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**Rohit Pawar**
Department of Vegetable Science, COH, Dr. Y. S. Paramr UHF, Nauni, Solan, Himachal Pradesh, India

**Santosh Barkule**
Department of Horticulture, Vasantrao Naik Marathawada Krishi Vidyapeeth, Parbhani, Maharashtra, India

**SG Patil**
Department of Horticulture, Vasantrao Naik Marathwada Krishi Vidyapeeth Parbhani Maharashtra, India

**Correspondence**
**Rohit Pawar**
Department of Vegetable Science, COH, Dr. Y. S. Paramr UHF, Nauni, Solan, Himachal Pradesh, India

# Effect of integrated nutrient management on post-harvest parameters of cauliflower (*Brassica oleracea* var. *botrytis* L.) cv. pusa snowball- 16

**Rohit Pawar, Santosh Barkule and SG Patil**

**Abstract**

In order to investigate the effect of integrated nutrient management on post-harvest component in cauliflower *Brassica oleracea* var. *botrytis* L., cv. Pusa snowball- 16, an experiment was conducted using Randomized Block Design with three replications. The experiment comprised of 14 different treatment combinations comprising of three different sources of nutrients including inorganic, organic and bio-fertilizers. The post-harvest parameters like length of root (cm), fresh weight of plant (g), dry weight of plant (g), fresh weight of root (g), dry weight of root (g), percent dry weight of plant and root (g) and per cent weight loss in cauliflower curds were observed in treatment combination 75% RDF + FYM + *Azotobacter* + *Azospirillum* ($T_6$) as compare to 100% RDF. From the studies it can be inferred that the application of 75% RDF + FYM @ 5 t/ha along with *Azospirillum* and *Azotobacter* was found to be the most effective treatment combination for getting enhanced post harvested parameters in cauliflower with saving of 25 per cent chemical fertilizers.

**Keywords:** Cauliflower, fertilizers, plant, root and curd

## 1. Introduction

Among different vegetables, cauliflower (*Brassica oleracea* var. *botrytis* L.) is one of the most important winter vegetable among the cole crops which belongs to the genus *Brassica* of the family Cruciferae. Cauliflower is essentially a cold weather hardy crop and thrives best in cool and moist climate. This was originated from Cyprus and the first crop of cauliflower was introduced in India in sixth century A.D. There is a great demand to this vegetable on account of its delicious taste due to abortive floral parts which are fleshy and closely crowded are used for culinary purposes either along or mixed with potato. Pickle can also be prepared from the firm curd (Thamburaj and Singh, 2014) [8].

The dramatic increase in vegetable productivity and the increase in fertilizer consumption point to the crucial role of fertilizers. Recently many countries are facing the problem of soil deterioration and environment pollution due to enormous use of chemical fertilizers. Therefore, the current trend is to use organic fertilizers like bio-fertilizers of microbial origin with limited use of chemical fertilizers. The ratio between the chemically fixed and biologically fixed nitrogen usually range between 1:4 to 1:25. *Azospirillum* inoculants increase to crop production by 5-20 per cent with the saving of elemental nitrogen up to 40 per cent of the recommended dose. (Dart, 1986) [2]

The ample quantity of nitrogen is existing in the atmosphere and the same is being fixing by the root nodules, existing in the legume vegetable crops under normal condition. It is not possible in non-legume vegetable crops. But the use of bio-fertilizers like *Azotobacter, Azospirillum*, in non-legume vegetable crops helps in fixing atmospheric nitrogen. The beneficial effects of *Azospirillum* have been related not only to their nitrogen fixation proficiency but also with their abilities to produce antibacterial and antifungal compounds, hormones and siderophores. The uses of bio-fertilizers also improve the texture and structure of the soil.

The use of bio-fertilizers with reducing dose of chemical fertilizers are as renewable and environmentally friendly supplementary source of nutrients, which helps to maintain soil fertility and eliminate the pollution hazards to increase the crop production. Keeping in view these facts the present investigation was under taken to explore the effect of inorganic fertilizers, organic manure and bio-fertilizers on post-harvest component of cauliflower.

## 2. Materials and Methods

The present investigation on effect of integrated nutri-ent management on growth and yield of cauliflower was carried out at vegetable Research Farm of Depart-ment of Horticulture, College of Agriculture, Latur, under Vasantrao Naik Marathawada krishi vidyapeeth Parbhani in Maharashtra. The experiment was laid out in randomized block design with two replications comprising of fourteen treatment combinations (Table 1). The seeds were sown in raised nursery beds. After sowing, seeds were covered with a thin film of soil mixed with Farm Yard Manure. Thereafter, paddy straws mulching was incorporated to reduce moisture loss. The beds were irrigated twice a day with the help of water can to maintain optimum moisture in soil.

Twenty five days old seedlings were used for trans-planting in the main field. The required quantity of bio-fertilizers such as *Azotobactor* and *Azospirillum* (10 kg/ha) was mixed in soil and given to the respective plots. The FYM (10 t/ha) and NPK (120:80:40 kg/ha) was applied as per the decided treatments in which half dose of nitrogen through urea along with the full dose of phosphorous through single super phosphate and potassium through murate of potash was applied. The half dose of nitrogen was given as per treatments after 30 days of transplanting. Healthy uniform seedlings of four weeks age were selected for transplanting and they were treated with bavistin @ 2 g /lit and trans-planted in the plot size 3.6 m x 2.7 m at spacing of 60 x 45 cm. Thus, the numbers of plants per plot were 36. Light irrigation was given immediately after trans-planting.

The observations were recorded for post-harvest characters viz. length of root (cm), fresh weight of plant (g), dry weight of plant (g), fresh weight of root (g), dry weight of root (g), percent dry weight of plant and root (g) and per cent weight loss in cauliflower curds. Five plants in each treatment combination and in each replication were randomly selected and tagged properly for recording various observations. The experimental data of all the parameters was subjected to statistical analysis for proper interpretation. The statistical analysis of data in respect of the post-harvest components was done according to the standard procedure given for randomized block design by Panse and Sukhatme (1967).

**Table 1:** Treatment details

| Symbol | Treatments |
|---|---|
| $T_1$ | 100% RDF (120:80:40 kg/ha.) |
| $T_2$ | 100% RDF + FYM + *Azotobacter* + *Azospirillum*. |
| $T_3$ | 100% RDF + *Azotobacter* + *Azospirillum*. |
| $T_4$ | 100% RDF + FYM + *Azotobacter*. |
| $T_5$ | 100% RDF + FYM + *Azospirillum*. |
| $T_6$ | 75% RDF + FYM + *Azotobacter* + *Azospirillum*. |
| $T_7$ | 75% RDF + *Azotobacter* + *Azospirillum*. |
| $T_8$ | 75% RDF + FYM + *Azotobacter*. |
| $T_9$ | 75% RDF + FYM + *Azospirillum*. |
| $T_{10}$ | 50% RDF + FYM + *Azotobacter* + *Azospirillum*. |
| $T_{11}$ | 50% RDF + FYM + *Azotobacter*. |
| $T_{12}$ | 50% RDF + FYM + *Azospirillum*. |
| $T_{13}$ | 50% RDF + *Azotobacter* + *Azospirillum*. |
| $T_{14}$ | Control. |

## 3. Result and Discussion

The data regarding post-harvest parameters of cauliflower as influenced by different treatments of INM are presented in Table 2.

### 3.1 Effect on root parameters

The data clearly showed that, the treatment of 75 per cent RDF + FYM + *Azotobacter* + *Azospirillum* ($T_6$) was recorded maximum root length (30.70 cm) and it was at par with the treatment $T_8$, $T_9$ and $T_7$. The minimum length of root (21.60 cm) was recorded in treatment control ($T_{14}$). As regards to the fresh weight of root, the maximum fresh weight of root (109.05 g) recorded in treatment of 75% RDF + FYM + *Azotobacter* + *Azospirillum* ($T_6$) and it was at par with the treatment $T_8$, $T_9$ and $T_7$. The minimum fresh weight of root (72.17 g) was recorded in treatment of 50% RDF + FYM + *Azotobacter* ($T_{11}$). However, maximum dry weight of root (26.51 g) was recorded in the treatment of 75% RDF + FYM + *Azotobacter* + *Azospirillum* ($T_6$), which was statistically at par with $T_9$, $T_2$, $T_8$, $T_1$ and $T_7$. The lowest value of dry weight of root (17.60 g) recorded in the treatment control ($T_{14}$). The data showed that, the maximum per cent dry weight of root (26.92%) was observed in treatment of 75% RDF + FYM + *Azotobacter* + *Azospirillum* ($T_6$). The minimum per cent dry weight of root (21.01%) was observed in treatment control ($T_{14}$).

The maximum biomass allocation in leaves was obviously due to more initial biomass synthesis in leaves, less biomass accumulation in stem and balanced distribution in roots. A bacterium increases rapidly specially in the rhizosphere thus, creating favorable condition for root development which might have absorbed more amounts of nutrients thus, enhancing the growth. These findings are supported by the Kolhe (1985) [5], Gurav (2002) [3] in cabbage, Sable and Bhamare (2007) [7] in cauliflower.

### 3.2 Effect of fresh weight of plant and dry weight of plant

There were significant differences in fresh weight of plant of cauliflower of all treatments studied. The maximum fresh weight of plant (1664.50 g) in treatment of 75% RDF + FYM + *Azotobacter* + *Azospirillum* ($T_6$) while, the treatments $T_9$, $T_1$ and $T_3$ were found at par. The minimum fresh weight of plant (682.50 g) was recorded in treatment control ($T_{14}$).There were significant differences in dry weight of plant, the treatment of 75% RDF + FYM + *Azotobacter* + *Azospirillum* ($T_6$) has recorded maximum (307.78 g) dry weight of plant which was significantly superior over rest of the treatments. The minimum dry weight of plant (97.50 g) was recorded in the treatment control ($T_{14}$). The data showed that, the maximum per cent dry weight of plant (18.49%) in treatment of 75% RDF + FYM + *Azotobacter* + *Azospirillum* ($T_6$) and minimum dry weight of plant (13.26%) was recorded in treatment control ($T_{14}$).

This increase in fresh and dry weight of plant may be due to initial growth of plant was maximum. The maximum plant height, more numbers of leaves and diameter of stem due to increase uptake of nutrients may be possible cause behind increase fresh weight of plant in treatment $T_6$ and thereby increase the dry weight of plant. These results are supported by Idnani and Thuan (2007) [4] and Sable and Bhamare (2007) [7] in cauliflower.

### 3.3 Per cent weight loss in cauliflower curds

The data in respect of per cent weight loss in curd of different treatments stored at room temperature up to 10 days and is presented in Table- 3 and Figure- 1. On 5th day, the minimum weight loss of curd (17.43 per cent) was recorded in treatment of 75% RDF + FYM + *Azotobacter* + *Azospirillum* ($T_6$) followed by (18.95 per cent) in treatment of 75% RDF+ FYM + *Azospirillum* ($T_9$) and (20.32 per cent) in treatment of 100% RDF+ FYM + *Azospirillum* ($T_5$). The maximum weight loss of curd (42.03 per cent) was recorded in treatment control ($T_{14}$). On 10th day, the minimum weight loss of curd (45.81 per cent) was recorded in treatment of 75% RDF + FYM +

*Azotobacter* + *Azospirillum* ($T_6$) followed by (51.20 per cent) in treatment of 100% RDF + FYM + *Azotobacter* + *Azospirillum* ($T_2$). The maximum weight loss of curd (80.56 per cent) was recorded in treatment of 100% RDF ($T_1$).

The maximum weight loss in curd was due to less organic nutrient supply to the curd from the soil. Application of chemical fertilizers resulted in fast growth and increases the respiration rate. The minimum weight loss was due to slower rate of respiration and transpiration which might have prevented the moisture loss from curd surface, resulted in delay the loosing of curd therefore, retained the curd quality for longer period. Due to maximum nutrient content in curd it reduces the respiration rate. The results are supported by the Chatterjee *et al.* (2012) [1] in cabbage.

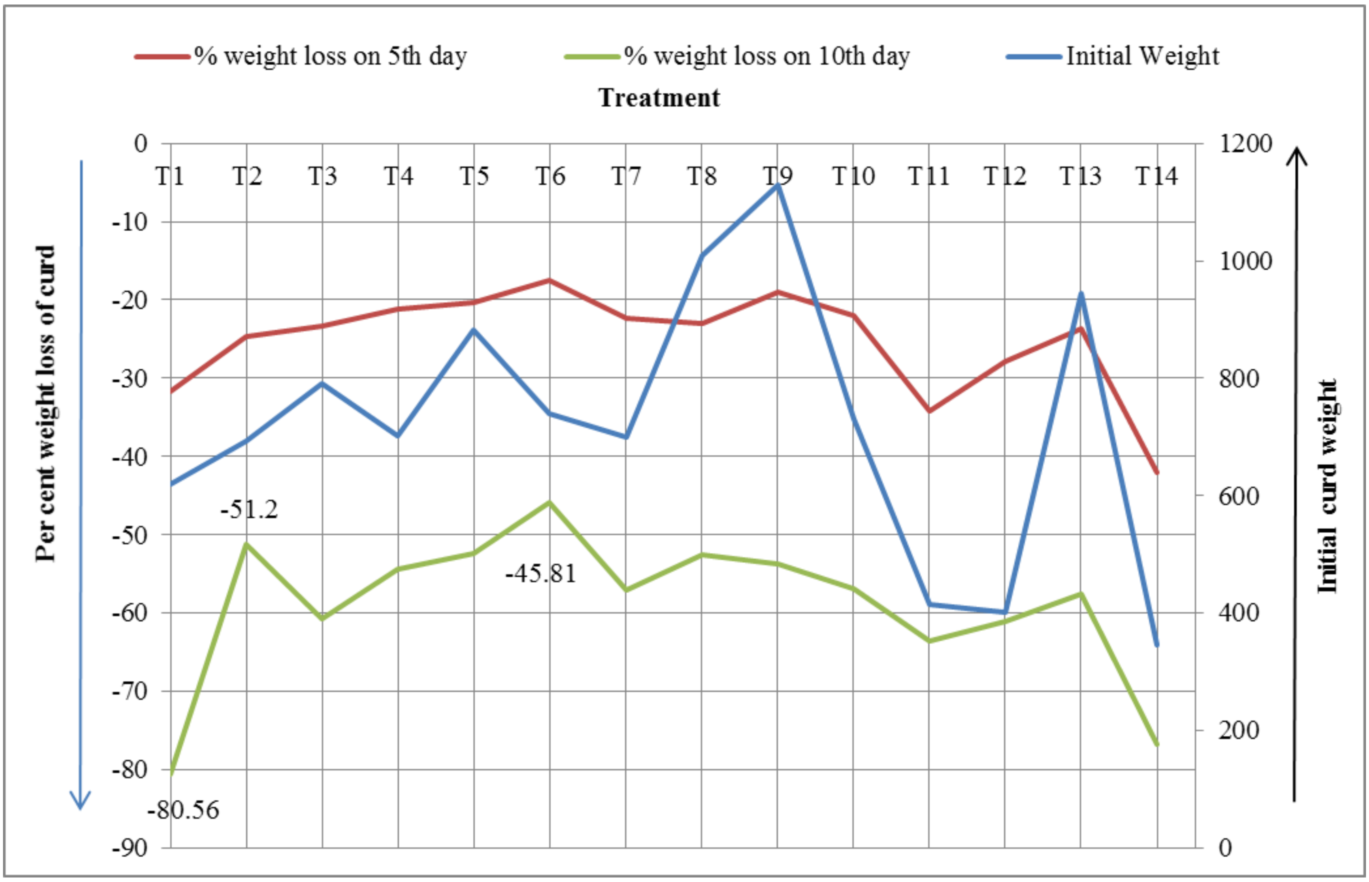


**Fig 1:** Effect of different INM treatments on per cent weight loss in cauliflower curds.

**Table 2:** Effect of different INM treatments on bio-mass characters of cauliflower

| T. No. | Treatments | Length of root (cm) | Fresh weight (g) | | Dry weight (g) | | Per cent dry weight of plant | Per cent dry weight of root |
|---|---|---|---|---|---|---|---|---|
| | | | Plant | Root | Plant | Root | | |
| $T_1$ | 100% RDF (120:80:40 kg/ha.) | 25.50 | 1455.00 | 96.65 | 207.86 | 25.69 | 14.29 | 24.31 |
| $T_2$ | 100% RDF+ FYM + *Azotobacter* + *Azospirillum* | 23.60 | 1234.60 | 96.50 | 206.36 | 25.98 | 16.71 | 26.58 |
| $T_3$ | 100% RDF + *Azotobacter* + *Azospirillum* | 23.70 | 1431.00 | 94.80 | 224.42 | 22.68 | 15.68 | 23.92 |
| $T_4$ | 100% RDF + FYM + *Azotobacter* | 24.30 | 1195.40 | 73.85 | 180.77 | 18.99 | 15.12 | 23.83 |
| $T_5$ | 100% RDF+ FYM + *Azospirillum* | 24.80 | 1393.30 | 99.60 | 204.04 | 22.18 | 14.64 | 22.27 |
| $T_6$ | 75% RDF + FYM + *Azotobacter* + *Azospirillum* | 30.70 | 1664.50 | 109.05 | 307.78 | 26.51 | 18.49 | 26.92 |
| $T_7$ | 75% RDF + *Azotobacter* + *Azospirillum* | 28.10 | 1296.10 | 101.30 | 195.15 | 25.33 | 15.06 | 25.00 |
| $T_8$ | 75% RDF+ FYM + *Azotobacter* | 30.30 | 1407.60 | 103.70 | 211.08 | 25.96 | 15.00 | 25.03 |
| $T_9$ | 75% RDF+ FYM + *Azospirillum* | 29.10 | 1536.40 | 102.25 | 234.49 | 26.09 | 15.26 | 25.52 |
| $T_{10}$ | 50% RDF+ FYM + *Azotobacter* + *Azospirillum* | 26.00 | 1067.10 | 90.00 | 147.44 | 22.17 | 13.82 | 24.63 |
| $T_{11}$ | 50% RDF+ FYM + *Azotobacter* | 25.60 | 875.00 | 72.70 | 120.99 | 18.18 | 13.83 | 25.01 |
| $T_{12}$ | 50% RDF + FYM + *Azospirillum* | 24.70 | 888.50 | 85.50 | 118.93 | 21.09 | 13.39 | 24.67 |
| $T_{13}$ | 50% RDF + *Azotobacter* + *Azospirillum* | 25.10 | 1064.50 | 85.30 | 142.04 | 21.33 | 13.34 | 25.01 |
| $T_{14}$ | Control | 21.60 | 682.50 | 90.40 | 97.50 | 17.60 | 13.26 | 21.01 |
| | S.E. ± | 1.59 | 82.90 | 3.94 | 13.04 | 1.08 | -- | -- |
| | C.D. at 5% | 4.87 | 248.77 | 12.04 | 39.10 | 3.29 | -- | -- |

**Table 3:** Per cent weight loss of curd in different treatments at different storage period

| T. No. | Treatments | Initial Weight (g) | Weight of curd (g) / Per cent weight loss of curd | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | $2^{nd}$ day | $3^{rd}$ day | $4^{th}$ day | $5^{th}$ day | $6^{th}$ day | $7^{th}$ day | $8^{th}$ day | $9^{th}$ day | $10^{th}$ day |
| $T_1$ | 100% RDF (120:80:40 NPK kg/ha). | 620 | 591.5 (4.6) | 528.5 (14.76) | 471 (24.03) | 423 (31.77) | 373 (39.84) | 323.5 (47.82) | 280.5 (54.76) | 156.5 (74.76) | 120.5 (80.56) |
| $T_2$ | 100% RDF+ FYM + *Ab* + *Ap*. | 693 | 640 (7.64) | 597 (13.78) | 550 (20.63) | 522.5 (24.6) | 490 (29.29) | 453 (34.63) | 422 (39.1) | 401 (42.55) | 385 (51.20) |
| $T_3$ | 100% RDF + *Ab* + *Ap*. | 791 | 758 (4.17) | 700.5 (11.44) | 637 (19.47) | 606 (23.39) | 569 (28.07) | 523.5 (33.82) | 487 (38.43) | 369.5 (53.29) | 310 (60.81) |
| $T_4$ | 100% RDF + FYM + *Ab*. | 702 | 651 (7.26) | 614 (12.54) | 573 (18.38) | 553 (21.23) | 529 (24.64) | 497.5 (29.13) | 466.5 (33.55) | 372 (47.01) | 320 (54.42) |
| $T_5$ | 100% RDF+ FYM + *Ap*. | 881 | 835 (5.22) | 783.5 (11.07) | 737 (16.35) | 702 (20.32) | 663 (24.74) | 628 (28.72) | 593.5 (32.63) | 476 (45.97) | 419.5 (52.38) |
| $T_6$ | 75% RDF + FYM + *Ab* + *Ap*. | 740 | 710 (4.05) | 670 (9.45) | 640 (13.51) | 611 (17.43) | 581 (21.48) | 549.5 (25.74) | 521.5 (29.52) | 428.5 (40.09) | 401 (45.81) |
| $T_7$ | 75% RDF + *Ab* + *Ap*. | 699 | 668 (4.43) | 619 (11.44) | 580 (17.02) | 543 (22.32) | 510 (27.04) | 475 (32.05) | 442 (36.77) | 326 (53.36) | 300 (57.08) |
| $T_8$ | 75% RDF+ FYM + *Ab*. | 1010 | 938 (7.13) | 871 (13.76) | 800 (20.79) | 778 (22.97) | 727 (28.02) | 690 (31.68) | 649 (35.74) | 505 (50.08) | 480 (52.48) |
| $T_9$ | 75% RDF+ FYM + *Ap*. | 1129 | 1096 (2.92) | 1029 (8.86) | 967 (14.35) | 915 (18.95) | 839 (25.69) | 803 (28.88) | 730 (35.21) | 700 (40.92) | 677 (53.69) |
| $T_{10}$ | 50% RDF+ FYM + *Ab* + *Ap*. | 731 | 693 (5.2) | 646 (11.68) | 588 (19.56) | 570 (22.02) | 540 (26.13) | 502 (31.33) | 471 (35.57) | 359 (50.89) | 315 (56.91) |
| $T_{11}$ | 50% RDF+ FYM + *Ab*. | 415 | 375 (9.52) | 312.5 (24.7) | 292 (29.64) | 273 (34.22) | 246 (40.72) | 238 (42.65) | 224 (46.02) | 170 (59.4) | 151 (63.61) |
| $T_{12}$ | 50% RDF + FYM + *Ap*. | 402 | 358.5 (10.82) | 332 (17.41) | 300 (25.37) | 290 (27.86) | 267 (33.86) | 252 (37.71) | 237 (41.04) | 175 (56.47) | 153 (61.14) |
| $T_{13}$ | 50% RDF + *Ab* + *Ap*. | 945 | 898.5 (4.92) | 833 (11.85) | 770 (18.52) | 722 (23.6) | 649 (31.32) | 618 (34.6) | 581 (38.52) | 435 (53.97) | 401 (57.57) |
| $T_{14}$ | Control. | 345 | 273 (20.87) | 243 (29.57) | 210.5 (38.99) | 200 (42.03) | 176 (48.99) | 162 (53.04) | 146 (57.68) | 94 (72.75) | 80 (76.81) |

## 4. Conclusion

From the result of present investigation it can be concluded that treatment of 75% RDF + FYM + *Azotobacter* + *Azospirillum* was found significantly superior comparison with 100% RDF for Post-Harvest Parameters of cauliflower and thus there is saving of 25 per cent inorganic fertilizer. Hence the treatment of 75% RDF + FYM @ 10t/ha + *Azotobacter* @ 10 kg/ha + *Azospirillum* @ 10 kg/ha was prove to be the optimum combination of inorganic and bio-fertilizer for better cauliflower cultivation.

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