EFFECT OF DIFFERENT SOURCES OF NUTRIENTS ON THE GROWTH AND YIELD OF BROCCOLI (cv. 'Premium crop') AND CAULIFLOWER (cv. 'BARI 1')

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CERTIFICATE

This is to certify that the thesis entitled, ***EFFECT OF DIFFERENT SOURCES OF NUTRIENTS ON THE GROWTH AND YIELD OF BROCCOLI* (cv. 'Premium crop') *AND CAULIFLOWER* (cv. 'BARI 1')** submitted to the Faculty of Agriculture, Sher-e-Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of *MASTER OF SCIENCE IN HORTICULTURE*, embodies the result of a piece of bonafide research work carried out by *MUHAMMAD SOHEL MAHAMUD, Registration No. 23979/00259* under my supervision and my guidance. No part of the thesis has been submitted for any other degree or diploma.

I further certify that any help or source of information, received during the course of this investigation has been duly acknowledged.

Dated:
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The Author

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ABSTRACT

An experiment was conducted at Horticulture Farm of Sher-e-Bangla Agricultural University, Dhaka during the period from October 2004 to February 2005 to study the effect of different sources of nutrients on the growth and yield of Broccoli and Cauliflower. The experiment consists of five different sources of nutrient; fertilizer; C_0 (control), C_1 (cowdung 20 t/ha), C_2 (inorganic fertilizer urea 250 kg/ha, TSP 150 kg/ha and MP 200 kg/ha) and C_3 (cowdung 10 t/ha, urea 250 kg/ha, TSP 150 kg/ha MP 200 kg/ha, agro-grow-granular 20 kg/ha) and C_4 (vermicompost 205 kg/ha) and two different cultivars Broccoli cv. 'Premium crop' (Br) and cauliflower cv. 'BARI 1' **(**Ca) were used in the experiment. The experiment was conducted in the Randomized Complete Block Design (RCBD) with three replications. The C_3 treatment gave the maximum gross yield (16.22 and 22.70 t/ha) and the minimum marketable yield (15.59 and 20.04 t/ha) in Br and Ca, respectively. While, the C_0 treatment gave the minimum gross yield (6.82 and 7.89 t/ha) and marketable yield (5.82 and 6.85 t/ha) in Br and Ca, respectively. Between the two different cultivars, the maximum marketable yield (20.04 t/ha) was found in Ca than that (15.59 t/ha) of Br. The maximum benefit cost ratio (2.42) and higher net return (Tk.137305) were recorded in Br compare to Ca from the similar treatment combinations. Comparing between the two different cultivars, Br performed better than Ca from the economic point of view. Among the five different sources of nutrient treatments, the C_3 treatment performed the best.

ABBREVIAT IONS AND ACRONYMS

FULL NAME	ABBREVIATION
Agro-Ecological Zone	AEZ
And others (at elli)	*et al.*
Bangladesh Bureau of Statistics	BBS
Duncan's Multiple Range Test	DMRT
Date After Transplanting	DAT
Etcetera	Etc
Food and Agricultural Organization	FAO
Month	mo
Murate of Potash	MP
Number	no.
Randomized Complete Block Design	RCBD
Sher-e-Bangla Agricultural University	SAU
Triple Super Phosphate	TSP
United Nations Development Program	UNDP

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INTRODUCTION

Broccoli (*Brassica oleracea* var. *italica* L. sub var. *cymosa* cv. 'Premium crop') and Cauliflower (*Brassica oleracea* L. var. *botrytis* sub var. *cauliflora* cv. 'BARI 1') are cole crops and belong to the family Cruciferae. They are commonly grown in the vegetables producing countries like USA, UK, New Zealand, Italy, Chiana, India, Egypt, Israel, Thailand and Bangladesh etc. Broccoli is probably originated from the west Europe and the Cauliflower is from Mediterranean region or Southern Europe and possibly was developed from Broccoli (Baily, 1942).

The popularity of Broccoli is a recent phenomenon in Olericulture in Bangladesh. It is a horticultural hybrid closely related to Cauliflower and can be harvested for a longer period of time (Thompson and Kelly, 1985). It is a very tasty vegetable with an important source of carbohydrate, vitamins and minerals. It contains 5.5g carbohydrate, 3.3g protein, 3200 IU carotene, 0.16 mg B_1, 0.11 mg B_2, 118 mg vitamin C, 160 mg calcium and 1.6 mg iron (Rashid, 1999). At present Broccoli is grown by a small percentage at home garden in Bangladesh during the winter season. It is environmentally better adapted than Cauliflower as reported to withstand comparatively higher temperature (Rashid, 1999). Cauliflower is also a very tasty and much popular vegetable in Bangladesh as well as all over the world, being cultivated in large area in the growing period. It also contains 8.0g carbohydrate, 2.3g protein, 40 IU carotene, 0.13 mg B_1, 0.11 mg B_2, 50 mg vitamin C, 30 mg calcium and 0.8 mg iron respectively (Rashid, 1999). The demand as well as the price of Broccoli and Cauliflower is also higher; both in the national and international market.

The cultivation of Broccoli and the Cauliflower is required proper supply of plant nutrients. The requirement of these plants nutrients can be provided by applying inorganic fertilizer or organic manure or both. However, farmers are now showing interest in organic farming because of, they are more aware about

the residual affect of chemical substances used in the crops field and environmental degradation. Besides, the execess application of inorganic fertilizer causes hazard to public health and to the environment. But the application of both organic and inorganic fertilizer combinedly, can increase the yield as well as keep the environmental sound (Hsieh *et al.*, 1996). Considering the above factors, the present experiment was undertaken with the following objectives.

- To assess the effect of different sources of nutrients on the growth and yield of Broccoli (cv. 'Premium crop') and Cauliflower (cv. 'BARI 1').
- To find out the optimum sources of nutrients for profitable Broccoli (cv. 'Premium crop') and Cauliflower (cv. 'BARI 1') production.
- To evaluate the relative cost and return in Broccoli (cv. 'Premium crop') and Cauliflower (cv. 'BARI 1') production with different sources of nutrients suppliment.

REVIEW OF LITERATURE

Effect of organic and inorganic nutrients management on the growth and yield performance of Broccoli and Cauliflower has been investigated by some investigators in different part of the world. But, there is no information about performance of Broccol with Cauliflower available at present in Bangladesh**.** However, some information's are available on the effect of organic and inorganic nutrients management on the performance of broccol and Cauliflower. So there is a brief review of the available literature has been furnished in this section.

2.1. Effect of fertilizer and manure of the growth and yield of Broccoli

Broccoli cv. 'Premium crop' is a vegetable crop and is grown in Rabi season. It's growth and yield is remarkably influenced by organic and inorganic nutrients management. Information on this crop is varying scanty in Bangladesh. Some of the relevant literatures in this regard have been reviewed and presented in this chapter.

Waltert and Theiler (2003) an experiment was conducted on the effects of growth of different cultivars of Cauliflower and Broccoli were analyzed by the diameter of curd, stem and weight of curd and showed that there was a strong correlation between the diameter of stem and plant biomass and diameter of stem and curd. Growth of stem and curd diameter is dependent on days after transplantation in the field, but dependence is even stronger if related to the sum of maximum daily temperature. Growth of curd showed higher cultivar variation and was more sensitive to environmental factors than growth of stem. In consequence there is a higher variation between curds of one crop, which

differs between cultivars. Depending on the correlations and the variation of harvesting period for cultivars can be predicted.

Malik *et al.* (2002) studied using secondary data on vegetable production in Haryana and found that the annual compound growth rates of area, production and yield were 11.44, 13.38 and 1.74% for onion; 9.32, 7.27, 1.88% for tomato; 14.52, 21.09 and 5.74% for Cauliflower; 19.97, 14.23 and 2.94% for chillies; 6.69, 7.38 and 0.64% for okra; and 2.82, -0.87, and -3.60% for potato, respectively. Overall, the annual growth rate for vegetable crops in the state was positive.

Sharma *et al.* (2002) a field experiment was conducted to evaluate the effects of N (60, 120, 180 and 240 kg/ha) and P (60, 120 and 18 kg/ha) on the growth and seed yield of Broccoli cv. Green Curd and observed that plant height, number of branches per plant, number of seeds per siliqua, seed yield, 1000-seed weight, germination percentage, seedling length and vigor index. In general, all parameters significantly improved with increasing concentrations of N and P.

Sharma (2000) studied and observed that integration of organic and inorganic fertilizer application on Broccoli production (variety Green curd) significantly increased the curd yield over inorganic fertilizer alone and also over control. The treatment N 175 kg/ha, P 75 kg/ha, K 60 kg/hand FYM 12.60 ton/ha gave the maximum yield (63.12 q/ac) which was at far with N 160 kg/ha, P 75 kg/ha, K 60 kg/ha and FYM 12.60 ton/ha (57.59q/ac) but significantly superior to rest of the treatments in terms of yield and net profit.

Rooster *et al.* (1999) a field study was carried out to compare two applications method (broadcasting and row injection using the Cultan system). N fertilizers used were calcium ammonium nitrate (KAS), urea ammonium sulfate (UAS, 25 kg N/100 liters) and urea ammonium nitrate (UAN, 39 kg N/100 liters) and

found that plant uniformity and color were better after fertilizer injection, while crop yields were also higher (99-107 kg/a acompared to 89 - 93 kg/a after broadcasting of N).

Gutezeit *et al.* (1996) carried out a micro plot field experiment with Broccoli cv. Emperor and showed no differences in FW growth for the first 3 weeks. After 3 weeks, crop growth with the 0 kg/ha N-buffer treatment was lower compared with the other N-buffer treatments. Destructive measurements at harvest showed a significant difference in the total FW of plants with N-buffers of 60 and 100 kg/ha compared with 0 kg/ha. None of the treatments affected marketable yield, which ranged from 22-24 t/ha.

Hsieh *et al.* (1996) conducted an experiment on conventional farming and partial organic farming and showed that growth and yield of Broccoli in the organic treatments were greater than in the control. Poultry manure compost treatment gave the highest yield, which was 26.28% higher than that of the control, followed by pig manure compost treatment, which was 18.38% higher.

Sharma *et al.*(1995) a trial carried out on dates of planting and plant density on growth of curd and seed yield in sprouting Broccoli at 45 X 45, 60 X 45 or 60 X 60 cm. Of the planting dates, 15 Sep. resulted in the greatest curd and seed yields (98.72 q/ha and 17.94 g/plant, respectively). Among the spacing treatments, inflorescence yield was highest (104.97 q/ha) at 60 X 45 cm, while seed yield per plant was highest (20.51g) at 60 X 60 cm.

Bracy *et al.* (1995) a field trails were conducted on direct sown Broccoli cv. Early (Dawn) during the autumn of 1991 and 1992 and reported that the effects of replanting NPK fertilizer at a rate of 45kg N + 59kg P + 112 kg K and 90 kg N + 118 kg P + 118 kg P +224 kg /ha plus side dressed N fertilizer at 134, 196

or 258 kg/ha, either dropped onto or knifed into the bed were determined. The marketable yield, early yield, curd weight and percentage of early to total yield were unaffected by fertilizer rate or method of application.

Steffen *et al.* (1994) carried out an experiment, on short term and log-term impact of an initial large scale spent mushroom soil (SMS) amendment on vegetable crop productivity and resource use efficiency at Pennsylvania University, USA. They observed the effect of organic matter (spent mushroom compost at 64 tm/ha + rotten cattle manure at 57 tm/ha, applied in spring 1990 on growth and yield of Broccoli. No fertilizer or other amendments were added to previously amended treatments, but 100% recommended NPK was added to all control treatments in all years. Broccoli yield and curd diameter were greater in the amended treatment.

Maynard (1994) conducted an experiment on sustained vegetable production for three years using composted animal manures and reported that intensive Broccoli production trails in spring summer and autumn were conducted for 3 years in Connecticut Windsor (Sandy trace soil) and Mt. Carmel (loamy upland soil) following annual application of spent mushroom compost (SMC) or chicken manure compost (CMC) applied at either 56 or 112 t/ha as the sole source of nutrients. Yields of Broccoli from these amended plots were compared with yields from control plots receiving NPK fertilizer. Yields of Broccoli increased with the rate of compost. Compost analysis and Broccoli yields are tabulated. The average yields of spring Broccoli and autumn Broccoli on all CMC amended plots at both rates and sites in all three years were equal to or greater than yields from the control plots.

Steffen *et al.* (1994) carried out an experiment, on short term and long term impact of an initial large scale spent mushroom soil (SMS) amendment on vegetable crop productivity and resource use efficiency at Pennsylvania University, USA. They observed the effect of organic matter (spent mushroom compost at 64 mt/ha+ rotten cattle manure at 57 mt/ha, applied in spring 1990 on growth and yield of Broccoli. No fertilizer or other amendments were added to previously amended treatments, but 100% recommended NPK was added to all control treatments in all years. Broccoli yield and curd diameter were greater in the amended treatment.

Brown *et al.* (1994) in a field experiment on sandy loam soil in 1988 - 89 at Crossville , Alabama applied 20 or 40 t/ha broiler litter or recommended NPK fertilizer in Sweet corn cv. Silver queen matured 1 week earlier in both years with 40 t broiler litter than with NPK fertilizer. This was related to improved P. nutrition.

Santamaria *et al.* (1994) in a crop rotation (spinach/beans/Broccoli), begun in 1976 at Policoro and reported that the effects of applying 100 or 200 kg N/ha and triflurain, chlorthal- dimethyl or oxfluorfen or Broccoli cultivars X PH 4142 and 89006 in 1991. Trifluralin and oxyfluorfen were applied at 2 liters/ha and chlorthal dimethyl at 15 liters/ha. Comparison was made with an unwedded control. Growth was at a maximum when the central curd was almost ready for harvesting. Yield and central curd quality were higher at the higher N rate. Chlorothal-dimethyl adversely affected both yield and quality at the lower N rate. Trifluralin and oxyflorfen had no adverse effect on yields.

Simoes *et al.* (1993) a field trials were conducted on Broccoli cv. Green Duke to investigate the effects of container size and substrate on transplant and

showed that the field, the final yield, the number of plants with curds, and the marketable yield at 2 different harvest dates were assessed. It was found that containers 21-31 mm wide and 71-75 mm deep, in combination with rich substrates, (180-210 mg N, 120-240 mg P_2O_5 and 220-270 mg K_2O/litre) produced the best results.

Magnifico *et al.* (1993) conducted a field trial on a silt clay soil at Policoro (Madtera) from January 1976 to September 1980 with Broccoli, spinach, snap beans and picking cucumbers grown in rotation comparing 12 NPK fertilizer rates and 3 herbicides (For each crop) . Trifulralin, Chlorthal [dimethy1] and Nitro fen were used on Broccoli, Lenacil, Cycloate and Chlorbufam + Cycluron were applied on Spinach; Trifluralin Alachlor and Nitrogen were applied on snap beans; and Trifuralin, Chlorthal and Asulam were applied on cucumbers. Over the 5 years, 17 crops were grown: 4 of Broccoli, 3 of spinach, 5 of snap beans and 5 of cucumber. An average of 94 days were needed for Broccoli , 85 for spinach, 65 for beans and 58 for cucumber, a total of 302 days/year/. The effects of sowing/transplanting dates and harvesting and the residual effects of herbicides were examined. Yields of each species varied widely and were mainly influenced by fertilizer rates and not herbicides. Cucumber was the only crop to show phytotoxicity from herbicides used earlier on spinach. It was concluded that this intensive system could not be recommended to farmers since it required very careful planning and yields depended on a number of contingencies

Simoes *et al.* (1993) reported that nursery a field trail was conducted on Broccoli cv. Green Duke to investigate the effects of container size and substance on transplant growth and subsequent field performance. In the

nursery the variables analyzed were plant height, leaf dry weight and leaf area per plant. In the field, the final yield the number of plants with curds, and the marketable yield at 2 different harvest dates were assessed. It was found that containers 21-31 mm wide and 71-75 mm deep, in combination with rich substrates (180-210mg N 120-240 mg P_2O_5 and 220-270 mg K_2o/litre) produced the best results.

Liu and Shelp (1993) a three year study conducted with field-grown Broccoli (cultivars Emperor, Baccus and Commander, differing between trails) under different management regimes, i.e. various NH_4 +: NO_3- ratios the addition of the nitrification inhibitor nitrifying, and B nutrition (rates and application methods) and reported that none of the treatments influenced the harvestable yield or the N composition I NO_3- NH_4 +, amino acids and protein) in xylem and phloem saps and plant tissue. The total N and the mol% NH_4 + in the xylem diminished over the growing season. NH_4 + constituted up to 20% of the N in the xylem, suggesting that this from of N as well as NO_3- was absorbed from the soil. The substantial recovery of NO_3- in xylem sap (30-70% N) indicated that, with an adequate supply of N, at least part of the incoming NO_3 - was reduced in the shoot tissue. Concentrations of all N components in the tissues declined as growth advanced, from the base to top of the: hoot. The concentrations of NO_3 - in the florets ranged from to 154 mg N/kg. Fresh weight, and were considered to be beneath the permissible maximum levels by European standards, whereas some of these in the foliage exceeded the permissible levels. There were significant cultivar differences in NO_3- accumulation within and between the study sites. The B concentrations in the

florets ranged from 29 to 42 mg/kg dry weight even when no B was applied to the plants, the values being generally considered as adequate.

Simoes *et al.* (1993) a field trials were conducted on Broccoli cv. Green Duke to investigate the effects of container size and substrate on transplant and showed that the field, the final yield, the number of plants with curds, and the marketable yield at 2 different harvest dates were assessed. It was found that containers 21-31 mm wide and 71-75 mm deep, in combination with rich substrates, (180-210 mg N, 120-240 mg P_2O_5 and 220-270 mg K_2O/litre) produced the best results.

Demchak and Smith (1990) reported from field experiments conducted at Rock Springs. Pennsylvania, Broccoli, cv. Green Comet was grown on plots to which 3 types of lime (calcite lime, a 3 : 1 ratio of calcite : dolomit1e lime, or dolomite lime) had been applied at 4.5t/ ha in 1972,1974 and 1978, and 56 kg N+ 56 kg P, 56 kg N + 56 Kg N + 112 kg P + 56 kg N + 112 kg P + 56kg N/ha were applied in bands 10 cm to the side of plants and at depth of 10 cm. Fertilizer and lime control were included . Previous liming had raised the soil P^H from 5.3 to 7.2 – 7.4. The effects of liming on yields were greatest when on fertilizer was applied. Diplomatic lime was the most effective liming metrical increasing total yield by 49 %, terminal shoot weights by 54% and hastening maturity. Fertilizer effects were most evident when no lime had been applied with all fertilizer treatments increasing total yield, terminal shoot and plant weight, and hastening maturity. There were no significant differences between the 3 fertilizer treatments with respect to those of fertilizer when lime had been applied were less consistent. Lime alone, especially types containing Mn increased leaf P content, which generally followed the same trend as total yield.

Calcites lime increased leaf Ca content and dolomites lime increased leaf Mg content compared with other lime treatments. The 3: 1 calcites: dolomites lime treatment increased leaf Ca content but not leaf content compared with the control. All lime treatments decreased leaf Men, B and Zn contents. Fertilizer treatments usually increased leaf N and Mn contents. P uptake was increased by either lime or fertilizer application. Regression analysis strongly suggested that P was the element most responsible for yield increases.

Mitra *et al.* (1990) stated that nitrogen application (90 kg/ha) greatly enhanced the yield of Broccoli. In Green Comet hybrid seedlings it was found that yield, number of inflorescence, chlorophyll content and leaf nitrate reduces activity increased with the increase in N application from 56 to 224 kg/ha. Increasing N rates from 56 to 224 kg/ha caused linear increase in Broccoli curd weight and marketable yield and decrease in cull yield. It is also reported that orthogonal comparisons of N rates effects with held constant, orthogonal comparisons of population effects with N rate held constant.

Magnifico *et al.* (1989) reported that the growth and accumulation of macro - and micro elements in various stages of the cultural cycle of 2 cultivars of Broccoli in Southern Italy. Plant samples were obtained every 2 weeks beginning at the time of thinning and contenting for 112 and 126 days, respectively, for cultivars Dig Geniis and Did Mario. Despite the different cultural recycle, the cultivars were similar in yield and element uptake. On a per hectare basis the plants removed about 460 kg N,140 kg P_2O_5, 692 kg K_2O,330 kg ca, 75 kg Na, and 42kg Mg. Microelement removal by Die Gennaio was 77kg S, 20 kg Al, 12kg Fe,1 kg Mn,479g Zn, 443 g So, 411 g B,72g Cu, 26g Mo, 23 Ni, and 20gCa. Total growth averaged 136 t/ha fresh

material, which included 14 t/ha of main curds, 28 t/ha of secondary curds, and 14 t/ha day matter. The highest removal rates were recorded from flower stem emission to main curd production.

Tremblay (1989) reported the effects of N source and rate on *Brassica oleracea* sp. *Italica* cv. Green Valiant in 2 years and on 2 soils. NH4 NO3, Ca (NO2)2, (NH4) SO_4 and Co (NO2)2 were side - dressed in a factorial in an arrangement with N rates of 75, 160 and 225kg/ha. Increasing N rates resulted in resulted in greater vegetative growth but also in hollowed stem development. In a swarm dry year, however, on a soil of near optimal pH, hollow stem development increased more with N rate than did marketable yield. In such conditions therefore, it was suggested to reduce N application. Nitrate congaing sources increased yields by 4% but induced 13% more hollow stem, and no N source produced high yields with minimum hollow stem. The effect of N source was not a function of year or N rate; it would not therefore be advantageous to modify N rate according to N source.

Lincoln (1987) reported that Broccoli stressed with inadequate soil nitrogen may develop button curds in which the terminal shoot fails to develop. He also reported that substantial increases in growth rate take place during the transition to reproductive growth and as the terminal curd nears maturity. Fertilization practices must ensure adequate nutrients, excessive nitrogen must be avoided it can increase the incidence of hollow stem.

Burghardt and Ellering (1986) observed that under sub-optimal total nutrients supply, a foliar fertilizer (12 N: 4 p: 6 K) at concentrations up to 15% was tolerated, without leaf damage by dwarf beans, carrots, beetroots, endives, Broccoli, leeks and white cabbages. These concentrations were equivalent to >100 kg N/ha. Plant development and leaf color improved and yields increased

by 12 to 74%. Crop quality was unchanged in most crops by foliar spraying, but it improved in beetroots and leeks. Leaf nitrate content was little affected by foliar spraying.

Sharma and Arora (1984) in a trial with cv. Improved Japanese reported increased day matter yield and curd yield by increasing the nitrogen level from 0 to 180 kg/ha. Application of half dose of N at transplanting and the rest 40 days later showed higher yield than application of the entire dose of fertilizer at transplanting.

Kowalenko (1983) stated that curd yield increased linearly in response to up to 260 kg N/ha without preferentially increasing vegetative growth. The maximum yields from nitrogen application had probably not been attained.

Letey *et al.* (1983) reported that two furrow irrigation experiments were conducted with the cv. Green Comet. The first consisted of 3 N rates 990, 180 and 270kg/ha), 2 irrigation treatments 9replenishment of water lost by vapor-transpiration and vapor-transpiration plus 30%) and 2 N application 9 to the soil or in the irrigation water). Plant growth increased with rising n rates. For a given N application, the average production was higher with the lesser amount of water. N application method had very little effect on production under low irrigating level but production was consistently higher for N application with water than to the soil at the high irrigation level. The ratio of N in the plant to N applied decreased with increasing N rate, with higher water application, and with N application in the irrigating water compared with soil application. The seconded experiment consisted of 2 N rates (115 and 225kg/ha) and 2 N application methods 9 to the soil or in the irrigation water). Yield and N uptake were significantly higher with the higher n rate. Conventional pre-plant and side-dressing application to the soil resulted in significantly higher Broccoli

yield than injecting N into the irrigating water. Leaching of N was not a factor under the experimental conditions reported.

Roy (1981) reported an increased curd diameter from 15.1-20.2 cm and yields from 1083-2614 kg/ha by increasing the levels of N from 60 - 200kg/ha in a period of 3 years with cv. Dania. He, however , suggested 100kg/N ha as the most economical N rate which gave a yield of 251 kg/ha, the diameter of curds being 20 cm.

The vegetables section of BARI (Annon, 1981) conducted an experiment to observe the response of different levels of nitrogen on the growth and yield of Broccoli and found the best yields by increasing the rate of nitrogen application up to a certain limit.

Magnifico *et al*. (1979) carried out a fertilizer experiment on growth and nutrients removed by Broccoli in the United States of America and found that Broccoli plants removed 559 kg N, 23 kg P_2O_5 and 723 kg K_2O/ha . The total yields were 1, 48,400 kg/ha fresh materials and 16,900 kg/ha of dry matter.

Lewandowaska and Shakpski (1977) conducted a series experiments on Broccoli to investigate into the effect of variety, spacing and levels of nitrogen fertilization on the quality and yield. In their studies with Broccoli cultivars, the plants were planted at a density of 9, 7, 5, 4.5 and 3/m^2 and supplied with N at the rate of 100,200 and 300 kg/ha and PK basal dressing. The total and marketable yields increased with plant density from 3 to 9 plants per m^2.

Peiters (1976) a 3 year trial conducted by at several places, sprouting Broccoli received a basic dressing of N at 60 kg/ha supplemented by further incremental doses totaling 260 kg/ha, applied 1, 3 and 4.5 months after planting. The

highest yield was obtained with a total application of 300kgN/ha, a high proportion of the supplementary doses being applied early.

Mathur *et al.* (1976) observed in their experiments conducted in India on the effect of different spacing-cum-nitrogen doses on the yield of Broccoli that, plants spaced at 45 x 45,61 x 61 and 76 x 76 cm yielded 14317,10331 and 8077 kg/ha respectively. They also reported that the response of plants to N in the range of 60-160 kg/ha was found to be insignificant.

Simon (1976) conducted an experiment on the effects of gradual incremental rates of nitrogen and irrigation on the yield of Broccoli. He observed that N application had a greater effect on yields than irrigation. Raising N rates increased yields and earliness proportionately.

El Behedi and Nansi (1975) conducted an experiment on the effect of nitrogen level and spacing on Broccoli yield. The crop was planted at 60, 70 and 90 cm in the row and supplied with N at 0, 20, 40 and 60 kg. The highest N rate increased the total and early yields.

Thompson and Kelly (1985) indicated that Broccoli might need more nitrogen than Cauliflower, especially late in the growing season. A highly of side shoots can be obtained by liberal side–dressing of nitrogen after the central curd is cut.

Rajput and Singh (1975) carried out an experiment in India and obtained higher curd yield and increase in growth with the increasing rates of N application. Application of 60 kg N/ha as basal dose followed by two to dressings with 30 kg N/ha each showed marked results related to yield of Broccoli. The results of foliar application were inferior to other methods of application.

Mital *et al*. (1975) observed the response of Broccoli to nitrogen and row spacing in India. In a 2- year trial, the effects of N at the rate of 40, 80 and 120

kg/ha and row spacing of 30, 45 and 60 cm were obtained. Yield was the highest with 80kg N/ha and 45 cm row spacing. Curtliffe (1975) reported that raising N application from 89.7 to 269.1 kg/ha greatly increased the incidence of hollow stem (30-60%).

Rajput and Singh (1975) suggested application of N at 60 kg/ha as a basal dose followed by top dressing with 30 kg N, 30 and 40 days after transplanting for Cauliflower cv. Snowball -16.

2.2. Effect of fertilizer and manure of the growth and yield of Cauliflower

Cauliflower is a vegetable crop and is grown in the winter season. Its growth and yield is remarkably influenced by of organic and inorganic nutrients management. Information is available on the effect of organic and inorganic nutrients management on the performance of Cauliflower. So there is a brief review of the available literature has been furnished in this section.

The result of organic Cauliflower trials conducted in the UK (2004) investigating the effects plant spacing, composted waste and FYM on the yield of 16 cultivars. The study showed a large variation in the categories of marketable yield among the cultivars.

Pathak and Nishi Keshari (2003) conducted a pot experiments with the supply of neem seed cake, mustard cake and pressmud at 25 and 10 g/kg soil, and 10 and 20 mg carbofuran/kg soil, alone or combination and reported that the heighest mean plant height (28.6 cm) and mean root length (19.3 cm) were obtained with 20 mg carbofuran/kg soil. The highest mean fresh shoot (30.3 g) and root weight (6.8 g) were obtained with 25 kg need seed cake /kg soil. The lowest mean number of galls per pant foot (6.67) was obtained with 25 g neem seed cake, 10 gm neem seed cake + 10 mg carbofuran, and 10 gm mustard cake /kg soil. The lowest mean number of galls per g root (1.00) was obtained with

25 kg neem seed cake/kg soil. The lowest mean nematode population in the soil (-763) was obtained with 20 mg carbofurun /kg soil.

Feller *et al.* (2003) observed that bunching carrots, Japanese radish, dill, lambs' lettuce, rocket salad, celeriac and celery. The average removal of nutrients by harvesting are tabulated for N, P, K and Mg. Nitrogen demand and the N main target value in kg/ha are compared with data published in 2001. Data are within a 10% variation range; however Japanese radish and celery had higher demands due to strong vegetative growth. The highest N demand was found in celery (270 kg N/ha), followed by Japanese radish (245 kg N/ha), spring onion (160 kg N/ha), bunching carrot (145 kg N/ha), dill (110 kg N/ha), rocket salad (100 kg N/ha) and lambs' lettuce (38 kg N/ha). For rocket salad, nitrogen uptake curves modeled and measured are presented for different sowing dates.

Pankaj Srivastava *et al.* (2002) investigated on the effects of planting date (26 July, and 10 and 25 August) and growing environment (open field flat planting, open field ridge planting, planting in low plastic tunnel and planting in low-cost polyhouse) on the growth and yield of Cauliflower cv. Pant Gobhi-4 and found that plant height increased, whereas root length and weight, plant spread, number of leaves per plant and leaf width decreased with delay in planting. Cauliflower yield was highest with planting at 10 August (194.56 q/ha). Planting under a low-cost playhouse resulted in the highest values of the parameters examined. The interaction between planting date and growing environment was significant for root length, number of leaves per plant, leaf length and width, and crop yield.

Yadav *et al.* (2002), a study was conducted to evaluate the effects of 5 levels of chloride and sulfate dominated salinity (0, 4, 6, 8 and 10 ds/m) and 4 levels of P fertilizer (0, 30, 60 and 90 mg/kg soil) on the growth and yield of Cauliflower cv. Snowball-16 and showed that Chloride-dominated salinity was

more harmful than sulfate-dominated salinity for all parameters studied (number of leaves per plant, leaf weight, root length, curd weight and harvest index). Root length and curd weight increased with increasing P levels, but decreased with increasing salinity levels. Curd weight was highest under a chloride salinity of 0 and 4 dS/m with 90 mg P/kg soil. Number of leaves and leaf weight were also significantly affected by salinity and P applications.

Stintzing *et al. (*2002) observed that the field trial show that the pelleted broiler manures gave a better effect on yield than stored broiler manure. Nutrients balances showed that it was difficult to attain a good balance between application and uptake of nutrientss when using broiler manure, especially pelleted. Soil samples indicate that the amount of mineral nitrogen in the soil after harvest did not differ significantly between the two broiler manures at the two levels of application.

Gautam *et al.* (2001) a field experiment conducted on the effects of different sowing dates (15 and 30 July, and 14 August), seed production methods (plants left in situ; and without scooping the curds) and cultivars (Pusa Katki, Pusa Deepali, Selected Early Dawn, Early Chinese Prince and Heavy Silver Plate) on the growth and seed yield of early Cauliflower and observed that the 15 July sowing recorded the maximum seed yield (4.5 q/ha). Yield significantly declined with delay in sowing irrespective of the cultivars. Scooping curds significantly increased the seed yield in Pusa Deepli and Heavy Silver Plate, while the rest did not respond to scooping. All cultivars differed significantly from each other in terms of seed yield. Selected Early Dawn recorded the highest yield (4.6 q/ha).

Thakur and singh (2001) conducted a field experiment in Cauliflower CV. Pusa snow ball K-1 plants were supplied with 0 (to), 600 (t1), 800 (T_2) and (1000) (T_3) Kg recycle commercial organic manure (ORGO)/ha to determine the effect

of ORGO on the seed yield of Cauliflower and reported that plant mortality was highest with T_2 (11%) and lowest with T_3 application (6%). seed yield per plot and total yield were highest in plants supplied with T_3 application (6%). seed yield per plot and total yield were highest in plants supplied with T_2 (839.90 g / plot and 8.20 g/ha, respectively) and lowest in those supplied with T_3 (540.15 g/ ha plot and 5.27 q/ ha, respectively). No significant differences among the treatments in terms of the number of outer leaves of Cauliflower were observed.

Prestele and Maync (2000), a study was conducted on the effects of a wide variety of organic fertilizers (ricinus, rape, sunflower, pea and bean fragments and granules) on yields of Cauliflower and fennel were studied. N release from toasted, pre-germinated and untreated fertilizers was very similar, except for whole meals and rapeseed pellets, which decreased yields. All tested fertilizers were cheaper than conventional fertilizers. Utilization of substances which are not explicit fertilizers, such as fodder peas and sunflower meal pellets, requires prior determination of N content.

Milagrosa *et al*. (1999) reported that lettuce, Bokashi and/or EM-1 did not increase the height of plants. Plots treated according to TFP were taller than in any other treatment. However, the highest yield of lettuce curds was obtained from the plot treated with inorganic fertilizer + Bokashi + EM-1, followed by EM-1 treatment. The lowest number of marketable lettuce curds was recorded in plots treated with TFP, due to the development of soft rot.

Rodrigues and Casali (1999) Showed that the highest estimated yields of 119.5, 119.4 and 153.9 g/ plant were obtained with 37.7 t/ha organic compost t/ha with no mineral fertilizer application, 18.9 t/ha organic compost t/ha with half the recommended mineral fertilizer rate and 13 t/ha organic compost/ha with the recommended mineral fertilizer rate. Organic compost application resulted

in lower foliar N and Ca concentrations and higher foliar P, K and Na concentrations compared with mineral fertilizer application.

Tisselli (1999) reported that maximum rates of organic manure (usually poultry manure) and NPK recommended in 1998 by the Crop for use in lettuce crops in Emilia-Romagna, Italy are tabulated. Trials showed that a combination of organic and mineral fertilizers gave higher yields of marketable curds, fewer rejects and a better average weight/curd than mineral fertilizer alone.

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Bambal *et al.* (1998) a field experiment was conducted to study the effect of biofertilizer as a seedling dip and nitrogen rate on growth and yield of Cauliflower cv. Snowball-16 and observed that the different treatments comprised 2 biofertilizers, Azospirillum (Asp) and Azotobacter (Azb), alone and in combination, and 3 N rates (100%, 75% and 60%); N was applied as urea. Azb + Asp + 100% N resulted in the highest chlorophyll content (1.48 mg/g), leaf area (634.58 cm2/plant) and yield (29.64 t/ha) and curds also matured earlier compared with the other treatments.

Vidigal *et al*. (1997) mentioned that dried pig manure gave the highest yields 65 days after sowing (54.4 t/ha), an increase of 33.3% above those supplied with NPK, with similar results in a succeeding crop planted on the same ground in late September (a 39.4% increase over NPK). Napier grass + coffee straw + pig slurry was the best mixture, increasing yields 10.8% and 17.6% above those produced by NPK in 1st and 2nd crops, respectively.

Zarate *et al*. (1997) observed that the interaction between rate and method of application was significant. In the absence of incorporated manure, surface application of 14 t manure/ha gave significantly higher yields (17.8 t fresh matter/ha) than other rates. When 7 t/ha was incorporated, the rate of surface application had no significant effect on yields (13.3-17.1 t/ha), whereas when 14 t/ha was incorporated, surface application of 7 t manure/ha gave the significantly highest yield (20.0 t fresh matter/ha).

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Ghosh and Hasan (1997) a field experiment was conducted to study the effects of B (applied as borax at 10, 15 or 20 kg/ha) on the growth of Cauliflowers cv. Early Kunwari and indicated that treatment with borax at 15 kg/ha produced plants with the highest number of leaves/plant (27.2), the largest curds (1048 g) and the highest yield (524 q/ha).

Kalayani *et al.* (1996) a field experiment was conducted to study the interaction of Azospirillum and fertilizer nitrogen on Cauliflower cv, Jawahar Moti and indicated that soil inoculation with Azospirillum coupled with less nitrogen (80

kg/ha) had a beneficial effect in improving the growth and yield besides saving on nitrogen fertilizer by up to 60%.

Gutezeit *et al.* (1996) carried out a micro plot field experiment with Broccoli cv. Emperor and showed no differences in FW growth for the first 3 weeks. After 3 weeks, crop growth with the 0 kg/ha N-buffer treatment was lower compared with the other N-buffer treatments. Destructive measurements at harvest showed a significant difference in the total FW of plants with N-buffers of 60 and 100 kg/ha compared with 0 kg/ha. None of the treatments affected marketable yield, which ranged from 22-24 t/ha.

Bijarnia and Dixit (1996) conducted a field experiment on the effect of S (75 or 160 kg/ha) on the growth of Cauliflowers (cv. Snowball-16) was investigated during Rabi [winter] and observed that S significantly increased growth and yield. Maximum curd yield (277.460 q/ ha) was obtained following application of 75 kg S/ha, which was similar to that observed following application of 160 kg S/ha (275.6 q/ha).

H.S. Bijarnia and V.S. Dixit (1996) conducted a field experiment on the effect of succinic acid (600 or 1000 p.p.m.) on the growth and yield of Cauliflowers and obtained maximum curd yield (277.73 q/ha) from application of 60 p.p.m. succinic acid, which was similar to that observed from application of 1000 p.p.m. succinic acid (274.85 q/ha). Two sprays of succinic acid were better at increasing growth and yield than one spray.

Bhardwaj (1995) a field experiment was conducted to study growth, seed yield and quality of fifteen Indian genotypes of Cauliflower and indicated that the highest number of leaves per plant, largest curd and highest number of inflorescence stalks were obtained in Superfine. Stem length varied in different genotypes, the longest being in Sutton Pusi (23 cm). The earliest bolting was noticed in Snow King, whereas the greatest height of inflorescence stalk and

siliquas per stalk was found in Maghi. Number of seeds/siliqua and seed yield were greatest in Superfine. The highest seed germination rate of 89.2% was observed in Silvery King.

Sharma *et al.*(1995) a trial carried out on dates of planting and plant density on growth of curd and seed yield in sprouting Broccoli at 45 X 45, 60 X 45 or 60 X 60 cm. Of the planting dates, 15 Sep. resulted in the greatest curd and seed yields (98.72 q/ha and 17.94 g/plant, respectively). Among the spacing treatments, inflorescence yield was highest (104.97 q/ha) at 60 X 45 cm, while seed yield per plant was highest (20.51 g) at 60 X 60 cm.

Khan *et al*, (1994) showed that the varying degree of toxicity to the fungi on Cauliflower seed sample collected from different localities in Aligrah. Isoamyl alcohol was highly effective in reducing the seed mycoflora.

McQuilken *et al*. (1994) observed that manure-straw mixtures were composted and water extracts, made by incubating compost in water for 3 to 18 d, were assessed for antagonistic activity against B Weekly sprays of 8-d-old extracts onto lettuce in the glasshouse had no effect on the incidence of grey mould, but significantly reduced its severity and increased marketable yield. The use of compost extracts in bio-control of plant diseases and their possible mode of action is discussed.

Nath and Mohan (1993), a field experiment was conducted to study the acidic nature of the soil in the Kahikuchi region and observed that causes poor yield and curd quality in Cauliflower. Slaked lime was applied to sandy clay soil at 6.3, 9.1, 11.9, 14.6 and 17.4 t/ha to raise the pH from 4.5 in untreated, control plots to 5.0, 5.5, 6.0, 6.5 and 7.0, respectively, for cultivation of cv. Snowball-16. The use of lime at 14.6 t/ha resulted in the best cost benefit ratio (4.56) and highest marketable yield (28.2 t/ha, compared with 11.6 t/ha for controls).

Huang and Tsai (1993) mentioned that hog manure was applied to a red soil and an older slate alluvial soil in a pot trial. The growth rate of spinach and leaf lettuce was proportional to the quantity of hog manure added. An application equivalent to 20 t/ha was the most effective and resulted in a yield increase over unfertilized controls of 113% and 44.9% for spinach and leaf lettuce, respectively, on the red soil and 80.2% and 59.4%, respectively, on the alluvial oil.

Rouchaud *et al*. (1992) showed the soil persistence of chorpyrifors, chlorfenvinphos and carvofuran (applied after Cauliflower planting) was studied in the field of Belgium during 1990. Persistence increase in plot treated with organic fertilizer (pig slurry, cow manure, city refuse or mushroom cultivation compost) compared with untreated plots. The effect was observed during the first main crop of 60 days, but is apparent at the end of the crop. The effect of organic fertilizer on insecticides persistence was related to total organic matter and humic acid conc., nitrogen conc. in the human acids and fictionalization of the humic acids. This paper was presented at the international symposium of crop protection held in Ghent, Belgium on 4 may 1992.

Rouchard *et al*. (1992), a field experiment was conducted and applied pig slurry, cow manure, city refuse or mushroom compost to plots in Cauliflower fields, in which had been incorporated and observed that persistence of each insecticide was greater (up to 2.4 times) in these plots than in those without organic fertilizers, and insecticide protection efficiency was correspondingly better and also showed that the increase in insecticide persistence corresponded to greater total organic matter, humic acids and human soil concn; to greater weight ratios of humic: fulvic acids; to greater nitrogen contents in the humic acids; and to humic acids with greater percentages of constituents able to fix

insecticides in soil. These results suggest that the increase in soil persistence due to manuring corresponded to greater absorption of the insecticides onto soil organic matter, thus protecting them against microbial activity.

Tripathi and Sharma (1991) Studies on the effect of age of seedling and spacing on the growth and yield of Cauliflower and showed that after eighty days planting, mean plant height, number of leaf sheaths, diameter of main shoot, root length and plant spread were all greatest (35.73 cm, 17.4, 5.02 cm, 18.42 cm and 24.22 cm, respectively, in 1988-89) in seedlings planted at 6 weeks old, but mean curd weight and diameter were greatest (0.54 kg and 13.31 cm, respectively, in 1988-89) in seedlings planted at 5 weeks old. The highest average yields were the same in both years and were obtained with 5-week-old seedlings (14.25 t/ha) and at a spacing of 30 X 60 cm (13.05 t/ha).

Rouchaud *et al.* (1991), a field experiment was conducted with Pig slurry, cow manure, city refuse or mushroom cultivation compost to study the effects of organic fertilizers on the rate of biodegradation of soil insecticides in Cauliflower crops After planting, an emulsion of chlorpyrifos, chlorfenvinphos or carbofuran was applied to the soil around Cauliflower stems And observed that The rate of biodegradation of the insecticides was slower in treated than in untreated plots. This paper was presented at the International Symposium on Crop Protection held in Gent, Belgium.

Tremblay (1989) reported the effects of N source and rate on *Brassica oleracea* sp. Italic cv. Green Valiant in 2 years and on 2 soils. NH4 NO3, Ca (NO2)2, (NH4) SO_4 and Co (NO2)2 were side- dressed in a factorial in an arrangement with N rates of 75, 160 and 225 kg/ha. Increasing N rates resulted in resulted in greater vegetative growth but also in hollowed stem development. In a swarm dry year, however, on a soil of near optimal pH, hollow stem development increased more with N rate than did marketable yield. In such conditions

therefore, it was suggested to reduce N application. Nitrate congaing sources increased yields by 4% but induced 13% more hollow stem, and no N source produced high yields with minimum hollow stem. The effect of N source was not a function of year or N rate; it would not therefore be advantageous to modify N rate according to N source.

Muthoo *et al.* (1987), a field experiment was conducted on foliar application of different concentrations of GA_3, NAA and Mo (in various combinations or separately) increased the average FW and DW of leaves and curd, and the yield. In addition to, observed that the individual treatments, GA_3 was the best for vegetative growth and Mo, followed by NAA, for curd growth and yield. A combination of 100 p.p.m. GA_3, 120 p.p.m. NAA and 0.2% Mo gave the best result for all growth and yield parameters

Sumiati (1989), a field experiment was conducted on the effect of four nitrogen fertilizers on harvesting time and yield of Cauliflower cv. Cirateun and showed that Cauliflowers fertilized with ammonium nitrate gave the highest yield of 16.43 t/ha. Yields in kg per plant were 0.488, 0.492, 0.386 and 0.412 and curd diameters were 13.8, 13.9, 12.2 and 12.1 cm for the 4 fertilizer treatments, respectively.

Sharma *et al.* (1985) conducted a pot culture experiments with applications of 120, 80 and 40 kg/ha of N, P_2O_5 and K_2O respectively and showed the best for reducing mortality caused by Rhizoctonia solani and R. bataticola (Macrophomina).

MATERIALS AND METHODS

Broccoli and Cauliflower are cole crops and commonly grown in the winter season. They are very tasty and much popular vegetable, being cultivated in large scale during the growing period. They are also rich with an important source of vitamins and minerals. In Bangladesh, Broccoli is being grown in a very limited area, but a good deal of interest has been generated for raising this crop due to its demand in the native and forgin markets. It is necessary to explore the possibilities of growing Broccoli in order to raise it's yield level. So, this experiment has undertaken to find out appropriate or optimum nutrients suppliment and performance of Broccol and Cauliflower for exploiting the yield potential of these crops.

3.1 Experimental Site

The experiment was conducted at the Horticultural Farm and Laboratories of Sher-e-Bangla Agricultural University, Sher-e-Bangla Nagar, Dhaka, during the period from September 2004 to February 2005. The experimental site was previously used as vegetable garden and recently developed for research work. The location of the site in 23º 74´ N latitude and 90º 35´ E longitude with an elevation of 8.2 meter from sea level (Anon 1989).

3.2 Climate

The climate of the experimental site is subtropical, characterized by heavy rainfall during the months from April to September (Kharif season) and scanty rainfall during the rest of the year (Rabi season). The total rainfall of the experimental site was 218 mm during the period of the experiment. The average maximum and minimum temperature were 29.45ºC and 13.86º C repectively during the experimental period. Rabi season in characterized by plenty of sunshine. The maximum and minimum temperature, humidity rainfall and soil temperature during the study period were collected from the

Bangladesh Meteorological Department (climate division) and have been presented (Appendix I).

3.3 Soil

The soil of the experimental area belongs to the Modhupur Tract (UNDP, 1988). The analytical data of the soil sample collected from the experimental area were determined in the SRDI, Soil Testing Laboratory, Khamarbari, Dhaka have been presented in appendix II. The experimental site was a medium high land and pH of the soil was 5.6. The morphological characters of soil of the experimental plots as indicated by FAO (1988) are given below –

AEZ No. 28

Soil series – Tejgaon

General soil- Non-calcarious dark grey.

3.4 Plant Materials

Broccoli *Brassica oleracea* var. *italica* sub var. *cymosa* cv. 'Premium crop' (by Takki company of Japan) and Cauliflower *Brassica oleracea* var. *botrytis* sub var. *cauliflora* cv. 'BARI 1' (by BARI, Joydevpure, Gazipure) were used in the experiment.

3.5 Treatment of the experiment

The experiment was designed to study the growth and yield performance of Broccoli and Cauliflower and to study the effects of different levels of manure and fertilizer on these two crops. The experiment consisted of two factors were as follows:

Factor **A**: Two cultivars of Broccoli and Cauliflower

i. Broccoli *Brassica oleracea* var. sub var. *cymosa italica* cv. 'Premium crop'**:** (Br), by Takki company of Japan and

ii. Cauliflower *Brassica oleracea* var. *botrytis* sub var. *cauliflora* cv. 'BARI 1'**:** (Ca), by BARI, Joydevpure, Gazipur.

Factor **B**: Manure and fertilizer management (Five levels)

i. Control (C_0): No fertilizer was used

ii. Organic (C_1): 20 ton CD/ha

iii. Inorganic fertilizers (C_2): Urea 250 kg/ha, TSP 150 kg/hg and MP 200 kg/ha

iv. Organic + inorganic fertilizers + Agro-grow granular (C_3): 10 ton CD/ha + C_2 + 20 kg Agro-grow granular/ha

v. Vermicompost (C_4): 205 kg/ha was used in the experiment.

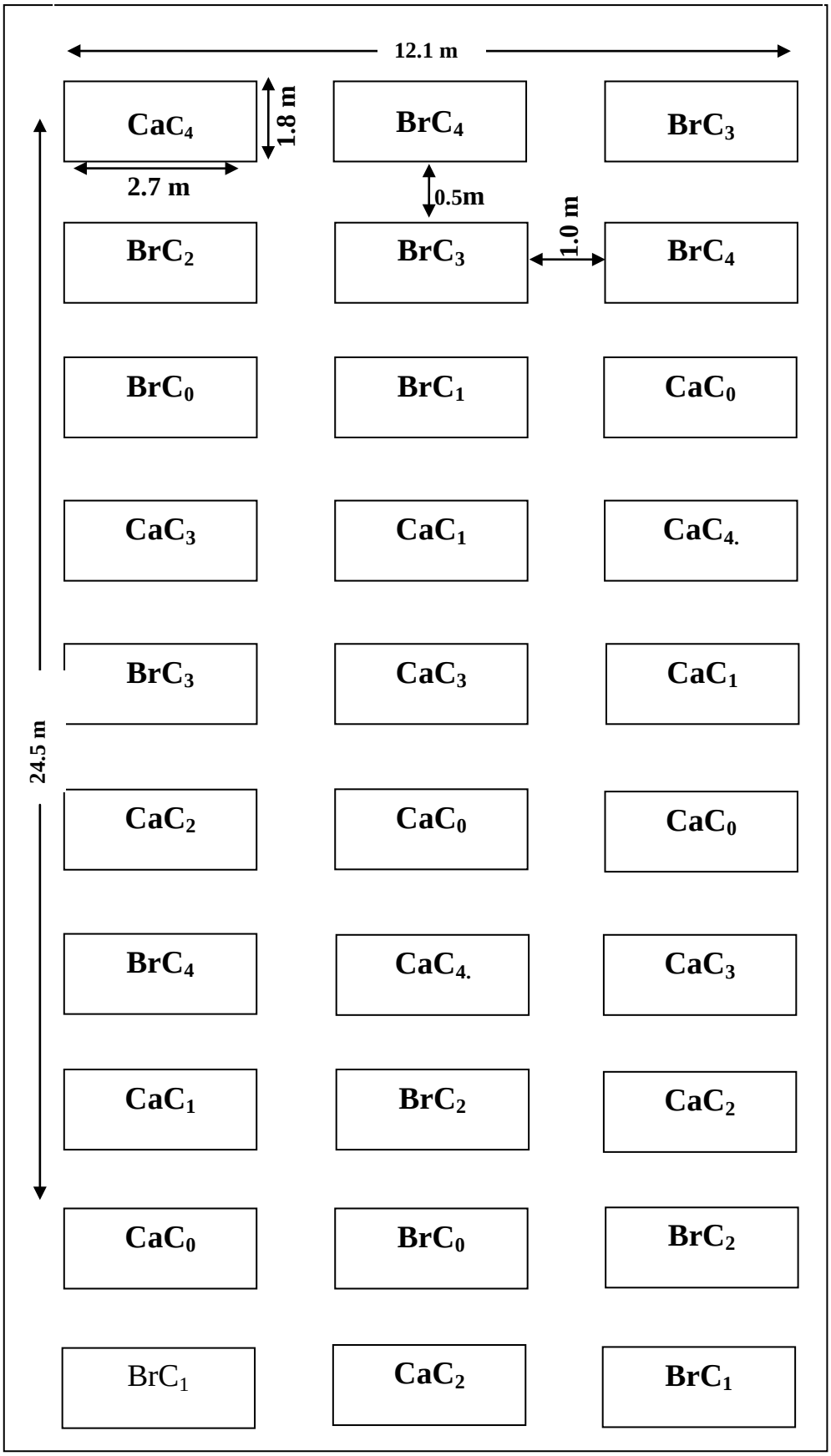
There were altogether 10 treatment combinations such as BrC_0, BrC_1, BrC_2, BrC_3, BrC_4, CaC_0, CaC_1, CaC_2, CaC_3 and CaC_4.

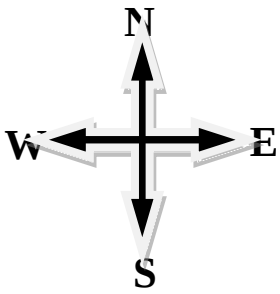
3.6 Experimental design and layout

The two factors experiment was laid out following Randomized Complete Block Desgin (RCBD) with three replications. An area of 24.5 m × 12.1 m was divided into three equal blocks. Each block was divided into 10 plots where 10 treatment were allotted at random. Thus there were 30 unit plots altogether in the experiment. The size of each plot was 2.7 m ×1.8 m. The distance between two blocks and two plots were kept 1 m and 0.5 m respectively. A layout of the experiment has been shown in Figure 1.

3.7 Seed bed preparation, seed germination and raising of seedlings

The 3m x 1m in size seed bed was selected. Seed beds were prepared with a mixture of sand, soil and compost. It was raised 15 cm from ground level. Germination of both Broccoli and Cauliflower seed is a major problem in in our country. Seeds were sown on 19 October, 2004. Complete germination of seed took place in seven days. When the seedlings were thirty seven days old they were transplanted in the experimental field on 25 November, 2004.





Plot size:

2.7 m×1.8 m

Spacing:

45 cm × 60 cm

Plot spacing: 0.5 m

Between replication: 1m

C_0 = Control

C_1 = Organic

C_2 = Inorganic fertilizer

C_3= Organic+inorganic fertilizers + Agro-grow- granular

C_4 = Vermicompost

Br = Broccoli (cv. 'Premium crop')

Ca = Cauliflower (cv. 'BARI 1')

Figure1. Field layout of the two fectors experiment in the Randomized Complete Block Design (RCBD)

3.8 Land preparation

The land which was selected to conduct the experiment was opened 20 October 2004 with the help of a power tiller and then it was kept open to sun for 7 days to further ploughing. Afterwards it was prepared by ploughing and cross ploughing followed by laddering. Deep ploughing was done to have good tilth which was necessary for getting better yield of the crop. The weeds and stubbles were removed after each laddering. Simultaneously the clods were broken and the soil was made into good tilth.

3.9 Application of manures and fertilizers

Following doses of manures and fertilizers were recommended for in Broccoli and Cauliflower production.

Manure and Fertilizer	Dose
Cowdung	20 (ton /ha)
N	115 (kg/ha)
P_2O_5	72 (kg/ha)
K_2O	120 (kg/ha)

The above doses of fertilizers were converted into manure and fertilizer mixed per treatment of the experiment and were supplied by each type of manure and fertilizer except control. After conversion the dose of each manure used in the experimental was as the next pages.

Treatment	Urea (g/plot)	TSP (g/plot)	MP (g/plot)	Cowdung (kg/plot)	Agro-grow granular (g/plot)	Vermicompost (g/plot)
C_0	-	-	-		-	-
C_1	-	-	-	9.72	-	-
C_2	121.5	72.9	97.2		-	-
C_3	121.5	72.9	97.2	4.86	10	-
C_4	-	-	-	-	-	100

Note:

C_0 = Control
C_1 = Organic
C_2 = Inorganic fertilizers
C_3 = Organic + inorganic fertilizers + Agro-grow granular
C_4 = Vermicompost

The calculated entire amount of all fertilizers and manures applied before transplanting of each plot.

3.10 Transplanting of seedlings

Thirtysix days of old seedlings were transplanted on 25 november, 2005 in the afternoon and light irrigation was given around each seedlings for their better establishment. The transplanted seedlings were protected from scorching sunlight by providing shed using banana leaf sheth. Dead seedlings were replaced by new seedlings from same stock.

3.11 Intercultural operation

3.11.1 Gap filing

Dead, injured and weak seedlings were replaced by new vigour seedling from the stock kept on the border line of the experiment.

3.11.2 Weeding

Significant number of weed were found in the control treatment. Weeding was done three times in these plots.

3.11.3 Irrigation

Light irrigation was given just after transplanting the seedlings. A week after transplanting the requerement of irrigation was envisaged through visual estimation. Wherever the plants of a plot had shown the symptom of wilting the plots were irrigated on the same day with a hosepipe until the entire plot was properly wet.

3.11.4 Insects and Diseases

There was no incidence of insects and diseases.

3.12 Harvesting

The compect matured curd were harvested. In case of Broccoli, after collecting the main curd, the secondary shoots were developed from the leaf axils, which also developed secondary curd and were harvested over a period of time. The crops under investigation was harvested for the first time on 28 January, 2005 and lasted on 25 February, 2005.

3.13 Data collection

Data were recorded on the following paramets from the sample plants during the course of experiment. Ten (10) plants were sampled randomly from each unit plot for the collection of data.

3.13.1 Plant height

Plant height was measured in centimeter (cm) by a meter scale at 30, 40, 50 DAT and at harvest from the point of ground level up to the tip of the longest leaf.

3.13.2 Number of leaves per plant

Number of leaves were counted from ten randomly selected plants at 30, 40, 50 DAT and at harvest. All the leaves of each plant were counted separately. Only

the smallest young leaves at the growing point of the plant were excluded from counting. The average number of leaves of ten plants gave number of leaves per plant.

3.13.3 leaf length

Leaf length of ten randomly selected plants was measured in centimeter (cm). It was measured from the base of the petiol to the tip of the leaf of each plant were measured separately with a meter scale. Only the smallest young leaves at the growing point of the plant were excluded from counting.

3.13.4 Leaf breath

Leaf breath of ten randomly selected plants was measured from the widest central and two terminal portion of the lamina with a meter scale and average breath was recorded in centimeter (cm). Leaves of each plant were measured separately. Only the smallest young leaves at the growing point of the plant were excluded from counting.

3.13.5 Area of leaf

The leaf size was recorded from ten randomly selected plants on the basis of Leaf length and Leaf breath in square centimeter (cm^2).

3.13.6 Weight of the largest leaves

Weight of (5-10) the largest leaves of each harvested plant was taken randomly selected ten plants were detached by a sharp knife and average fresh weight of leaves was recorded in gram(g).

3.13.7 Days required for 50 % curd initiation

Curd initiation started on the 16 January, 2005 and lasted to the 14 February, 2005 and the number of days was counted from transplanting to initiate 50 % curd and 50 % curd initiation was found with in the 29 January, 20005.

3.13.8 Days required for total (100%) curd initiation

Number of days was counted at transplanting to total (100%) curd initiation also recorded and 100% curd was initiated within 14 February, 2005.

3.13.9 Days required for first curd initiation to harvest

The crops under investigation was harvested for the first time on 28 January, 2005 and lasted on 27 February, 2005. Number of days required was recoded carefully from first curd ignition to harvest for each plot. Normally it took 10-16 day after curd initiation (Rashid, 1999).

3.13.10 Curd diameter

Curd diameter was recorded in several directions with a meter scale at matured stage from ten randomly selected plants and measured in centimeter (cm) and each of plant was measured separately.

3.13.11 Height of the curd

Height (cm) of the curd was also recorded from the junction of last upper leaves (up to tip of leaf) at matured stage from ten randomly selected plants was measured in centimeter (cm) and each of plant was measured separately.

3.13.12 Weight of plant

After harvesting the mature plant, the plant including all parts was weighted (g) and recorded from ten randomly selected plants.

3.13.13 Yield per plant

The mature curd of plant including well sized stem with half cut several leaves was weighted (g) and recorded from ten randomly selected plants.

3.13.14 Weight of curd

After separating all parts except the curd was weighted from ten randomly selected plants was measured in gram per curd and each of curd was measured separately. In case of Broccoli, the weight of pure secondary curd (g**)** was added to the weight of main curd.

3.13.15 Secondary Marketable Yield of Broccoly(t/ha)

It consisted of only the quality mature secondary curd of Broccoly. It was also calculated in ton per hectare by converting the total yield per plot and finaly added to the main yield in ton per hectare.

3.13.16 Gross yield

The gross yield per hectare was calculated in tons by converting the total curd yield t/ha.

3. 13.17 Marketable yield

It consisted of only quality curd yield of plant and was also calculated by converting the total yield per plot. In case of Broccoly, total marketable yield per hectare was calculated in ton by converting the total (Main yield + Secodary yield) curd yield per plot (t/ha).

3.18 Statistical analysis

The data collected from the experimental plots were statistically analyzed. The mean values for all the treatments was calculated and the analysis of variance for most of the characters was accomplihsed by ‘Duncan’s Multiple Ranges Test’. The significance of difference between pair of means was tested by the least significant difference (lsd) test at 5% and 1% level of probabilty (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

The experiment was conducted to investigate the effect of different sources of organic and inorganic fertilizer management on the comparative performance of Broccoli (*Brassica oleracea* L. var. *italica* sub var. *cymosa italica* cv. 'Premium crop') and Cauliflower (*Brassica oleracea* L. var. *botrytis* sub var. *cauliflora* cv. 'BARI 1'). The analysis of variances for different characters has been presented in appendices III and IV. Data of the different parameters analyzed statistically and the results have been presented in the Table 1 to 9 and Figures 2 to 5. The results of the present study have been presented and discussed in this chapter under the following heading.

4.1 Effect of fertilizer management on growth and yield of Broccoli (cv. 'Premium crop') and Cauliflower (cv. 'BARI 1').

4.1.1 Plant height (cm)

The combination of different sources of nutrients with the two crops had the significant effect on the plant height of Broccoli (cv. 'Premium crop') and Cauliflower (cv. 'BARI 1'), which has been shown in the appendix III. BrC_3 and CaC_3 treatments gave the maximum (66.40 and 38.10 cm) plant height followed by BrC_2 and CaC_2 (59.70 and 33.73 cm); BrC_1 and CaC_1 (44.37 and 31.77 cm); BrC_4 and CaC_4 (42.70 and 31.35 cm), BrC_0 and CaC_0 (38.10 and 29.43 cm) respectively. The effect of different sources of nutrientss treatments on the plant height was similar on the different dates recorded at 30, 40, 50 DAT and at harvest and the plant height was increased with the time for the DAT (Table 1).

The main effect of different sources of nutrients treatments had also significant on the plant height (Appendix III). At harvest, C_3 treatment gave the maximum (52.25 cm) plant height followed C_2 (46.42 cm), C_4 (37.03 cm), C_1 (38.07 cm) and C_0 (33.77 cm) respectively. The effect of different sources of nutrientss treatments on the plant height was also similar on the different dates recorded at 30, 40, 50 DAT and at harvest and the plant height was increased with the time for the DAT (Table 1).

Table 1. Effect of different sources of nutrients on plant height at different days after transplanting (DAT) and at harvest of Broccoli (cv. 'Premium crop') and Cauliflower (cv. 'BARI 1')

Combined effect of fertilizer on Broccoli (cv. 'Premium crop') and Cauliflower (cv. 'BARI 1').														
Treatment combination		Broccoli (Br)					Cauliflower (Ca)					LSD 5%	LSD 1%	Level of significance
		Co	C_1	C_2	C_3	C_4	Co	C_1	C_2	C_3	C_4			
Parameters	Plant height at 30 DAT	12.40	16.33	20.98	28.12	13.38	11.16	13.72	14.69	14.70	12.62	2.380	4.441	*
	Plant height at 40 DAT	17.03	25.55	32.78	38.61	21.56	13.96	15.19	16.30	18.19	13.48	2.537	5.099	*
	Plant height at 50 DAT	27.06	35.50	43.13	53.26	30.86	18.70	23.28	24.90	28.07	22.53	4.058	7.575	*
	Plant height at harvest	38.10	44.37	59.70	66.40	42.70	29.43	31.77	33.73	38.10	31.35	4.516	8.430	**

Main effect of fertilizer on Broccoli (cv. 'Premium crop') and Cauliflower (cv. 'BARI 1')									
Treatment		Co	C_1	C_2	C_3	C_4	LSD 5%	LSD 1%	Level of significance
Parameters	Plant height at 30 DAT	12.29	14.48	17.35	21.41	13.55	1.683	3.141	NS
	Plant height at 40 DAT	15.50	20.37	24.54	28.40	17.52	1.932	3.606	*
	Plant height at 50 DAT	22.88	29.39	34.01	40.67	26.70	2.87	5.357	*
	Plant height at harvest	33.77	38.07	46.72	52.25	37.03	3.194	5.962	*

** Significance at 1% level *Significance at 5% level NS= Non significant

C_0 = Control
C_1 = Organic
C_2 = Inorganic fertilizers
C_3 = Organic + inorganic fertilizers + Agro - grow – granular
C_4 = Vermicompost

4.1.2 Number of leaves per plant

The combination of different sources of nutrients with the two crops had significantly effect on the number of leaves per plant except, 30 and 40 DAT of Broccoli (cv. 'Premium crop') and Cauliflower (cv. 'BARI 1'), which has been shown in the appendix III. BrC_3 and CaC_3 treatments gave the maximum (17.83 and 18.70) number of leaves per plant followed by BrC_2 and CaC_2 (15.40 and 15.27); BrC_4 and CaC_4 (13.77 and 13.47 cm); BrC_1 and CaC_1 (13.73 and 14.20) and BrC_0 and CaC_0 (13.27 and 13.37) respectively. The effect of different sources of nutrientss treatments on the number of leaves per plant was also similar on the different dates recorded at 30, 40, 50 DAT and at harvest and the number of leaves per plant was increased with the time for the DAT (Table 2).

The main effect of different sources of nutrients had also significant on the number of leaves per plant (Appendix III). At harvest, C_3 treatment gave the maximum number (17.83) of leaves per plant followed by C_2 (15.33), C_4 (13.97), C_1 (13.57) and C_0 (13.37) respectively and effect of different sources of nutrientss treatments on the number of leaves per plant was similar on the different dates recorded at 30, 40, 50 DAT and at harvest and the plant height was increased with the time for the DAT (Figure 2).

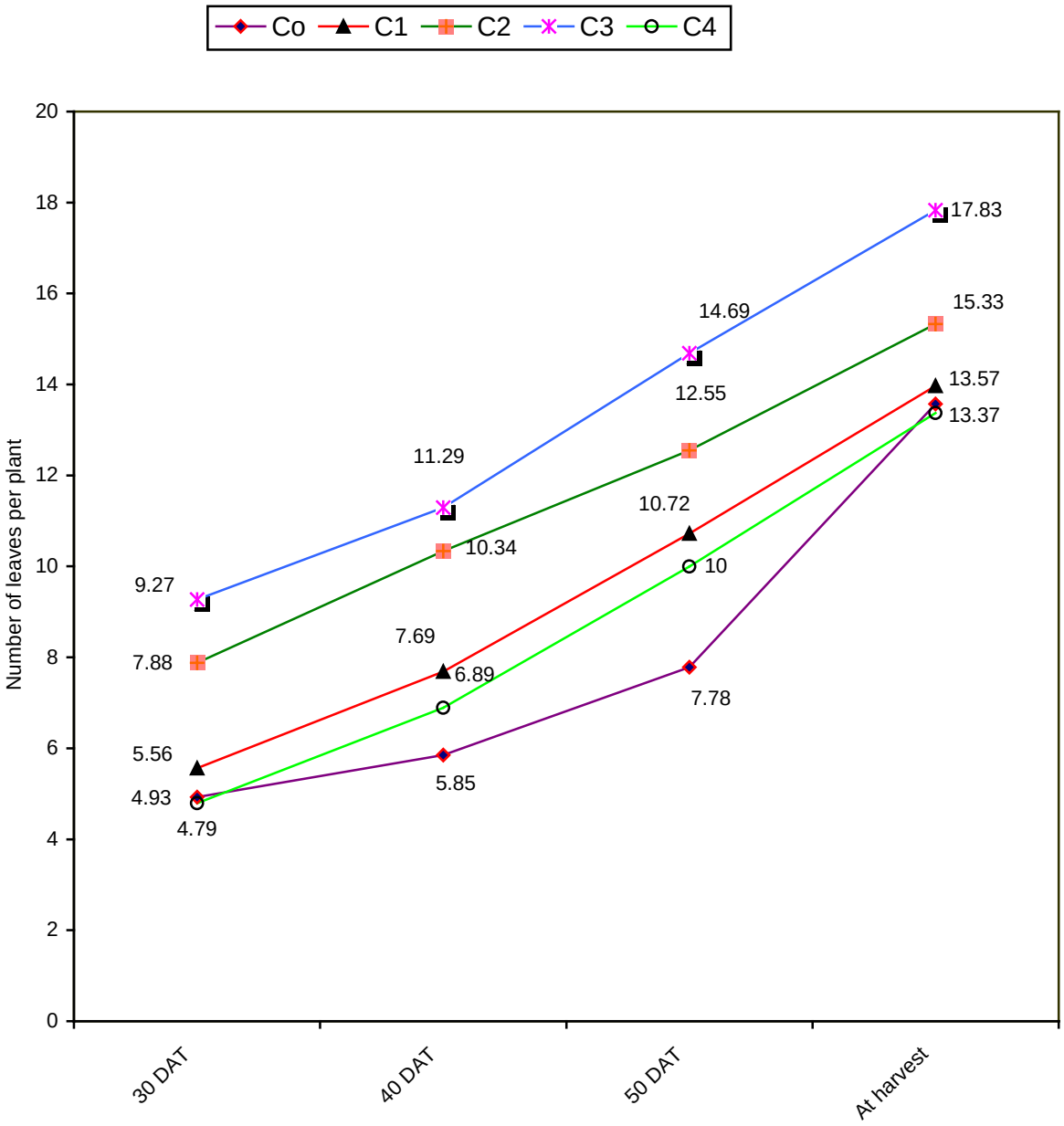


Fig. 2.Effect of different sources of nutrients on the number of leaves per plant

Note:

C_0 = Control

C_1 = Organic

C_2 = Inorganic fertilizers

C_3 = Organic + inorganic fertilizers + Agro-grow-granular

C_4 = Vermicompost

Table 2. Effect of different sources of nutrients on number of leaves per plant at different days after transplanting (DAT) and harvest of Broccoli (cv. 'Premium crop') and Cauliflower (cv. 'BARI 1')

Treatment combinations		Number of leaves/ plant at different DAT and at harvest			
		30 DAT	40 DAT	50 DAT	At harvest
Broccoli (cv. 'Premium crop')	Co	4.58	6.40	8.56	13.27
	C_1	5.65	7.24	9.78	13.77
	C_2	7.37	9.07	10.90	15.40
	C_3	7.97	9.87	14.03	17.83
	C_4	4.68	7.10	10.00	13.73
Cauliflower (cv. 'BARI 1')	Co	5.00	5.30	7.00	13.37
	C_1	5.38	8.15	11.67	14.20
	C_2	8.40	11.61	14.23	15.27
	C_3	10.57	12.70	15.22	18.70
	C_4	5.18	6.67	10.00	13.47
LSD 5%		0.518	0.928	2.602	2.828
LSD 1%		1.368	1.546	4.990	5.412
Level of significance		NS	NS	*	*

Note:

NS= Non significant

** Significance at 1% level

* Significance at 5% level

C_0 = Control
C_1 = Organic
C_2 = Iinorganic fertilizers
C_3 = Organic + inorganic fertilizers + Agro- grow - granular
C_4 = Vermicompost

4.1.3 Leaf length and leaf breath (cm)

The combined effect of different sources of nutrients had significantly influenced on the length and breath of leaf of Broccoli (cv. 'Premium crop') and Cauliflower (cv. 'BARI 1'), which has shown in the appendix III. At harvest, the longest (46.67 and 43.70 cm) leaf of a plant was recorded in BrC_3 and CaC_3 treatments respectively followed by BrC_2 and CaC_2 (43.43 and 40.40); BrC_1 and CaC_1 (35.77 and 27.83); BrC_4 and CaC_4 (33.60 and 26.20 cm); BrC_0 and CaC_0 (31.90 and 24.77) respectively and similarly, the widest (19.10 and 18.73 cm) leaf was obtained from BrC_3 and CaC_3 treatments followed by BrC_2 and CaC_2 (17.83 and 17.43); BrC_1 and CaC_1 (16.07 and 15.37); BrC_4 and CaC_4 (13.53 and 11.43 cm) and BrC_0 and CaC_0 (14.83 and 11.23) respectively (Table 3).

The leaf length and breath also varied significantly due to the effect of different sources of nutrients treatments (Appendix III). At harvest, the longest and the widest (45.18 and 18.92 cm) leaf was measured in the C_3 treatment followed by C_2 (41.92 and 17.83 cm), C_1 (31.80 and 15.73 cm) C_4 (29.90 and 12.48 cm) and C_0 (28.33 and 14.03 cm) treatment respectively (Table 3).

Table 3. Effect of different sources of nutrients on the leaf length (cm) and breadth (cm) of Broccoli (cv. 'Premium crop') and Cauliflower (cv. 'BARI 1')

Combined effect of fertilizer on of Broccoli (cv. 'Premium crop') and Cauliflower (cv. 'BARI 1')														
Treatment combinations		**Broccoli (cv. 'Premium crop')**					**Cauliflower (cv. 'BARI 1')**					LSD 5%	LSD 1%	Level of significance
		Co	C_1	C_2	C_3	C_4	Co	C_1	C_2	C_3	C_4			
Parameters	**Leaf length (cm)**	31.90	35.77	43.43	46.67	33.60	24.77	27.83	40.40	43.70	26.20	4.127	7.703	*
	Breadth of Leaf (cm)	14.83	16.07	17.83	19.10	13.53	11.23	15.37	17.43	18.73	11.43	1.716	3.203	*

Main effects of fertilizer on Broccoli (cv. 'Premium crop') and Cauliflower (cv. 'BARI 1')									
Treatment combinations		Co	C_1	C_2	C_3	C_4	LSD 5%	LSD 1%	Level of significance
Parameters	**Leaf length (cm)**	28.33	31.80	41.92	45.18	29.90	2.918	4.447	**
	Breadth of Leaf (cm)	14.03	15.73	17.63	18.92	12.48	1.214	2.266	*

** Significance at 1% level *Significance at 5% level

C_0 = Control
C_1 = Organic
C_2 = Inorganic fertilizers
C_3 = Organic + inorganic fertilizers + Agro- grow - granular
C_4 = Vermicompost

4.1.4 Weight of the largest leaf (g)

The combined effect of different sources of nutrients with the two crops had significantly influenced on the fresh weight of the largest leaf of plant (Appendix III). At harvest, the maximum weight of the largest leaf was 128.69 g and 131.02 g recorded in BrC_3 and CaC_3 treatments followed by BrC_2 and CaC_2 (125.07 and 129.89 g); BrC_4 and CaC_4 (72.38 and 64.50 g); BrC_1 and CaC_1 (69.60 and 72.86 g) and BrC_0 and CaC_0 (57.16 and 71.23g) treatment respectively (Table 4).

The effect different sources of nutrients had also significant on fresh weight of largest leaves per plant (Appendix III). The maximum fresh weight of leaf (129.85 g) was recorded from the treatment C_3 followed by C_2 (127.48 g), C_4 (68.44 g), C_1 (71.83 g) and C_0 (64.10 g) respectively (Table 4).

4.1.5 Leaf area (cm^2)

The combined effect of different sources of nutrients with the two crops had significantly influenced on the area of leaf of plant (Appendix III). At harvest, the maximum the area of a leaf was recorded in BrC_3 and CaC3 (883.47 and 807.83 cm^2) treatments followed by BrC_2 and CaC_2 (788.84 and 695.63 cm^2); BrC_4 and CaC_4 (447.33 and 416.60 cm^2); BrC_1 and CaC_1 (585.67 and 433.86 cm^2) and BrC_0 and CaC_0 (450.60 and 388.40 cm^2) treatments respectively (Table 4).

The effect of different sources of nutrients had also significant on the area of a leaf of plant (Appendix III). The maximum area of a leaf (865.62 cm^2) was recorded from the C_3 treatment followed by C_2 (742.24 cm^2), C_4 (431.97 cm^2), C_1 (509.77 cm^2) and C_0 (419.50 cm^2) respectively (Table 4).

Table 4. Effect of different sources of nutrients on leaf area (cm^2) and weight of largest leaf (g) of Broccoli (cv. 'Premium crop') and Cauliflower (cv. 'BARI 1')

Combined effect of fertilizer of Broccoli (cv. 'Premium crop') and Cauliflower (cv. 'BARI 1').														
Treatment combination		**Broccoli (Br)**					**Cauliflower (Ca)**					LSD 5%	LSD 1%	Level of significance
		Co	C_1	C_2	C_3	C_4	Co	C_1	C_2	C_3	C_4			
Parameters	**Weight of largest leaf (g)**	57.16	69.60	125.07	128.69	72.38	71.23	72.86	129.89	131.02	64.50	45.76	85.421	**
	Leaf area (cm2), (at the time of harvesting)	450.6	585.67	788.84	883.47	447.33	388.40	433.86	695.63	807.77	416.60	31.23	58.297	**

Main effects of fertilizer on Broccoli (cv. 'Premium crop') and Cauliflower (cv. 'BARI 1')									
Treatment combinations		Co	C_1	C_2	C_3	C_4	LSD 5%	LSD 1%	Level of significance
Parameter	**Weight of largest leaf (g)**	64.10	71.23	127.48	129.85	68.44	8.206	15.318	**
	Leaf area (cm2) (at the time of harvesting)	419.50	509.77	742.24	845.62	431.97	31.23	58.297	**

** Significance at 1% level *Significance at 5% level

C_0 = Control
C_1 = Organic
C_2 = Inorganic fertilizers
C_3 = Organic + inorganic fertilizers + Agro- grow - granular
C_4 = Vermicompost

4.1.6 Days required for 50% curd initiation

Number of days required for 50% curd initiation after transplanting was significantly influenced by effect of the different sources of nutrients (Appendix III). The longest time (53.96 and 52.62 days) was required to initiate 50% curd in BrC_1 and CaC_4 treatments and the shortest time (53.06 and 52.13 days) recorded in BrC_0 and CaC_2 treatment, while BrC_4 and CaC_0 were required 53.55 and 52.16 days; BrC_3 and CaC_1 required 53.19 and 52.51 days and BrC_2 and CaC_2 required 53.10 and 52.13 days to initiate 50% curd (Table 5).

The effect of different sources of nutrients on the days required for the 50% curd initiation was significantly influenced by the effect of nutrients management (Appendix III). The longest time required (53.24 days) rerecored in C_1 treatment and the shortest time duration was 52.61 days rerecored from C_0 treatment. C_4 required 53.09 days; C_2 required 52.62 days and C_3 52.75 days recorded from C_3 respectively (Table 5).

4.1.7 Days to 100% curd initiation

The combined effect of different sources of nutrients had significantly influenced on the number of days required for 100% curd initiation after transplanting (Appendix III). The maximum time (56.10 and 54.85 days) was required to initiate 100% curd from BrC_4 and CaC_4 treatments and the minimum time (54.92 and 54.11 days) recorded from BrC_2 and CaC_2 treatments, while BrC_3 and CaC_1 were required 55.95 and 54.62 days; BrC_0 and CaC_0 required 55.59 and 54.16 days; BrC_2 and CaC_2 required 53.10 and 52.13 days to initiate 100% curd respectively (Table 5).

The effect of different sources of nutrients on the days required for the 100% curd initiation was significantly influenced by the effect of nutrients management (Appendix III). The maximum time required (55.47 days) recored

from C_4 treatment and the minimum duration was 54.51days recorded from C_2 treatment. C_3 required 55.19 days; C_2 required 55.18 days and 54.88 days recorded from C_0 respectively (Table 5).

4.1.8 Days required from curd inition to harvest

There was no significant difference among the treatments on the number of days required from curd inition to harvest influenced by the combined effect of different sources of nutrients treatments. The maximum time (12.10 and 12.19 days) was required for BrC_4 and CaC_0 and the minimum time (9.86 and 10.34 days) was required in BrC_0 and CaC_2 in treatments (Fig. 3).

There was also no significant difference among the treatments on the days required from the curd initiation to harvest for the effect of nutrients management (Appendix III). The minimum days was (10.95 days) recorded from C_2 treatment and the maximum time (11.62days) was from C_4 treatment (Table 5).

4.1.9 Weight of full plant

The combined effect of different sources of nutrients with the two crops had significantly influenced on the weight of the full of plant (Appendix III). At harvest, the maximum weight (893.28 g and 998.80 g) of the full weight of plant was recorded from BrC_3 and CaC_3 treatments followed by BrC_2 and CaC_2 (856.86 and 880.12 g); BrC_4 and CaC_4 (590.08 and 528.50 g); BrC_1 and CaC_1 (450.22 and 455.15 g) and BrC_0 and CaC_0 (434.08 and 413.30 g) treatment respectively (Table 6).

The effect of different sources of nutrients had also significant on the weight of the full plant (Appendix III). The maximum weight of the full plant (129.85g) was recorded from the treatment C_3 (946.13g) followed by C_2 (668.49g), C_1 (452.68g) and C_0 (423.69g) respectively (Table 6).

Table 5. Effect of different sources of nutrients on the days required for 50%, 100% curd initiation and days required for harvesting of Broccoli (cv. 'Premium crop') and Cauliflower (cv. 'BARI 1')

Combined effect of fertilizer on Broccoli (cv. 'Premium crop') and Cauliflower (cv. 'BARI 1')														
Treatment		**Broccoli (Br)**					**Cauliflower (Ca)**					LSD 5%	LSD 1%	Level of significance
		Co	C_1	C_2	C_3	C_4	Co	C_1	C_2	C_3	C_4			
Parameters	**50% curd initiation**	53.06	53.96	53.10	53.19	53.55	52.16	52.51	52.13	52.31	52.62	8.080	15.083	*
	100% curd initiation	55.59	55.75	54.92	55.95	56.10	54.16	54.62	54.11	54.42	54.85	7.512	14.022	*

Main effect of fertilizer on Broccoli (cv. 'Premium crop') and Cauliflower (cv. 'BARI 1')									
Treatment combinations		Co	C_1	C_2	C_3	C_4	LSD 5%	LSD 1%	Level of significance
Parameters	**50% curd initiation**	52.61	53.24	52.62	52.75	53.09	5.34	9.79	*
	100% curd initiation	54.88	55.18	54.51	55.19	55.47	5.71	10.66	*
	Days from curd inition to harvest	11.023	11.415	10.957	11.368	11.622	1.21	2.27	NS

** Significance at 1% level *Significance at 5% level NS= Non Significant

C_0 = Control
C_1 = Organic
C_2 = Inorganic fertilizers
C_3 = Organic + inorganic fertilizers + Agro- grow - granular
C_4 = Vermicompost

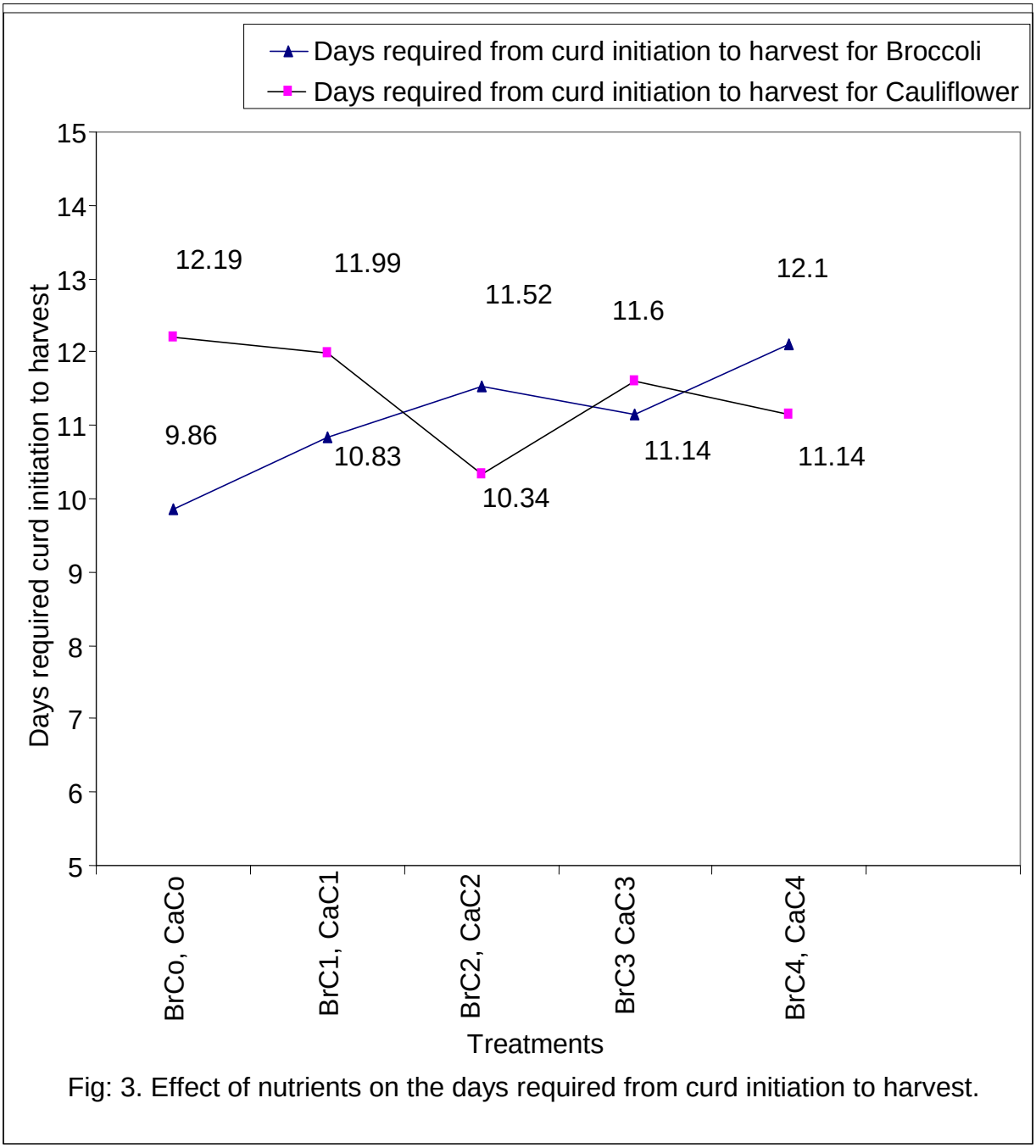


Fig: 3. Effect of nutrients on the days required from curd initiation to harvest.

Br = Broccoli (cv. 'Premium crop') Ca = Cauliflower (cv. 'BARI 1')	C_0 = Control C_1 = Organic C_2 = Inorganic fertilizers C_3 = Organic + inorganic fertilizers + Agro-grow - granular C_4 = Vermicompost

4.1.10 Yield per plant (g), (with Secondary yield per plant of Broccoli)

The combined effect of different sources of nutrients with the two crops had also significantly influenced on the marketable yield of curd per plant (Appendix III). The maximum yield (438.64 g and 613.48g) per plant was recorded from the BrC_3 and CaC_3 treatment followed by BrC_2 and CaC_2 (357.39 and 386.02 g); BrC_4 and CaC_4 (216.36 and 310.90 g); BrC_1 and CaC_1 (209.65 and 264.73 g); BrC_0 and CaC_0 (184.32 and 213.14 g) treatments respectively (Table 6). In case of Broccoli, the maximum yield (69.94 g) per plant was recorded from the BrC_3 treatment followed by BrC_2 (50.52g), and inorganic fertilizer treatment BrC_1 (36.44g) respectively, but no secondary yield per plant was found in C_0 treatment as well as in C_4 treatment (Table 6).

Yield per plant also significantly influenced due to the effect of nutrients management (Appendix III). The maximum yield per plant 526.06 g was recorded in treatment C_3 treatment followed by C_2 (371.71 g), C_1 (237.92g) and C_0 (198.73g) respectively (Table 6).

In case of secondary yield per plant of Broccoli, the maximum yield (66.45 g) per plant was recorded from the C_3 treatment followed by C_2 (48.67g), and inorganic fertilizer treatment C_1(33.05g) respectively, but no secondary yield per plant was found in C_0 treatment as well as in C_4 treatment (Table 6).

Finally, the above secondary yield per plant was calculated and added to the primary or main yield per plant, which was further calculated in tons per hectare and added to the primary or main yield.

Table 6. Effect of different sources of nutrients on weight of plant and curd yield per plant (g) of Broccoli (cv. 'Premium crop') and Cauliflower (cv. 'BARI 1')

Combined effect of fertilizer on Broccoli (cv. 'Premium crop') and Cauliflower (cv. 'BARI 1')															
Treatment combination		**Broccoli (Br)**					**Cauliflower (Ca)**					LSD 5%	LSD 1%	Level of significance
		Co	C_1	C_2	C_3	C_4	Co	C_1	C_2	C_3	C_4			
Parameters	**Weight of full plant (g)**	434.08	455.15	856.86	893.28	528.50	413.30	450.22	480.12	998.80	590.08	59.74	111.52	**
	Secondary yield / plant(g) of Broccoli	-	36.44	50.52	69.94	-	-	-	-	-	-	6.34	13.56	*
	Yield/ plant (with Secondary yield (g) / plant of Broccoli)	184.32	209.65	357.39	438.64	216.36	213.14	264.73	386.02	613.48	310.90	31.38	58.577	**

Main effect of fertilizer on Broccoli (cv. 'Premium crop') and Cauliflower (cv. 'BARI 1')									
Treatment combinations		Co	C_1	C_2	C_3	C_4	LSD 5%	LSD 1%	Level of significance
Parameters	**Weight of full plant (g)**	423.69	452.68	668.49	946.13	559.29	42.24	78.85	**
	Secondary curd yield per plant (g) of Broccoli	-	33.05	48.67	66.45	-	4.36	8.35	*
	Yield/ plant (with Secondary yield (g)/plant of (Broccoli)	198.73	237.92	371.71	526.06	263.63	22.19	41.422	**

** Significance at 1% level *Significance at 5% level

C_0 = Control
C_1 = Organic
C_2 = Inorganic fertilizers
C_3 = Organic + inorganic fertilizers + Agro- grow – granular
C_4 = Vermicompost

4.1.11 Curd diameter (cm)

The combined effect of different sources of nutrients with the two crops had significant on the curd diameter of Broccoli cv. 'Premium crop' and Cauliflower cv. 'BARI 1' (Appendix III). At harvest, the BrC_3 and CaC_3 treatments gave the maximum curd diameter (15.19 and 17.02 cm) of plant followed by BrC_2 and CaC_2 (13.01 and 14.91 cm); BrC_1 and CaC_1 (8.93 and 9.12 cm); BrC_4 and CaC_4 (10.37 and 10.11 cm); and BrC_0 and CaC_0 (8.37 and 8.80 cm) respectively (Table 7).

The effect of different sources of nutrients had significant effect on the curd diameter (Appendix III). At harvest, the longest and widest (16.11 cm) leaf was measured in the C_3 treatment followed by C_2 (13.96 cm), C_4 (10.24 cm), C_1 (9.02 cm) and C_0 (8.58 cm) treatment respectively (Table 7).

4.1.12 Curd height (cm)

The combined effect of different sources of nutrients with the two cultivars had significant on the curd height of Broccoli (cv. 'Premium crop') and Cauliflower (cv. 'BARI 1'), which has shown in the appendix III. At harvest, the BrC_3 and CaC_3 treatments gave the maximum curd height (15.77 cm and 15.98 cm) followed by BrC_2 and CaC_2 (14.44 and 14.72 cm), BrC_1 and CaC_1 (11.04 and 10.94 cm); BrC_4 and CaC_4 (13.44 and 13.46 cm); BrC_0 and CaC_0 (8.83 and 9.4 cm) respectively (Table 7).

The effect of different sources of nutrients treatments had significant on the curd height (Appendix III). At harvest, the widest curd (15.8 cm) was measured in the C_3 treatment followed by C_2 (14.58 cm), C_4 (13.45 cm) C_1 (10.99 cm) and C_0 (9.12 cm) treatment respectively (Table 7).

4.1.13. Curd weight (g)

The combined effect of different sources of nutrients treatments with the two crops had significant on the pure curd weight (Appendix III). At harvest, the maximum curd weight (336.59g and 475.51g) per plant were recorded from BrC_3 and CaC_3 treatments followed by BrC_2 and CaC_2 (137.24 and 264.37 g); BrC_4 and CaC_4 (120.65 and 136.63g); BrC_1 and CaC_1 (116.59 and 137.29g) and BrC_0 and CaC_0 (88.86 and 106.19 g) treatment respectively (Table 8). The effect of different sources of nutrients had also significant on the weight of curd per plant (Appendix III). The maximum curd weight per plant (406.05 g) was recorded from the treatment C_3 followed by C_2 (250.51g), C_1 (126.94 g) and C_0 (97.53 g) respectively (Fig. 4).

4.1.14 Gross yield (t/ha)

The combined effect of different sources of nutrients treatments with the two crops had significant on the gross yield (Appendix III). At harvest, the maximum gross yield (16.22 and 22.70 t/ha) were recorded in BrC_3 and CaC_3 treatments followed by BrC_2 and CaC_2 (13.21 and 14.28 t/ha); BrC_4 and CaC_4 (7.99 and 10.26 t/ha); BrC_1 and CaC_1 (7.76 and 9.78 t/ha) and BrC_0 and CaC_0 (6.82 and 7.89 t/ha) treatment respectively (Table 8).

The effect of fertilizer management had also significant on the gross yield (Appendix III). The maximum gross yield (19.46 t/ha) was recorded from the treatment C_3 followed by C_2 (13.75 t/ha), C_4 (9.13 t/ha), C_1 (8.77 t/ha) and C_0 (7.36 t/ha) respectively (Fig. 5).

Table 7. Effect of different sources of nutrients on the diameter (cm), height (cm) of the curd and weight of curd (g) of Broccoli (cv. 'Premium crop') and Cauliflower (cv. 'BARI 1')

Combined effect of fertilizer on Broccoli (cv. 'Premium crop') and Cauliflower (cv. 'BARI 1')															
Treatment		**Broccoli (Br)**						**Cauliflower (Ca)**					LSD 5%	LSD 1%	Level of significance
		Co	C_1	C_2	C_3	C_4		Co	C_1	C_2	C_3	C_4			
Parameters	**Diameter of curd (cm)**	8.37	8.93	13.01	15.19	10.37		8.801	9.12	14.91	17.02	10.11	2.663	5.104	*
	Height of the curd (cm)	8.83	11.04	14.44	15.77	13.44		9.40	10.94	14.72	15.98	13.46	2.913	6.059	*

Main effect of fertilizer on Broccoli (cv. 'Premium crop') and Cauliflower (cv. 'BARI 1')									
Treatment combinations	Co	C_1	C_2	C_3	C_4	LSD 5%	LSD 1%	Level of significance
Parameters	**Diameter of curd (cm)**	8.58	9.02	13.96	16.11	10.24	1.663	3.104	NS
	Height of the curd (cm)	9.12	10.99	14.58	15.8	13.45	1.639	3.059	NS

** Significance at 1% level *Significance at 5% level NS= Not significant

C_0 = Control
C_1 = Organic
C_2 = Inorganic fertilizers
C_3 = Organic + inorganic fertilizers + Agro- grow - granular
C_4 = Vermicompost

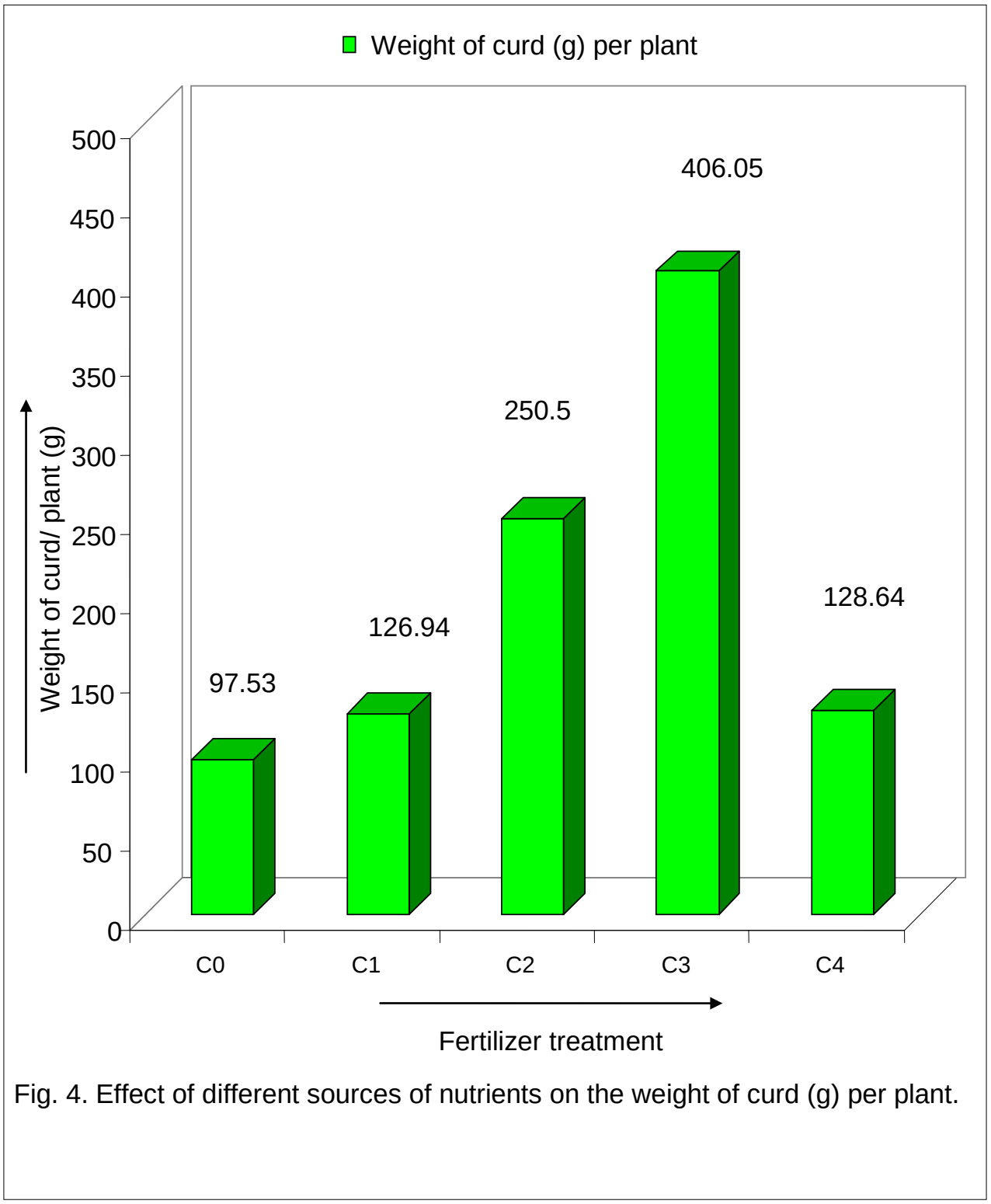


Fig. 4. Effect of different sources of nutrients on the weight of curd (g) per plant.

Note:
C_0 = Control
C_1 = Organic
C_2 = Inorganic fertilizers
C_3 = Organic + inorganic fertilizers + Agro- grow - granular
C_4 = Vermicompost

4.1.15 Marketable yield (t/ha)

The combined effect of different sources of nutrients treatment had significant on the marketable yield (Appendix III). At harvest, the maximum marketable yield (15.59 and 20.04 t/ha) were recorded in BrC_3 and CaC_3 treatments followed by BrC_2 and CaC_2 (12.69 and 13.04 t/ha); BrC_4 and CaC_4 (7.07 and 9.22 t/ha); BrC_1 and CaC_1 (5.82 and 6.85 t/ha) and BrC_0 and CaC_0 (6.82 and 7.89 t/ha) treatment respectively (Table 8).

The effect of different sources of nutrients treatment had also significant on the marketable yield (Appendix III). The maximum marketable yield (17.82 t/ha) was recorded from the treatment C_3 followed by C_2 (12.83 t/ha), C_4 (8.12 t/ha), C_1 (7.72 t/ha) and C_0 (6.34 t/ha) respectively (Fig. 5).

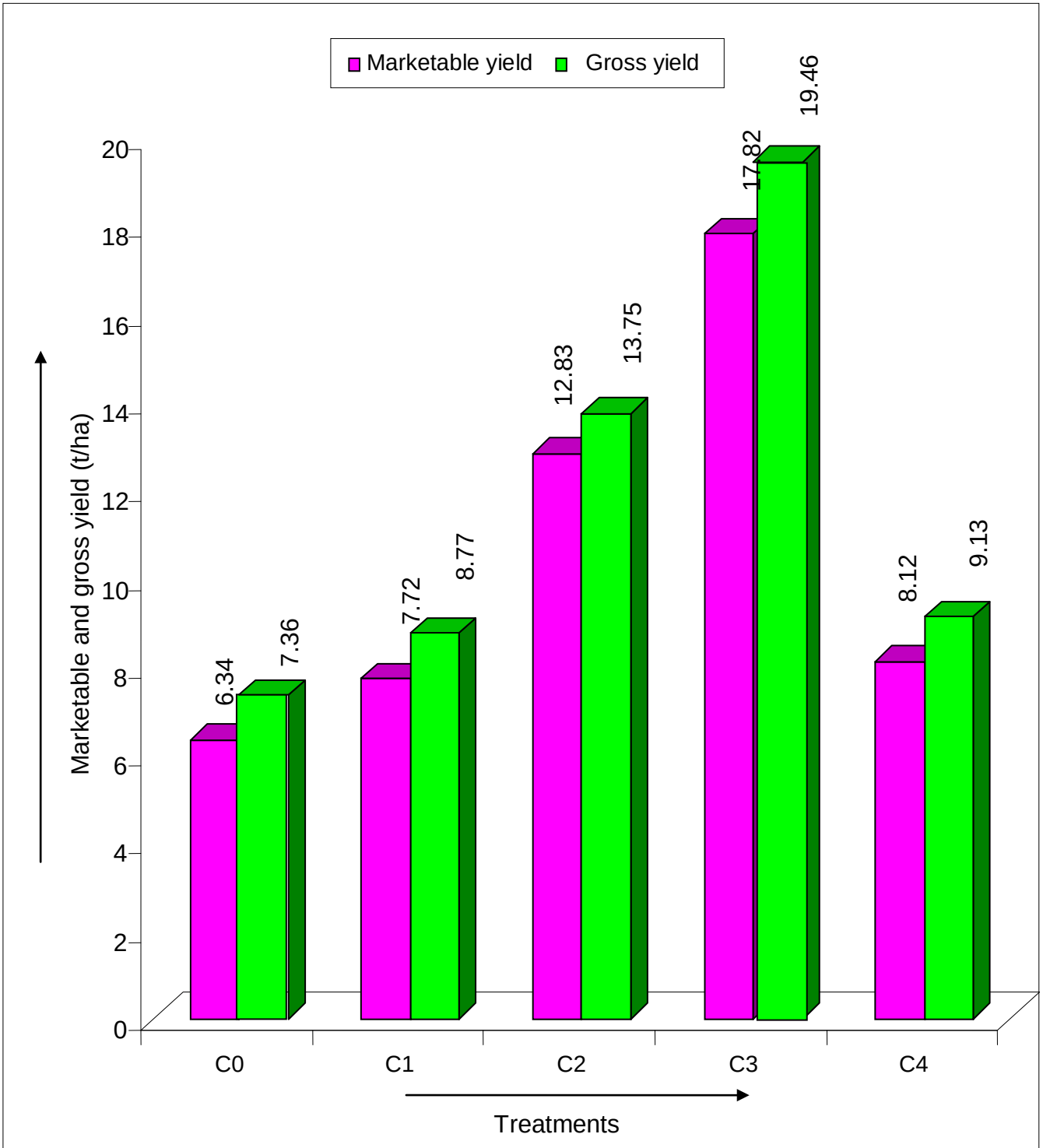


Fig: 5. Effect of different sources of nutrients treatment on the marketable yield and gross yield of crops

Note:

C_0 = Control
C_1 = Organic
C_2 = Inorganic fertilizers
C_3 = Organic + inorganic fertilizers + Agro- grow - granular
C_4 = Vermicompost

Table 8. Effect of different sources of nutrients on the gross yield (t/ha), marketable yield (t/ha) and weight of curd/plant (g) of Broccoli (cv. 'Premium crop') and Cauliflower (cv. 'BARI 1')

Treatment combinations		Combined effect of fertilizer management on		
		Gross yield (t/ha)	Marketable yield (t/ha)	weight of curd (g)
Broccoli (Br)	Co	6.82	5.82	88.86
	C1	7.76	6.78	116.59
	C2	13.21	12.69	237.24
	C3	16.22	15.59	336.59
	C4	7.99	7.07	120.65
Cauliflower (Ca)	Co	7.89	6.85	106.19
	C1	9.78	8.67	137.29
	C2	14.28	13.04	264.37
	C3	22.70	20.05	475.51
	C4	10.26	9.22	136.63
LSD 5%		2.641	2.501	42.22
LSD 1%		5.063	4.668	78.813
Level of significance		*	*	**

** Significance at 1% level

*Significance at 5% level

C_0 = Control
C_1 = Organic
C_2 = Organic + inorganic fertilizers
C_3 = Organic + inorganic fertilizers +Agro- grow- granular
C_4 = Vermicompost

4.2 Cost and return analysis

The details of economic analysis have been presented in table 9 and appendix IV. Materials (1A), non materials (1B) and over curd cost were recoded for all the treatments of unit plot and calculated on per hectare basis (Marketable yield) the price of Broccoli (cv. 'Premium crop') and Cauliflower (cv. 'BARI 1') at the local market rats was considered.

For Broccoli (cv. 'Premium crop'), the total cost of production ranges from Tk. 69100 to Tk. 96545 per ha among the different treatment combinations. The maximum cost of production Tk. 96545 per hectare was recorded in the BrC_3 treatment, while the lowest cost of production Tk 69100 per ha was recorded in the BrC_0 treatment (Appendix IV). Gross return from the different treatment combinations ranges between Tk 87300 and Tk. 248100 per ha. Among the various treatment combinations BrC_3 gave the maximum net return 137305 Tk. per ha while the lowest net return Tk. 18200 was obtained from the BrC_0 treatment.

Similarly for Cauliflower (cv. 'BARI 1') production, the maximum cost of production was Tk. 93005 per ha was required for the $CarC_3$; while the lowest cost of production Tk 65560 per ha was concerned with the CaC_0 treatment (Appendix IV) and gross return from the different treatment combinations ranges from Tk 200400 to Tk. 68500 per ha. The treatment combinations of CaC_3 gave the maximum net return Tk. 107395 per ha while the lowest net return Tk. 2940 was recorded from the CaC_0treatment.

The maximum BCR (2.42) measured in BrC_3 treatment while, the lowest BCR (1.18) was recorded from the BrC_0 treatment in Broccoli (cv. 'Premium crop') production. For Cauliflower (cv. 'BARI 1'), the maximum BCR (2.14) found from treatment CaC_3 while, the lowest BCR (1.04) was recorded from the treatment CaC_0.

From the above result and considering the growth and yield performance of the two crops Broccoli (cv. ‘Premium crop’) and Cauliflower (cv. ‘BARI 1’); it was clear that Broccoli (cv. ‘Premium crop’) give more the maximum economic return Tk.137305 consequently the maximum BCR (2.42) while, the maximum economic return Tk. 107395 per ha and the maximum BCR (2.14) found in Cauliflower (cv. ‘BARI 1’) from the similar treatment combination (CaC_3).

Considering all the above factors, finally this experiment achieved that the BrC_3/CaC_3 treatment showed the tremendous performance than any other treatment combinations. From the economic point of view, the crop Broccoli (cv. ‘Premium crop’) could be performed better than Cauliflower (cv. ‘BARI 1’) and there is great opportunity to get maximize economic return. However, further studies in this relation should be carried out in other regions of the country before final recommendation.

Table 9. Cost and return of Broccoli (cv. 'Premium crop') and Cauliflower (cv. 'BARI 1') due to fertilizer management

Treatment combination		Marketable yield (t/ha)				Gross return (Tk/ha)	Total cost of production (Tk/ha)	Net return (Tk/ha)	Benefit cost ratio (BCR)
		Cauliflower (cv. 'BARI 1')	Broccoli (cv. 'Premium crop')		Total yield (t/ha)				
			Primary yield (t/ha)	Secondary yield (t/ha)					
Broccoli (Br)	Co	-	5.43	0.00	5.82	87300	69100	18200	1.18
	C1	-	5.82	1.35	7.17	110550	85223	25327	1.29
	C2	-	10.78	1.91	12.69	190350	79838	110512	2.38
	C3	-	13.00	2.59	15.59	233850	96545	137305	2.42
	C4	-	7.07	0.00	7.07	106050	81799	24251	1.30
Cauliflower (Ca)	Co	6.85	-	-	6.85	68500	65560	2940	1.04
	C1	8.67	-	--	8.67	86700	81683	5017	1.06
	C2	13.04	-	-	13.04	130400	76301	54099	1.71
	C3	20.04	-	-	20.04	200400	93005	107395	2.14
	C4	9.22	-	-	9.22	92200	77787	14413	1.18

Note : Sale of

Broccoli (cv. 'Premium crop') ……. @ Tk. 150000/t

Cauliflower (cv. 'BARI 1') …… @ Tk. 100000/t

Gross return / Total income = Marketable yield (t/ha) × Tk.

BCR = Gross return ÷ Total cost of production

C_0 = Control
C_1 = Organic
C_2 = Inorganic fertilizers
C_3 = Organic + inorganic fertilizers +Agro- grow - granular
C_4 = Vermicompost

SUMMARY OF FINDINGS

An experiment was conducted at the Horticultural Farm of Sher-e-Bangla Agricultural University, Dhaka, to study the effects of different sources of nutrientss treatment on the growth and yield performance of Broccoli (cv. 'Premium crop') and Cauliflower (cv. 'BARI 1') during the period of October 2004 to February 2005.

Data of growth and yield parameters were colleted and analyzed statistically. The mean differences were adjusted by least significant different (lsd) test. The experiment consisted of two different cultivars viz Broccoli (cv. 'Premium crop') and Cauliflower (cv. 'BARI 1') and both the crops treated with different five levels of fertilizers treatments viz. Co (control), C_1 (cowdung 20 t/ha), C_2 (Urea 250 kg/ha, TSP 150 kg/ha and MP 200 kg/ha), C_3 (cowdung 10 t/ha, Urea 250 kg/ha, TSP 150 kg/ha MP 200 kg/ha, Agro-grow-granular 20 kg/ha) and C_4 (205 kg/ha). The experiment comprised of 10 treatment combinations in this experiment with three replications, which was laid out in Randomized Complete Block Design and the unit plot size was 2.7 m × 1.8 m where, 1.0 m block to block and 0.5m plot to plot gaps were maintained. The experimental plots were fertilized with C_1, C_2, C_3 and C_4 as per treatment maintaining the above recommended doses. Manure and fertilizers were applied during final land preparation. The seeds of Broccoli (cv. 'Premium crop') and Cauliflower (cv. 'BARI 1') were sown on 19th October 2004 and transplanted on 25th November 2005. Ten plants of each plot were randomly selected from for data collection up to final harvest and observation was made on plant height, number of leaves per plant, leaf length, leaf breath, leaf area, weight of the largest leaf, days required for 100% curd initiation, days required for first curd initiation to harvest, curd diameter (cm), height of the curd (cm), weight of full plant, yield per plant (g), weight of pure curd (g), secondary marketable yield of Broccoly(t/ha), gross yield (t/ha) and marketable yield (t/ha).

The combined effects of different sources of nutrientss treatment significantly influenced all the parameters.The maximum plant height (66.40 and 38.10 cm), number of leaves per plant (16.97 and 18.70), leaf area (883.47 and 807.77 cm^2), the longest and widest leaf (46.77, 43.70 and 19.10,18.73 cm), fresh weight of the largest leaf (128.69 and 131.02g), the weight of full plant (893.28 and 998.70 g), yield per plant (438.64 and 613.483 g),curd diameter (15.93 and 17.02 cm) height of curd (15.77 and 15.96 cm), pure curd weight per plant

(336.69 and 475.51 g), gross yield (16.22 and 22.70 t/ha) and the maximum marketable yield (15.59 and 20.04 t/ha) recorded in BrC_3 and CaC_3 treatment. Beside this, the minimum plant height (28.10 and 351.35 cm), number of leaves per plant (13.77and13.36), leaf area (419.50 and 388.40 cm^2), the shortest and narrowest leaf (31.90, 24.77 cm and 14.83, 13.23 cm), lowest fresh weight of leaf (57.16 and 64.49g), Weight of full plant (434.08 and 413.03 g) yield per plant (184.32 and 213.14g), diameter curd (8.38 and 8.81 cm), height of curd (8.83 and 9.40 cm), pure curd weight of per plant (88.86 and 106.19g), the minimum gross yield (6.82 and 7.89 t/ha) and marketable yield (5.82 and 6.85 t/ha) recorded in BrC_0 and CaC_0 treatment. For 100% curd initiation the shortest time (54.92 and 54.11 days) required in BrC_2 and CaC_2 treatment and the maximum time (56.10 and 54.85 days) recorded in BrC_4 and CaC_4 treatment respectbly. The maximum time (12.10 and 12.19 days) requred in BrC_4 and CaC_0 treatments while, the shortest time (9.86 and 10.34 days) required in BrC_0 and CaC_2 treatments respectbly to harvest the curd.

The effects of of different sources of nutrientss treatment had also significant on various parameters studied. The maximum plant height (52.25 cm), number of leaves per plant (17.83), leaf area (845.62 cm^2), the longest and widest leaf (45.18 and 18.92 cm), fresh weight of largest leaf (129.85g), Weight of full plant (946.13g) yield per plant (438.64 g), diameter curd (16.11 cm), pure curd weight of per plant (406.05g), the highest gross yield (22.70 t/ha) and marketable yield (17.82t/ha) recorded in C_3 at harvest. Similarly, the minimum plant height (22.83 cm), number of leaves per plant (13.36), leaf area (419.50 cm^2), the shortest and narrowest leaf (12.48 and 12.48 cm), lowest fresh weight of leaf (64.20g), weight of full plant (423.69g) yield per plant (198.73g), diameter curd (8.58 cm), height of curd (9.11 cm), pure curd weight of per plant (97.53g), the highest gross yield (7.36 t/ha) and marketable yield (6.33 t/ha) obtained from C_0 treatment. In case of curd initiation, the shortest time (54.51 days) required for100% curd initiation in C_2 treatment and longest time (54.47 days) in C_4 treatment while, longest time duration was 11.62 days required found in C_4 treatment and the shortest time (9.96 days) required for C_2 treatment to harvest. The highest BCR (2.42 and 2.14) was obtained from BrC_3 and CaC_3; while the lowest BCR (1.18 and 1.04) was recorded from BrC_0 and CaC_0 treatment.

CONCLUSION

Finally, the maximum outcome was obtained from BrC_3 and CaC_3 treatments that was considered to be the best combination of different sources of nutrientss for maximising yield. Consequently, for increasing the production of Br and Ca both organic and inorganic fertilizers may be used. Between the two cultivars, Cauliflower (cv. 'BARI 1') gave more yields per hectare than that of Broccoli (cv. 'Premium crop') under similar investigation of treatment. But, considering the BCR, it showed that the higher BCR was obtained in Broccoli (cv. 'Premium crop') than that of Cauliflower (cv. 'BARI 1'). So it could be suggested that this result would grow more interest to study of Broccoli (cv. 'Premium crop') and Cauliflower (cv. 'BARI 1') further. In order to confirm the result of this study, further experiment is suggested since this experiment was conducted in one year and in a certain place only. Consequently, for increasing the production of Br and Ca both organic and inorganic fertilizers may be used.

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APPENDICS

Appendix I. Monthly record of year temperature, rainfall, relative humidity, soil temperature and sunshine of the experimental site during the period from October 2004 to March 20005

Year	Month	*Air temperature (°c)			Relative humidity (%)	Rainfall (mm)	Soil temperature			**Sunshine (hr)
		Maximum	Minimum	Mean			5 cm depth	10 cm depth	20 cm depth	
2004	**October**	30.97	23.31	27.14	75.25	208	16.09	17.2	17.3	208.9
	November	29.45	18.63	24.04	69.52	00	13.8	14.4	14.8	233.2
	December	26.85	16.23	21.54	70.61	00	12.6	13.6	14.0	210.5
2005	**January**	24.52	13.86	19.19	68.46	04	11.3	11.3	13.0	194.1
	February	28.88	17.98	23.43	61.04	03	12.9	12.9	13.8	221.5
	March	32.22	21.78	27.00	66.69	155	16.2	16.2	17.2	210.2

*Monthly average

** Monthly total

Source: Bangladesh Meteorological Department (climate division)

Agargoan, Dhaka-1207

Appendix II.Characteristics of Horticulture Farm soil is analyzed by Soil Resource and Development Institute (SRDI), Khamar Bari, Farmgate, Dhaka.

A. morphological characteristics of the experimental field

Morphological features	Characteristics
Location	Horticulture Garden ,SAU, Dhaka
AEZ	Madhupur Tract (28)
General Soil Type	Shallow red brown terrace soil
Land type	High land
Soil series	Tejgaon
Topography	Fairly leveled
Flood level	Above flood level
Drainage	Well drained
Cropping pattern	Fellow – Broccoli and Cauliflower

B. Physical and chemical properties of the initial soil

Characteristics	Value
Partical size analysis	
% Sand	27
% Silt	43
% clay	30
Textural class	silty-clay
Ph	5.6
Organic carbon (%)	0.45
Organic matter (%)	0.78
Total N (%)	0.03
Available P (ppm)	20.00
Exchangeable K (me/100 g soil)	0.10
Available S (ppm)	45

Source: SRDI

Appendix III. Analysis of variance of different characters of Broccoli (cv. 'Premium crop') and Cauliflower (cv. 'BARI 1')

Source of variation	Degree of freedom	Mean square			
		Plant height (cm)			
		At 30 DAT	At 40 DAT	At 50 DAT	At harvest
Replication	2	1.168^{NS}	12.167**	23.941**	29.670**
Factor-A (Crops)	1	177.33**	2.537^{NS}	1570.357**	2264.962**
Factor-B (Fertilizer)	4	79.66**	164.645**	283.713**	351.611**
Interaction(AB)	4	52.04**	70.648**	78.481**	123.084**
Error	18	64.96**	1023.285	5.597	6.932

Note:

** Significance at 1% level *Significance at 5% level NS = Non significant

Appendix III. Contd.

Source of variation	Degree of freedom	Mean square			
		No. of leaves / plant			
		At 40 DAT	At 40 DAT	At 50 DAT	At harvest
Replication	2	0.701^{NS}	0.034^{NS}	2.8^{NS}	3.616*
Factor-A (Crops)	1	5.470*	6.843**	7.037*	1.045^{NS}
Factor-B (Fertilizer)	4	23.946**	32.145**	40.382**	20.632**
Interaction(AB)	4	1.746^{NS}	4.609**	5.187**	1.029^{NS}
Error	18	0.339^{NS}	0.293	0.872	1.135

Note:

** Significance at 1% level *Significance at 5% level NS = Non significant

Appendix III. Contd.

Source of variation	Degree of freedom	Mean square			
		Leaf length (cm)	Leaf breadth (cm)	Leaf size (cm^2)	Weight of largest leaf (g)
Replication	2	19.834**	3.604*	1514.21NS	82.072**
Factor-A (Crops)	1	243.105**	8.008*	15489.127**	82.568**
Factor-B (Fertilizer)	4	346.987**	40.790**	223497.60**	6676.835**
Interaction(AB)	4	9.193**	0.906^{NS}	11980.921**	91.592**
Error	18	5.787	1.001	663.104	45.764

Note:

** Significance at 1% level *Significance at 5% level NS = Non significant

Appendix III. Contd.

Source of variation	Degree of freedom	Mean square		
		50% curd initiation	100% curd initiation	Days required for curd initiation to harvest
Replication	2	21.382**	53.757**	0.683^{NS}
Factor-A (Crops)	1	7.957*	11.408**	1.057^{NS}
Factor-B (Fertilizer)	4	0.486^{NS}	0.804^{NS}	0.470^{NS}
Interaction(AB)	4	0.086^{NS}	0.119^{NS}	3.167^{NS}

Note:

** Significance at 1% level * Significance at 5% level

NS = Non significant

Appendix III. Contd.

Source of variation	Degree of freedom	Mean square		
		Height of curd (cm)	Diameter of curd (cm)	Weight of curd (g)
Replication	2	4.195*	2.910^{NS}	2290.091**
Factor-A (Crops)	1	0.275^{NS}	4.994*	14525.284**
Factor-B (Fertilizer)	4	44.694**	65.172**	98923.271**
Interaction(AB)	4	0.099^{NS}	1.466^{NS}	4249.878**
Error	18	0.913	0.940	605.681

Note:
** Significance at 1% level * Significance at 5% level NS = Non significant

Appendix III. Contd.

Source of variation	Degree of freedom	Mean square		
		Height of curd(cm)	Diameter of curd(cm)	Weight of curd(g)
Replication	2	4.195*	2.910^{NS}	2290.091**
Factor-A (Crops)	1	0.275^{NS}	4.994*	14525.284**
Factor-B (Fertilizer)	4	44.694**	65.172**	98923.271**
Interaction(AB)	4	0.099**	1.466^{NS}	4249.878**
Error	18	0.913	0.940	605.681

Note:
** Significance at 1% level * Significance at 5% level NS = Non significant

Appendix III. Contd.

Source of variation	Degree of freedom	Mean square	
		Yield/plant(g)	Yield/plant(t/ha)
Replication	2	1.026^{NS}	0.047^{NS}
Factor-A (Crops)	4	8.25**	3.994*
Error	8	0.124	0.015

Note:

** Significance at 1% level * Significance at 5% level NS = Non significant

Appendix III. Contd.

Source of variation	Degree of freedom	Mean square			
		Weight of full plant (g)	Yield/plant(g)	Gross yield (t/ha)	Marketable yield (t/ha)
Replication	2	4046.839**	318.301**	3.642**	7.886**
Factor-A (Crops)	1	16591.947**	43755.046**	60.008**	30.140**
Factor-B (Fertilizer)	4	267648.457**	104813.740**	147.760**	134.511**
Interaction(AB)	4	54858.801**	5632.753**	7.543**	3.569*
Error	18	1212.800	334.613	0.915	2.126

Note:

** Significance at 1% level * Significance at 5% level NS = Non significant

Appendix III. Contd.

Source of variation	Degree of freedom	Mean square			
		Weight of full plant (g)	Yield/plant(g)	Gross yield (t/ha)	Marketable yield (t/ha)
Replication	2	4046.839**	318.301**	3.642*	7.886**
Factor-A (Crops)	1	16591.947**	43755.046**	60.008**	30.140**
Factor-B (Fertilizer)	4	267648.457**	104813.740**	147.760**	134.511**
Interaction(AB)	4	54858.801**	5632.753**	7.543**	3.569*
Error	18	1212.800	334.613	0.915	2.126

Note:

** Significance at 1% level * Significance at 5% level NS = Non significant

Appendix IV. Production cost of Broccoli and Cauliflower hectare

(A)Material cost (Tk.)

Treatment combinations		Seed (Tk./ ha)	Fertilizer and manure				Agro-grow – granular (Tk./ ha)	Vermicompost (Tk./ ha)	Sub total 1 (A) (Tk./ ha)
			Cowdung (Tk./ ha)	Urea (Tk./ ha)	TSP (Tk./ha)	MP (Tk./ ha)			
Broccoli (Br)	Co	6000	-	-	-	-	-		6000
	C1	6000	12000	-	-	-	-		1800
	C2	6000	-	2000	2400	3200	-		13600
	C3	6000	12000	2000	2400	3200	2058		27658
	C4	6000	-	-	-	-		10262	16262
Cauliflower (Ca)	Co	3000	-	-	-	-	-		3000
	C1	3000	12000	664	-	-	-		15664
	C2	3000	-	2000	2400	3200	-		10600
	C3	3000	12000	2000	2400	3200	2058		24658
	C4	3000	-	-	-	-	10262		13262

Broccoli Seed…… @ Tk. 40,000/ kg.
Cowdung …….@ Tk. 600/ton.
Urea ……..@ Tk.8/kg
TSP ……. @ Tk.16/kg.

Cauliflower Seed ……@ Tk.20,000/ kg
MP …..……@ Tk.16/kg.
Vermicompost ……..@ Tk.50/kg
Agro-grow granular ……..@ Tk.50/kg

Appendix IV. Contd.

(B) Non-material cost (Tk./ ha)

Treatment combination		Land preparation (Tk./ha)	Fertilizer and manure application (Tk./ha)	Seed sowing and transplanting (Tk./ha)	Intercultural operation (Tk./ha)	Harvesting(Tk./ha)	Sub total 1 (B) (Tk./ha)	Total input cost 1 (A) + 1 (B) (Tk./ha)
Broccoli (Br)	Co	15000	-	7000	15000	2000	39000	45000
	C1	15000	1000	7000	15000	2000	40000	58664
	C2	15000	1500	7000	15000	2000	40500	54100
	C3	15000	1600	7000	15000	2000	40600	68258
	C4	15000	500	7000	15000	2000	39500	55762
Cauliflower (Ca)	Co	15000	-	7000	15000	2000	39000	42000
	C1	15000	1000	7000	15000	2000	40000	55664
	C2	15000	1500	7000	15000	2000	40500	51100
	C3	15000	1600	7000	15000	2000	40600	65258
	C4	15000	100	7000	15000	2000	39100	52362

Labour cost @ Tk. 100 / day.

C_0 = Control
C_1 = Organic
C_2 = Inorganic fertilizers
C_3 = Organic + inorganic fertilizers + Agro – grow- granular
C_4 = Vermicompost

Appendix IV. Contd.

(C) Overhead cost and total cost of production (Tk.)

Treatment combinations		Cost of lease of land	Miscellaneous cost (5% of input cost)	Interest on running capital for 6 months (13% of the total input cost)	Total	Total cost of production (input cost + interest on running capital, Tk/ha)
Broccoli (Br)	Co	16000	2250	5850	24100	69100
	C1	16000	2933	7626	26559	85223
	C2	16000	2705	7033	25738	79838
	C3	16000	3413	8874	28287	96545
	C4	16000	2788	7249	26037	81799
Cauliflower (Ca)	Co	16000	2100	5460	23560	65560
	C1	16000	2783	7236	26019	81683
	C2	16000	2555	6646	25201	76301
	C3	16000	3263	8484	27747	93005
	C4	16000	2618	6807	25425	77787

C_0 = Control
C_1 = Organic
C_2 = Inorganic fertilizers
C_3 = Organic + inorganic fertilizers + Agro – grow- granular
C_4 = Vermicompost