Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2018; 7(1): 506-509
Received: 19-11-2017
Accepted: 21-12-2017

Gocher P
Research Scholar, Department of Horticulture S.K.N. College of Agriculture SKNAU, Jobner, Jaipur, Rajasthan, India

Soni AK
Professor, Department of Horticulture S.K.N. College of Agriculture SKNAU, Jobner, Jaipur, Rajasthan, India

Deepika Sharma
Research Scholar, Department of Horticulture S.K.N. College of Agriculture SKNAU, Jobner, Jaipur, Rajasthan, India

Bairwa RK
Research Scholar, Department of Horticulture S.K.N. College of Agriculture SKNAU, Jobner, Jaipur, Rajasthan, India

Correspondence
Deepika Sharma
Research Scholar, Department of Horticulture S.K.N. College of Agriculture SKNAU, Jobner, Jaipur, Rajasthan, India

Interactive effect of NPK and Sulphur on Yield and Economics of Cauliflower (*Brassica oleracea* var. *botrytis* L.) variety Pusa Synthetic

Gocher P, Soni AK, Deepika Sharma and Bairwa RK

Abstract
A field experiment was conducted at Horticulture Farm, S.K.N. College of Agriculture, Jobner (Jaipur) during *Rabi* season 2015-16. The experiment consisting four levels of NPK (0, 75, 100 and 125% RD of NPK) and four doses of sulphur (0, 20, 40 and 60 kg sulphur ha^{-1}) with total 16 treatment combinations were tested in randomized block design and three replications. Results revealed that application of 125 per cent recommended dose of NPK and sulphur dose @ 60 kg ha^{-1} to the cauliflower significantly increased the average weight of curd (g), total curd yield (kg $plot^{-}$ and q ha^{-1}), net returns and B: C ratio as compared to control, 75 per cent recommended dose of NPK and 20 kg sulphur ha^{-1} but statistically at par with 100 per cent recommended dose of NPK with 40 kg sulphur ha^{-1}. The combined application of 100 per cent recommended dose of NPK with 40 kg sulphur ha^{-1} proved to be most superior treatment combination in terms of average weight of curd (g), total yield of curd per plot (kg), total curd yield (q ha^{-1}) because resulting saving of 25 per cent recommended dose of NPK and 20 kg sulphur ha^{-1}.

Keywords: Cauliflower, NPK, sulphur, yield attributes, net returns and B: C ratio

Introduction
Cauliflower (*Brassica oleracea* var. *botryitis* L.*)* is the most popular vegetable crop among cole crops belong to the family Cruciferae. It is being grown round the year for its white and tender curd. The typical Indian or Tropical cauliflowers have been developed from the inter-crossing of Cornish type (biennial) with European strains and tropical types have more variability and strong self-incompatibility. Temperate types have less variability and less or no self-incompatibility. Temperate type has small thick stem, bearing whorl of leaves and branched tap root system. The main point develops into shortened shoot system whose apices make up the convex surface of curd. It is used as fried vegetable, dried vegetable, making soup and pickles. In Rajasthan, Cauliflower is grown extensively in the district of Ajmer, Alwar, Tonk, Sikar, Bundi, Bharatpur, Nagaur, Rajsamand, Ganganagar, Jaipur and Jodhpur. Total area of cauliflower in Rajasthan about 9.42 thousand ha with an annual production of about 36.61 thousand tonnes and productivity about 3.89 MT (Anonymous, 2013) [2].

Among various essential plant nutrients, nitrogen is an essential for plant growth, development and reproduction. Nitrogen is associated with vigorous vegetative growth. It is helpful in large size compact curd development. The proper use of nitrogen improves the curd size, nutrient value and reduces the chances of buttoning (Markovic and Diurovaka, 1990) [13]. Phosphorus is a constituent of nucleic acid, phytin and phosphorus. So, an adequate supply of phosphorus in early stage of plant life is an important in laying down the primordia for the reproductive parts of the cauliflower. It is also an essential constituent of majority of enzymes which are of great important in the transformation of energy in carbohydrate and fat metabolism and also in respiration in plants (Yawalkar *et al*., 1996) [18]. Potassium imparts increased vigour and disease resistance to plant. It also regulates water conduction within the plant cell and water loss from the plant by maintaining the balance between anabolism, respiration and transpiration. Thus reduces tendency to wilt and help in better utilization of available water which ultimately help in the formation of protein and chlorophyll and quality (Rutkauskiene and Poderys, 1999) [14]. Sulphur is an essential plant nutrient and it stands next to primary nutrients in importance. Sulphur plays a vital role in biosynthesis of certain amino acids (cysteine, cystine and methionine) that are essential component of protein and also help in the synthesis of coenzyme-A and formation of chlorophyll and nitrogenase enzyme. Further, sulphur also provides winter hardiness and drought tolerance, control of insect pests and disease *etc*. Two natural growth regulators, thiamin and biotin contain sulphur. Sulphur occurs in glutathione that is important in oxidation reduction reaction (Kanwar, 1976) [11]. It is one of

the constituents of vitamin B_1, some volatile oils and amino acids like methinine (21% S). It is involved in various metabolic and enzymatic processes in the plant (Goswami, 1988) [8].

Material and methods

The field experiment was conducted at Horticulture farm, S.K.N. College of Agriculture, Jobner, Jaipur during *Rabi* season 2015-16 during October to January. The climate of Jobner is typically semi-arid characterized by extremes of temperature both in summer and winter, low rainfall and moderate relative humidity. The experiment was comprised of 16 treatment combinations carried out in Randomized Block Design (RBD) with four levels of NPK (0, 75, 100 and 125 % RD of NPK) denoted by F_0, F_1, F_2 and F_3 and Sulphur (0, 20, 40 and 60 kg ha^{-1}) denoted by S_0, S_1, S_2 and S_3. The recommended dose of NPK for cauliflower is 120 kg, 80 kg and 80 kg per ha respectively. Full dose of P_2O_5, K_2O and half dose of N in various treatments were applied manually as the basal dose at the time of transplanting. Remaining dose of nitrogen was given as top dressing in two split doses at 30 and 45 days after transplanting. Sulphur was applied as per treatment through agriculture grade elemental sulphur and was broadcasted uniformly before transplanting and incorporated in the soil. Seeds of cauliflower *cv*. Pusa Synthetic obtained from National Seed Corporation and treated with 0.02 per cent *Thiram* to save the seedlings from damping off disease. A thin layer of powered leaf mould was used to cover the seeds. Regular watering was done. The seedlings were ready for transplanting in 4-5 weeks. Five weeks old seedlings were transplanted on 24, October 2015, when average height of seedlings was about 10-12 cm. The distance between row to row and plant to plant was kept at 45 x 45 cm. Thus, 16 plants were accommodated in each plot (1.8 x 1.8 m.). The transplanting was done in evening hours followed by light irrigation.

Result and discussion

Effect of NPKs on yield attributes and yield

The perusal of data presenting in Table 1 shows that the effect of NPK had significant influence on the average weight of curd and total yield of curd per plot and ha^{-1}. The mean maximum average weight of curd (371.68 g), yield of curd per plot (5.95 kg) and total curd yield ha^{-1} (183.55 q ha^{-1}) was observed in F_3 *i.e.* 125 per cent recommended dose of NPK, which was found to be significantly higher over F_0 and F_1 but it was statistically at par with F_2 *i.e.* 100 per cent recommended dose of NPK, whereas, minimum average weight of curd (213.83 g), curd yield per plot and ha^{-1} (3.42 kg, 105.60 q ha^{-1}) was recorded under F_0 (control) treatment. This might be due to the fact that increased NPK levels, helped in the expansion of leaf area and chlorophyll content which together might have accelerated the photosynthetic rates and in turn increased the supply of carbohydrates to plants. The application of 100 per cent recommended dose of NPK favoured the metabolic and auxin activities in plant and ultimately resulted in increasing curds weight, volume of curd finally the total yield. However, potassium does not increase the yield of plant but indirectly supported to yield. These results are also in close conformity with the finding of Batel *et al.* (1997) [4], Everaarst and Boou (2000) [6], Yaldas *et al.* (2008) [17] and Abd el-All and EL- Shabrawy (2013) [1].

Effect of sulphur on yield attributes and yield

A perusal of data given in Table 1 reveals that the application of 40 kg S ha^{-1} significantly increased yield attributes *viz.*, average weight of curd (g), total curd yield per plot (kg) and total curd yield per ha (q) as compared to control and 20 kg sulphur but remained statistically at par with 60 kg sulphur per ha. The maximum average weight of curd (372.05 g), curd yield per plot (5.95 kg) and per ha (105.77 q ha^{-1}) was recorded with 60 kg ha^{-1} which was statistically at par with 40 kg ha^{-1} whereas minimum was recorded under control.

The increase in yield and yield attributes might be due to the important role of sulphur in lowering the pH of saline-alkaline soil resulting in increased availability of many nutrients (Hossan and Olsen, 1966) or might to be the activation of a number of enzymes and also in carbohydrate metabolism (Tandon, 1986) which in turn might have favoured better development of curd and resulted in increased growth and ultimately higher yield. The results are in close conformity with those of Bhagavatagoudra and Rokhade (2001) [5] and Gautam (2012) [7].

The increase in yield attributes was probably due to source and sink relationship. The increase in yield attributes can be attributed to increase the size of source and consequently the enhanced partitioning of photosynthates towards sink. The results revealed that application of 60 kg sulphur ha^{-1} significantly increased the curd yields ha^{-1} of cauliflower as compared to control and 20 kg sulphur per ha, which were found statistically at par with 60 kg S ha^{-1}. These finding corroborates with the findings of Jamre *et al.* (2010) [10] and Talukder *et al.* (2013) [15].

Table 1: Effect of NPKs and sulphur on yield attributes and yield of cauliflower

Treatments	Average weight of curd (g)	Curd yield (kg/plot)	Curd yield (q/ha)
Fertility levels			
Control (F_0)	213.83	3.42	105.60
75 per cent RD of NPK (F_1)	286.65	4.59	141.56
100 per cent RD of NPK (F_2)	358.73	5.74	177.15
125 per cent RD of NPK (F_3)	371.68	5.95	183.55
SEm±	5.62	0.09	2.74
CD at 5%	16.24	0.26	7.92
Sulphur levels (kg/ha)			
Control (S_0)	214.18	3.43	105.77
Sulphur 20 kg ha^{-1} (S_1)	286.28	4.58	141.37
Sulphur 40 kg ha^{-1} (S_2)	358.39	5.73	176.98
Sulphur 60 kg ha^{-1} (S_3)	372.05	5.95	183.73
SEm±	5.62	0.09	2.74
CD at 5%	16.24	0.26	7.92

Interactive effect (FxS) on yield attributes and yield

The perusal of data on combined effect of different fertility levels and sulphur doses has been presented in Table 2. The maximum average weight of curd (449.84 g), curd yield per plot (7.20 kg) and curd yield per ha (222.14 q ha^{-1}) were recorded under the treatment combination F_3S_3, which was a significantly superior over to control and other treatment combination. However, F_3S_3 was statistically at par with F_2S_2, F_3S_2 and F_2S_3, while minimum curd weight (148.98 g), curd yield per plot (2.38 kg) and curd yield per ha (73.57 q ha^{-1}) was recorded with F_0S_0 treatment combination. The application of sulphur has been reported to help in lowering soil pH and improve not only the availability of sulphur but of other nutrient too, which resulted in increased consequently the yield. Sulphur plays a vital role in the activation of number of enzymes and carbohydrate metabolism in plant. The results are conformity with the finding of Kumhar (2004), Jamre *et al.* (2010) [10], Abd el-All and EL- Shabrawy (2013) [1] and Bairwa (2015) [3].

Table 2: Interactive effect of NPKs and sulphur on yield attributes of cauliflower

Treatments	Fertility levels											
	Average weight of curd (g)				Curd yield (kg/plot)				Curd yield (q ha^{-1})			
Sulphur levels	F_0	F_1	F_2	F_3	F_0	F_1	F_2	F_3	F_0	F_1	F_2	F_3
S_0	148.98	199.71	249.07	258.96	2.38	3.20	3.99	4.14	73.57	98.62	123.00	127.88
S_1	199.13	266.94	332.91	346.13	3.19	4.27	5.33	5.54	98.34	131.82	164.40	170.93
S_2	248.42	333.02	420.31	431.81	3.97	5.33	6.72	6.91	122.68	164.45	207.56	213.24
S_3	258.79	346.92	432.65	449.84	4.14	5.55	6.92	7.20	127.80	171.32	213.65	222.14
SEm+	11.25				0.18				5.48			
CD (0.05)	32.49				0.52				15.83			

Interactive effect (FxS) on economics

The perusal of data on interactive effect of different levels of NPK and sulphur has been presented in Table 3. The maximum net return (365016) and B:C ratio (4.60) was recorded under the treatment combination F_3S_3, which was a significantly superior over to control and other treatment combination. However F_3S_3 was statistically at par with F_2S_2, F_3S_2 and F_2S_3. While minimum net return (77942) and B:C ratio (1.13) was recorded with F_0S_0 treatment combination. The application of sulphur has been reported to help in lowering soil pH and improve not only the availability of sulphur but of other nutrient too, which resulted in increased consequently the yield. Sulphur plays a vital role in the activation of number of enzymes and carbohydrate metabolism in plant. The results are conformity with the finding of Jamre *et al.* (2010) [10] and Bairwa (2015) [1].

Table 3: Combined effect of NPK and sulphur on net returns (Rs/ha) and B:C ratio of cauliflower

Sulphur levels (kg/ha)	Fertility levels							
	Net returns (Rs/ha)				B:C ratio			
Treatments	F_0	F_1	F_2	F_3	F_0	F_1	F_2	F_3
Control (S_0)	77942	126774	174755	184298	1.13	1.81	2.48	2.58
Sulphur 20 kg ha^{-1} (S_1)	123266	188966	253524	266556	1.67	2.53	3.36	3.50
Sulphur 40 kg ha^{-1} (S_2)	170413	252522	338143	349631	2.25	3.31	4.39	4.50
Sulphur 60 kg ha^{-1} (S_3)	178596	263994	347911	365016	2.31	3.39	4.43	4.60
SEm+	15004				0.16			
CD (0.05)	43330				0.48			

Conclusion

The results of present investigation indicated that application of 125 per cent recommended dose of NPK (F_3) and 60 kg S ha^{-1} (S_3) have maximum yield of cauliflower. However, in the case of total yield of curd per plot, total yield of curd per ha, net return and B:C ratio, the treatment combination 100 per cent recommended dose of NPK (F_2) and 40 kg S ha^{-1} (S_2) gave best result by economic point of view (recommended point of view) of farmers.

References

1. Abd el-All, HM, EL- Shabrawy RA. Effect of some phosphorus sources, nitrogen and sulphur levels on yield, quality, sulforaphane and Vit. C content in broccoli. Research Journal of Agriculture and Biological Sciences. 2013; 9(6):351-365.
2. Anonymous. Ministry of Food Processing Industries, Government of India, Gurgaon Haryana, 2013.
3. Bairwa RK. Effect of sulphur and spacing on growth, yield and quality of knol-khol (*Brassica oleracea* var. *gongylodes* L.) cv. White Vienna. *M.Sc. (Ag.) Thesis, submitted to Sri Karan Narendra College of agriculture, SKNAU, Jobner (Rajasthan,* 2015.
4. Batel KM, Granberry DM, Mullinix BG. Nitrogen, magnesium and boron application effect on cauliflower yield, curd mass and hollow stem disorder. Horticulture Science. 1997; 32(1):75-78.
5. Bhagavatagoudra KH, Rokhade AK. Effect of sources and levels of sulphur nutrition on growth and yield of cabbage. Karnataka Journal of Agricultural Science. 2001; 14(3):724-726.
6. Everaarts AP, Boou R. The effect of nitrogen application on nitrogen utilization by white cabbage (*Brassica oleracea* var. *Capitata* L.) and on nitrogen in the soil at harvest. Journal Horticulture Science and Biotechnology. 2000; 75(6):705-712.
7. Gautam P. Response of knol-khol (*Brassica oleracea* var. *caulorapa*) to organic manures and inorganic fertilizers. *Thesis submitted to SKRAU,* Bikaner, 2012.
8. Goswami NN. Sulphur in Indian Agriculture. *The Fertilizer Association*, New Delhi, India, 1988.
9. Hossan N, Olsen RA. Influence of applied sulphur on availability of soil nutrients for corn (*Zea mays* L.) nutrition. *Proc. Soil Science Society America*. 1966; 30(2): 284-286.
10. Jamre BR, Nagaich KN, Verma H. Effect of different

levels of sulphur and zinc on growth and yield of cauliflower (*Brassica oleracea* var. *botrytis* L.). *The Asian Journal of Horticulture*. 2010; 5(2):323-325
11. Kanwar JS. Soil fertility–Theory and practice. ICAR, New Delhi, 1976.
12. Kumhar R. Effect of NPK and vermicompost on growth, yield and quality of cauliflower (*Brassica oleracea* var. *botrytis* Lamk.) *CV* Pusa Katki. M.Sc. (Ag.) Thesis submitted to Rajasthan Agriculture University, Bikaner, Campus-Jobner, 2004.
13. Markovic V. Diurovaka M. The effect of mineral nutrition on the yield and quality of cauliflower (Brassica oleracea var. botryitis L.). Acta Horticulture. 1990; 267:101-109.
14. Rutkauskiene G, Poderys M. Influence of NPK fertilizers on the yield and quality of white cabbage heads. *Sodininkyste ir darzininkyste*. 1999; 18:155-162.
15. Talukder MR, Banu MB, Hoque AKMS, Hoque MA. Response of knol-khol to different levels of nutrients. Eco-friendly Agricultural Journal. 2013; 6(2):29-33.
16. Tandon HLS, Fertilizer recommendation for horticultural crops in India. A Guide Book F.D. Co., New Delhi. 1986, 112.
17. Yaldas FS, Cylan B, Yagmur, Modogan N. Effect of nitrogen fertilizer on yield, quality and nutrient content in broccoli. Journal Plant Nutrition. 2008; 311:1333-1343.
18. Yawalkar KS, Agarwal JP, Bokde S. Manures and Fertilizers. Agri-Horticulture Publishing House, Nagpur, india, 1996.