THE ASIAN JOURNAL OF HORTICULTURE
Volume **8** | Issue 2 | December, 2013 | 568-571

Research Paper

Article history **:**
Received : 12.06.2013
Revised : 23.09.2013
Accepted : 07.10.2013

Influence of chemical fertilizers and biofertilizers on dry matter yield and NPK uptake by cabbage (*Brassica oleracea* var. capitata Linn.)

V.K. SINGH[1], K.P. SINGH AND **ASHISH RANJAN[1]**

Members of the Research Forum

Associated Authors:
[1]Department of Horticulture, Bhiar Agricultural University, Sabour, BHAGALPUR (BIHAR) INDIA

Author for correspondence :
K.P. SINGH
Department of Horticulture, Bhiar Agricultural University, Sabour, BHAGALPUR (BIHAR) INDIA
Email : vikuranjan@gmail.com

ABSTRACT : An experiment was carried out during Rabi 2006-07 and 2007-08 at Bihar Agricultural College, Sabour to find out the effect of inorganic fertilizers and bio fertilizers on dry matter yield per plant and NPK-uptake by plant from soil. Five levels of inorganic fertilizers (F_1-N_{80} P_{40} K_{40}, F_2 – N_{120} P_{60} K_{60}, F_3-N_{160} P_{80} K_{80} F_4 – N_{200} P_{100} K_{100} and F_5 – N_{240} P_{120} K_{120}) and five treatments of bio fertilizers (M1-O, M_2-*Azotobacter*, M_3 – *Azospirillum*, M_4 – VAM and M_5 – PSB) were taken. The data of two years were pooled and analysed. The results of the investigation revealed that maximum dry matter production per plant and NPK- uptake by plant from soil was obtained at fertility level of N_{200} P_{100} K_{100}. The interaction effect of inorganic fertilizers and bio fertilizers were also found highly significant. The plant grown at fertility level of N_{200} P_{100} K_{100} along with application of *Azospirillum* as seed and seedlings treatment as well as soil application gave the highest dry matter yield per plant as well as NPK – uptake by plant from the soil.

KEY WORDS : Chemical fertilizer, Biofertilizer, NPK, Cabbage

HOW TO CITE THIS ARTICLE : Singh,V.K., Singh, K.P. and Ranjan, Ashish (2013). Influence of chemical fertilizers and biofertilizers on dry matter yield and NPK uptake by Cabbage (*Brassica oleracea* var. capitata Linn.). *Asian J. Hort.*, **8**(2) : 568-571.

Among the cole crops, Cabbage (*Brassica oleracea* var. Capitata Linn.) is one of the most important commercial vegetable crop. It is widely grown all over India and abroad for its special high nutritive value, high productivity and wider adaptability under different agro climatic conditions. In general, hybrids have greater yield potential and higher nutritional requirement than the existing improved open pollinated varieties. A crop yielding more is bound to extract more nutrients from the soil which shall have to be replenished by different sources of nutritive feed to minimize the doses of chemical fertilizers. A judicious combination strategy of using inorganic fertilizers as well as bio fertilizers may be helpful in increasing vegetable production. Such efforts will be effective not only in sustaining productivity and soil health but also in supplementing a part of chemical fertilizers requirement of the crop. These conditions thus make it necessary to investigate into the effect of inorganic fertilizers in relation to bio fertilizers to assess the nutrient uptake by plant.

RESEARCH METHODS

The present investigations were carried out in the Department of Horticulture (Vegetables and Floriculture), Bihar Agricultural College, Sabour during the Consecutive years 2006-07 and 2007-08. Five levels of chemical fertilizers *i.e.*, F_1- N_{80} P_{40} K_{40}, F_2-N_{120} P_{60} K_{60}, F_3 – N_{160} P_{80} K_{80}, F_4-N_{200} P_{100} K_{100} and F_5-N_{240} P_{120} K_{120} per hectare and treatments of bio fertilizers (M_1-O_0, M_2-*Azotobacter,* M_3-*Azospirillum*, M_4- VAM and M_5- PSB) and their combinations were applied in three replications having Factorial Randomized Block Design experimental design. Microbial inoculants were applied as seed and seedlings treatment as well as soil application @ 5 kg/ha. For estimation of dry matter yield, the plant material was washed and chopped into fine pieces and dried in an oven at 80^0 C till constant weight was attained. For estimation of nutrient, the dried plant material was grinded in the grinder. From grinded material only 0.5g was taken for digestion in flask and nitrogen was estimated by modified Kjeldahl's method (A.O.A.C., 1980

and Jackson 1963), phosphorus by vanadomolybdo phosphoric yellow colour method (Koening and Johnson, 1942) and potash by using flame photometer (Jackson, 1967).

RESEARCH FINDINGS AND DISCUSSION

A perusal of data in Table-1 revealed that dry matter yield per plant was markedly increased by different dosages of inorganic fertilizers with successive increment in the dosages of fertilizers upto F_4 (N_{200} P_{100} K_{100}). The highest dry matter yield per plant (201.87g) was recorded by F_4 treatment. The possible reason of increasing dry matter yield/ plant might be the increased plant growth parameter such as plant height, leaf number, leaf area, heavier head etc. due to application of higher level of inorganic fertilizers. Another possible explanation for increasing dry matter yield may be that the matured leaves and stem might have contributing more food materials and minerals for the development of head by supplying higher carbohydrates to head leading to compact and healthy head with higher dry matter content. These findings are in conformity with the results obtained by Sorenson (1999), Loncaric. *et al.* (2003) and Choudhary (2005). The different biofertilizers caused significant variations in increasing the dry matter yield/plant. The microbial inoculants M_3 (*Azospirillum*) induced the maximum dry matter yield / plant (206.16g). This might be due to its ability to produce some growth promoting substances involved in increasing accumulation of food in plant. This obserbation is in conformity with the findings of Kalyani *et al*. (1992) , Chattoo *et al.* (1997) and Bahadur *et al*. (2003).

The interaction effects of biofertilizers and inorganic fertilizers were also found to be highly significant. The microbial inoculants M_3 (*Azospirillum*) gave the maximum total dry matter yield /plant (216.04g) at the fertility level F_4 (N_{200} P_{100} K_{100}). Narayanamma *et al*. (2005), Bahadur *et al.* (2006) and Bhardwaj *et al*. (2007) also reported similar results.

It is clear from the Table -2 that N- uptake by plant was increased due to different levels of fertilizers and biofertilizers. There was a significant increase in N- uptake by plants due to increasing level of fertilization upto F_4 (N_{200} P_{100} K_{100}) and at this level maximum N-uptake (234.88 kg/ ha.) was recorded. The plots receiving the lowest dose of fertilizers F_1 (N_{80} $P_{60}K_{60}$) took up minimum nitrogen (183.76kg/ha) from the soil . This may be attributed to the dearth of nitrogen in the native soil in coping with enough supply of nitrogen to the crop for optimum growth. The application of NPK nutrients made up the deficiency and resulted in the improvement of nitrogen content in plant. This result is in conformity with those reported by Eversats and Booij (2000), Shanmugasundaram and Savithri (2000) and Loncaric etal. (2003). The maximum N-uptake (238.99kg/ha.) by plant was witnessed with the application of M_3 (*Azospirillum*). Therefore the use of *Azospirillum* showed tangible impact on chemical composition of plants. The increase of nitrogen content in plant of cabbage might be due to enhancement of the total uptake of nitrogen by the

Table 1 : Effect of biofertilizers and chemical fertilizers on total dry weight/plant (g) of cabbage (pooled data of 2006-07 and 2007-08)

Biofertilizers	Level of chemical fertilizers (kg/ha)					Mean
	F_1 N80 P40 K40	F_2 N120 P60 K60	F_3 N160 P80 K80	F_4 N200 P100 K100	F_5 N240 P120 K120	
M_1-O	111.35	177.97	177.35	178.82	180.66	165.23
M_2-Azotobacter	186.39	191.96	195.98	208.94	195.46	195.74
M_3-Azospirillum	195.49	208.75	210.68	216.04	199.83	206.16
M_4-VAM	180.24	187.42	190.40	201.03	189.53	189.73
M_5-PSB	183.38	189.72	194.23	204.51	192.74	192.91
Mean	171.37	191.16	193.73	201.87	191.66	

C.D. (P=0.05) Biofertilizer (M) – 6.49 Chemical fertilizer (F) – 6.49 MxF – 13.73

Table 2 : Effect of biofertilizers and chemical fertilizers on N-uptake (kg/ha.) by plant of cabbage (pooled data of 2006-07 and 2007-08)

Biofertilizers	Level of chemical fertilizers (kg/ha.)					Mean
	F_1 N80 P40 K40	F_2 N120 P60 K60	F_3 N160 P80 K80	F_4 N200 P100 K100	F_5 N240 P120 K120	
M_1-O	115.39	193.38	197.85	202.47	206.82	183.18
M_2-Azotobacter	200.05	217.34	232.15	244.27	230.10	224.78
M_3-Azospirillum	214.71	240.21	246.60	256.03	237.43	238.99
M_4-VAM	191.67	209.82	217.12	233.08	221.21	214.58
M_5-PSB	197.00	214.11	223.27	238.56	226.93	219.97
Mean	183.76	214.97	223.40	234.88	224.50	

C.D. (P=0.05) Biofertilizer (M) - 6.77 Chemical fertilizer (F) – 6.77 MxF - 14.33

Table 3 : Effect of biofertilizers and chemical fertilizers on P-uptake by plant (kg/ha) of cabbage (pooled data of 2006-07 and 2007-08)

Biofertilizers	Level of chemical fertilizers (kg/ha)					Mean
	F_1 N80 P40 K40	F_2 N120 P60 K60	F_3 N160 P80 K80	F_4 N200 P100 K100	F_5 N240 P120 K120	
M_1-O	38.39	64.91	66.19	67.81	69.36	61.33
M_2-Azotobacter	65.73	71.86	76.66	81.19	76.52	74.39
M_3-Azospirillum	69.97	78.73	81.07	84.42	78.81	78.60
M_4-VAM	64.94	71.38	73.75	79.00	74.99	72.81
M_5-PSB	67.46	73.57	75.41	81.65	77.15	75.05
Mean	61.30	72.09	74.62	78.81	75.36	

C.D. at 5% Biofertilizer (M) - 2.23 Chemical fertilizer (F) – 2.23 MxF - 4.72

Table 4 : Effect of biofertilizers and chemical fertilizers on K-uptake (kg/ha) by plant of cabbage (pooled data of 2006-07 and 2007-08)

Biofertilizers	Level of chemical fertilizers (kg/ha)					Mean
	F_1 N80 P40 K40	F_2 N120 P60 K60	F_3 N160 P80 K80	F_4 N200 P100 K100	F_5 N240 P120 K120	
M_1-O	158.93	268.09	273.43	279.90	286.01	253.27
M_2-Azotobacter	271.98	296.62	316.40	334.89	315.49	307.07
M_3-Azospirillum	289.40	325.14	334.49	348.18	325.01	324.44
M_4-VAM	273.60	295.98	308.23	328.62	314.11	304.11
M_5-PSB	274.84	297.30	310.06	331.23	314.87	305.66
Mean	253.75	296.62	308.52	324.56	311.10	

C.D. (P=0.05) Biofertilizer (M) - 9.30 Chemical fertilizer (F) – 9.30 MxF - 19.74

efficient strains of *Azospirillum*. This result also finds support in the observations made by Kalyani *et al.* (1992) and Choudhary *et al*. (2004). Further it was found that microbial inoculant M_3 *Azospirillum* at fertility level of F_4 (N_{200} P_{100} K_{100}) caused maximum N-uptake (256.03kg/ha) by the plant from the soil, however it was statistically similar to treatment combinations of *Azospirillum* + N_{160} P_{80} K_{80} and Azotobacter+ N_{200} P_{100} K_{100} recording 246.60 kg/ha. and 244.27kg/ha, respectively. Therefore, it might be inferred that under optimum supply of N by virtue of microbial inoculants, availability of other nutrients at all stages of crop growth might have induced a luxuriant growth thereby accumulating more nutrients in vegetative organ. These results are in agreement with the findings of Choudhury *et al*. (2004) and Sable and Bhamare (2007).

A perusal of data in Table-3 revealed that P-uptake by plant increased gradually with increasing levels of inorganic fertilizers upto F_4 (N200 P_{100} K_{100}). The application of higher dosages of NPK, in turn, might have led to better root development, better transportation and water uptake and deposition of nutrients. These results are in accordance with the findings of Shanmuaga sundaram and Savithri (2000), Sharma and Arya (2001). Biofertilizers appeared to have caused significant increase in P-uptake by plant and the maximum P-uptake (78.60kg/ha.) was associated with M_3 (*Azospirillum*). The *Azospirillum* might have helped to solubilise iron phosphate as well as rock phosphate present in the soil and making the fixed phosphorus available to the plant. These results are in consonance with the findings reported earlier by Chatto *et al* (1997) and Kumar and Sharma (2004). The interaction effect was also found significant. The highest p-uptake (84.42 kg/ha.) by plant was observed at the fertility level F_4 ($N_{200}P_{100}$ K_{100}) along with microbial inoculants *Azospirillum*. Similar results observed by Sable and Bhamare (2007) support the present findings.

It is clear from Table-4 that K-uptake by plant increased gradually with increasing dosages of inorganic fertilizers upto F_4(N_{200} P_{100} K_{100}) and at this level plant took up maximum K (324.56kg/ha.). The plant developed with application of M_3 (*Azospirillum*) took up maximum K (324.44kg/ha.) from the soil. The interaction effect was also found significant in respect of K-uptake by plant. The plant grown with application of microbial inoculants M_3 (*Azospirillum*) at the fertility level of F_4 (N_{200} P_{100} K_{100}) took up the highest K (348.18kg/ha.) from the soil. Similar trends were also reported by Kumar and Sharma (2004).

REFERENCES

A.O.A.C. (1980) Official methods of analysis, Assoocation of official analytical chemist 13th Edition Washington , D.C., U.S.A.

Bahadur, Anant, Jagdish Singh, Upadhyay, A.K. and Singh, K.P. (2003). Effect of organic manures and biofertilizers on growth , yield and quality attributes of broccoli (*Brassica Oleracea* var. Italica plenck). *Veg. Sci.*, **30** (2) 192-194.

Bahadur, Anant, Jagdish Singh, Singh, K.P., Upadhyay, A.K. and Rai, Mathura (2006). Effect of organic amendments and biofetilizers on growth, yield and quality attributes of Chinese cabbage (*Brassica pekinensis*). *Indian J. Agril. Sci.,* **76**(10): 596-598.

Bhardwaj, A.K., Kumar, P. and Singh, Raj Kumar (2007). Response of nitrogen and pre-planting treatment of seedlings with the Azotobacter on growth and productivity of broccoli (*Brassica Oleracea* var. Italica). *Asian J. Hort.*, **2**(1): 15-17.

Chatto, M.A., Gandroo, M.Y. and Zorgar, M.Y. (1997). Effect of Azospirillum and Azotobacter on growth, yield and quality of knol khol (*Brassica Oleracea* var. Gangylodes L.) Veg. Sci., **24** (1) : 16-19.

Choudhary, R.K. and Choudhary, D.N. (2005). Effect of different level of nitrogen and phosphorus on growth, yield and quality of hybrid Cabbage. *Haryana J. Hort. Sci.,* **34** (1/2) : 145-146.

Chodhury, M.R., Saikia, A. and Talukdar, N.C. (2004). Response of cauliflower to integrated nutrient management practice. *Bioved,* **15** (1/2) : 83-87.

Everaats, A.P. and Booij, R. (2000). Nitrogen use of white Cabbage. PAV Bulletin Vallagrondsroenteteelt, **2** : 24-26.

Jackson, M.L. (1963). Nitrogen determination for soil and plant tissues. Prentice Hall of India Pvt. Ltd. , New Delhi, India

Jackson, M.L. (1967). Soil chemical analysis, printice Hall of India Pvt. Ltd. New Delhi, India.

Kalyani, D.P.C., Ravi Sankar, Pillai, R.N. and Manoher Prasad, D. (1992). Studies on the effect of nitrogen and Azospirillum on dry matter and nutrient uptake of Cauliflower. *Veg. Sci.,* **19**(2) : 147-151.

Koening, R.A. and Johnson, C.R. (1942). Colorimetric determination of P in biological materials, *Indian Chem. Anal.,* **14**:155-156.

Kumar, Pardeep and Sharma, S.K. (2004). Integrated nutrient management for sustainable Cabbage-tomato cropping sequence under mid hill condition of Himachal Pradesh. *Indian J. Hort.,* **61**(4): 331-334.

Loncaric, Z.T., Teklic, N. Paradjikovic and Jug, I. (2003). Influnce of fertilization an early savoy cabbage yield. *Acta Hort.*. **627** : 145-152.

Narayanamma, M.C.H., Chitranjeevi, I.P. Reddy and S.R. Ahmed (2005). Integrated nutrient management in cauliflower (*Brassica oleracea* var botrytis.). *Veg. Sci.,* **32** (1) : 62-64.

Sable, P.B. and Bhamare, V.K. (2007). Effect of biofertilizers (Azotobacter and Azospirillum) alone and in combination with reduced levels of nitrogen on quality of Cauliflower cv. SNOWBALL-16. *Asian J. Hort.,* **2**(1): 215-217.

Shanmugasundaram, R and Savithri, P. (2000). Effect of N levels on the alkaline KmNo4-N, N content and uptake of nitrogen during growth of Cabbage: *Internat. J. Trofical Agric.,* **18**(4) : 367-371.

Sharma, K.C. and Arya, P.S. (2001). Effect of nitrogen and farmyard ,manure on Cabbage (*Brassica oleracea* var. Capitata) in dry temperate Zone of Himachal Pradesh. *Indian J. Agric. Sci.,* **71**(1) : 60-61.

Sorensen, J.N. (1999). Nitrogen effect on vegetable crops production and chemical composition, *Acta Hort.,* (506):41-59.