasen Himalayan Garhwal University Shiv Nagar, Dhaid Gaon, Block pokhra, District Pauri Garhwal, Uttarakhand Pin Code – 246169

[2]Assistant Professor Maharaja Agrasen Himalayan Garhwal University Shiv Nagar, Dhaid Gaon, Block pokhra, District Pauri Garhwal, Uttarakhand Pin Code – 246169

[3]M.Sc. (Ag.) student, Department of Entomology, Raja Balwant Singh college of Agriculture, Bichpuri, UP.

[4]M.Sc. (Ag.) student, Department of Plant Breeding, Raja Balwant Singh college of Agriculture, Bichpuri, UP.

*Corresponding Author

Received:- 16 April 2025/ Revised:- 24 April 2025/ Accepted:- 28 April 2025/ Published: 30-04-2025

Abstract— *A field experiment entitled "Effect of Integrated Nutrient Management on Growth and Yield of Cauliflower (Brassica oleracea var. Botrytis L.)" was conducted at Research Farm, Himalayan Garhwal University, Uttarakhand during Rabi season of 2020-21. The experiment was laid out in factorial randomized block design with three replications and consisting four fertility levels (Control, 50% RDF, 75% RDF and 125% RDF) and three treatments of organic manure (control, FYM @ 20 t/ha + Azospirillum and vermicompost @ 7.5 t/ha + Azospirillum).*

Results showed that application of 100% RDF significantly increased the plant height, number of leaves per plant, plant spread, days taken to curd maturity, biological yield, curd diameter, fresh weight of curd, curd yield, nitrogen, phosphorus and potassium content, net returns and B: C ratio of cauliflower which was superior as compared to control and 50% RDF.

Keywords— Integrated, Nutrient Management, manure, experiment.

I. INTRODUCTION

Cauliflower (*Brassica oleracea var. botrytis* L.) is one of the most popular cruciferous vegetables among the cole crops grown in India. It is cultivated for its attractive curd which is used for making vegetable curry, soup and pickles. Cauliflower predominant due to its attractive appearance, good taste, source of minerals, protein and vitamins and has high yielding capacity. Hundred-gram edible portion of cauliflower has high quality protein (2.6g), moisture (90.8 g), fat (0.4 g), carbohydrates (4.0 g), calcium (33.0 mg), phosphorous (57.0 mg), iron (1.5 mg), thiamine (0.04 mg), riboflavin (0.10 mg), vitamin C (56.0 mg) and energy (30 kcal). In fact, cauliflower contains calcium nearly ten times as much as meat and four times as much as eggs. India is the largest producer of cauliflower in the world.

There has been substantial increase both in the production and productivity of the vegetables with the adoption of high yielding varieties and improved production technologies. Cauliflower is a heavy feeder of nutrients they're by the use of chemical fertilizers is increasing day by day and the indiscriminate use of chemical fertilizers has simultaneously resulted in many problems like degradation of soil productivity, environment pollution, depletion of non- renewable source of energy etc. Moreover, chemical fertilizers are becoming costlier input in agriculture. Thus, integrated nutrient management refers to the "maintenance of soil fertility and plant nutrient supply at an optimum level for sustaining the productivity through optimization of the benefits from all possible sources of organic, inorganic and biological compounds in an integrated approach."

Nitrogen plays a key role in nutrition of the plants. As a matter of fact, the plant life would not be possible without this element. Adequate amount of nitrogen is also required to obtain good yield in vegetable crops. Phosphorous and potassium are considered as major nutrients in crops and they are involved in all the metabolic process in the plant and there is considerable evidence to show that, these element plays an important role in photosynthesis and helps in building up of carbohydrate in the plant. The production of dry matter is further affected by the effect of potassium on rate of respiration.

Organic manures and biofertilizers are the important components of integrated nutrient management as supply the trace

amounts of micronutrients which are generally not supplied by the farmers to their vegetable crops. Vermicompost is the product of ingested biomass by earthworm after undergoing physical, chemical and microbial transformations and available in the form of cast.

II. MATERIAL AND METHODS

2.1 Characteristics of the experimental field:

The soil of the field selected for the present study was sandy loam having uniform fertility. Representative soil samples were taken before transplanting of the crop from five different places of the experimental field at depth of 20 cm. The soil samples were mixed thoroughly and three uniform samples were analyzed for assessing the initial status of the soil. The physic-chemical characteristics of the soil.

TABLE 1
INITIAL PHYSIO-CHEMICAL CHARACTERISTICS OF THE EXPERIMENTAL SOIL

Soil properties	Value (0-15 cm)	Methods of analysis with reference
A. Mechanical Composition		
Sand (%)	72	Hydrometer method (Bouyoucos, 1962)
Silt (%)	19	
Clay (%)	9	
Texture	Loamy sand	Triangular method (Brady, 1983)
B. Physical properties		
Bulk density (Mg m^{-3})	1.53	Method No. 38, USDA Hand Book No. 60 (Richards, 1972)
Particle density (Mg m^{-3})	2.52	Method No. 39, USDA Hand Book No. 60 (Richards, 1972)
Porosity (%)	39.28	Method No. 40, USDA Handbook No. 60 (Richards, 1972)
C. Chemical properties		
Organic carbon (%)	0.42	Walkley and Black's rapid titration method (Walkley and Black, 1934)
Available N (kg ha^{-1})	134.66	Alkaline KMnO4 method (Subbiah and Asija, 1956)
Available P2O5 (kg ha^{-1})	21.08	Olsen's method (Olsen *et al*., 1954)
Available K2O (kg ha^{-1})	233.23	Flame photometric Method (Jackson, 1973)
EC (dsm^{-1})	0.27	Method No. 4 USDA Handbook No.60 (Richards, 1972)
Soil pH (1:2 soil water suspension at 25^0C)	7.6	Method No. 21 b, USDA Handbook No. 60 (Richards, 1972)

III. RESULT AND DISCUSSION

3.1 Effect of integrated nutrient management on growth attributes:

3.1.1 Plant height (cm):

- **Effect of fertility levels:** The data presented indicated that plant height of cauliflower was affected significantly by different fertility levels at harvest stage. Application of 100% RDF being remained at par with application of 75% RDF, recorded significantly highest plant height at harvest as compared to control and 50% RDF. The increase in plant height due to application 100% RDF was 25.88 and per cent at harvest over control and 50% RDF, respectively.
- **Effect of organic manure:** The data presented revealed that the plant height of cauliflower was affected significantly by application of organic manure at harvest. Maximum plant height of cauliflower was recorded with the application of vermicompost @ 7.5 t/ha + *Azospirillum* which was significantly higher than control and FYM @ 20 t/ha + *Azospirillum*. The increase in plant height due to application of vermicompost @ 7.5 t/ha + *Azospirillum* was 18.47 and 7.82 per cent at harvest over control and FYM @ 20 t/ha + *Azospirillum*, respectively.

TABLE 2
EFFECT OF INTEGRATED NUTRIENT MANAGEMENT ON PLANT HEIGHT OF CAULIFLOWER

Treatments	Plant height (cm) at harvest
Fertility levels	
Control	43.04
50 % of RDF	48.66
75 % of RDF	53.22
100 % of RDF	54.17
SEm ±	1.39
CD (P=0.05)	4.07
Organic manure	
Control	45.47
FYM @ 20 t/ha + *Azospirillum*	49.97
Vermicompost @ 7.5 t/ha + *Azospirillum*	53.88
SEm ±	1.2
CD (P=0.05)	3.53

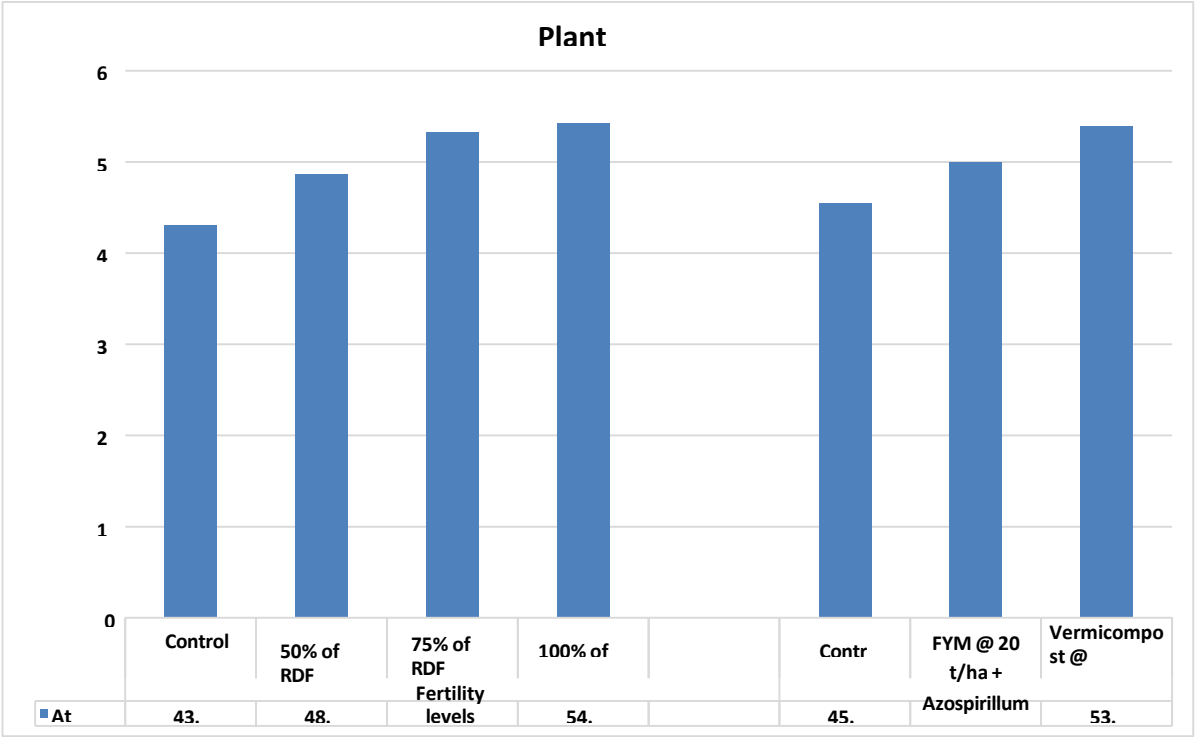

FIGURE 1

3.1.2 Number of leaves per plant:

- **Effect of fertility levels:** A close perusal of revealed that the application of 100% RDF recorded significantly highest number of leaves per plant in cauliflower at harvest as compared to control and 50% RDF. The increase in number of leaves per plant due to application of 100% RDF was 27.40 and 11.38 per cent over control and FYM @ 20 t/ha + *Azospirillum*, respectively.
- **Effect of organic manure:** A critical screening of revealed that the significantly highest number of leaves per plant in cauliflower at harvest was recorded with the application of vermicompost @ 7.5 t/ha + *Azospirillum* which was superior to control and FYM @ 20 t/ha + *Azospirillum*. The enhancement in number of leaves per plant in cauliflower

due to application of vermicompost @ 7.5 t/ha + *Azospirillum* was 20.93 and 8.03 per cent, respectively over control and FYM @ 20 t/ha + *Azospirillum*.

3.2 Plant spread (cm2):

3.2.1 Effect of fertility levels:

The data given showed that the application of different fertility levels significantly influenced the plant spread of cauliflower at harvest. Application of 100% RDF recorded significantly maximum plant spread of cauliflower at harvest as compared to control and 50% RDF but it was found at par with 75% RDF. Plant spread of cauliflower increased due to application 100% RDF by 28.47 and 11.31 per cent over control and 50% RDF, respectively at harvest.

3.2.2 Effect of organic manure:

It is evident from the plant spread of cauliflower was affected significantly by application of organic manure. Maximum plant spread of cauliflower was recorded with the application of vermicompost @ 7.5 t/ha + Azospirillum which was significantly higher than control and FY2.1M @ 20 t/ha + Azospirillum. The increase in plant spread of cauliflower at harvest due to application of vermicompost @ 7.5 t/ha + Azospirillum was 27.37 and 8.60 per cent over control and FYM @ 20 t/ha + Azospirillum, respectively.

3.3 Days taken to curd maturity:

- **Effect of fertility levels:** The experimental findings presented revealed that the application of different fertility levels brings significant variation in days taken to curd maturity of cauliflower. The maximum and minimum days taken to curd maturity of cauliflower was recorded in control and application of 100% RDF treatment.
- **Effect of organic manure:** A perusal of data presented indicated that the days taken to curd maturity of cauliflower was affected significantly due to application of organic manures. The maximum and minimum days taken to curd maturity of cauliflower was recorded in control and application vermicompost @ 7.5 t/ha + *Azospirillum* treatment.

The findings of the present investigation showed that different fertility levels significantly enhanced the vegetative growth of cauliflower. The maximum value of growth parameters was recorded with 100% of RDF which was significantly superior over control and 50% RDF. The increase in growth parameters under application of 100% RDF may be due to better start and early seedling vigor under the optimum levels of inorganic sources of nutrient which indicates proper nutrients utilization during early growth stages of the crop. Increased nutrient status of the soil and more availability of the nutrients at initial stage under optimum moisture status in the soil provide favorable conditions for effective growth and development of the crop. This might have resulted in increase in vegetative growth mainly by elongation of cells and partly cell division. The adequate supply of the three major nutrients *viz.* NPK is expected to regulate plant physiological functions and morphological responses favorably because nitrogen is considered one of the major nutrients required for proper growth and development of plant. Nitrogen is an important constituent of protoplasm and its favourable effect on chlorophyll content of leaves might have increased the synthesis of carbohydrates, amino acids etc., from which the phyto-hormones such as auxins, gibberellins and cytokinins have been synthesized resulting in increased plant height. Whereas, the beneficial effect of phosphorus in early stage of growth may be due to early stimulation of root system, efficient translocation of compounds in phosphorus fed plants, leading to enhanced absorption and utilization of nitrogen and other nutrients. Potassium helps in the protein synthesis, chlorophyll formation and increasing resistance against stress which might have improved growth and development of the plant. The faster availability of nutrients from adequate supply of inorganic fertilizers through-out the cropping period enhances the nutrient requirement of the crop and production of greater number of photo-synthetically active leaves which might have led to higher production of carbohydrates and phyto-hormones which resulted in increased growth attributes of cauliflower. The results are in close agreement with the finding of Singh et al. (2018) and Singh et al. (2020).

IV. CONCLUSION

Keeping in view the objectives to undertake the study and the results obtained after conducting the experiment for one year, it has been concluded that application of different integrated nutrient management treatments significantly enhanced the growth parameters, yield attributes, yields, nutrient content and economics of cauliflower. Application of 100% RDF gave significantly higher growth parameters, yield attributes, yield, and nutrient content and net returns of cauliflower over control and application of 50% RDF. The application of vermicompost @ 7.5 t/ha + Azospirillum gave significantly highest growth parameters, yield attributes, yield, nutrient content and net returns of cauliflower as compared to control and application of FYM @ 20 t/ha +

Azospirillum. However, these results are only indicative and required further experimentation to arrive some more consistent and final conclusion.

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