EEFECT OF DIFFERENT ORGANIC FERTILIZERS ON ECONOMIC YIELD OF CAULIFLOWER (Brassica oleraceae var. botrytis L.) at ILAM, NEPAL

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ABSTRACT

A study was conducted at Department of Horticulture and Floriculture Management, Fulgaachi, Ilam during Oct, 2013 to April, 2014 with the aim to determine appropriate organic manure for the optimal cauliflower yield. The effect of five organic manures, viz., bansoon (14.4 mt ha-1), poultry manure (14.4mt ha-1), mustard oil cake (8.0 mt ha-1), farmyard manure (18 t ha-1), and vermi-compost (11.4 mt ha-1) were evaluated on the performance of Kathmandu Local cultivar- laid out in Randomized Complete Block Design (RCBD) with four replications. The performance of vermi-compost was found promising as compared to other tested manures. Measured parameters i.e. plant height, stem diameter and leaf number, length were significantly highest at the vermi-compost as compared to other manures. The maximum biological yield of 54.06 mt ha–1 was recorded with vermi-compost and found to be minimum with farmyard manure, 28.73 mt ha–1. Both root length (37.46 cm) and root weight (169.13 g plant-1) found to be highest with vermi-compost and lowest root length (23.47 cm) and root weight (130.30 g plant-1) were recorded with farmyard manure. Similarly, the curd diameter was significantly highest (20.99 cm) with vermi-compost and lowest at bansoon (15.43 cm). The significant variation on curd yield was found to be highest with vermi-compost with highest curd yield (12.94 t ha-1) and the lowest curd yield (5.64 t ha-1) recorded on farm yard manure application. Curd initiation and curd maturity observed earlier i.e. 64 and 89 days after transplanting respectively with vermi-compost application, whereas the longest days to curd initiation (78 days) and curd maturity (103 days) was recorded with farmyard manure. In addition, BC ratio was found highest (4.31) with vermi-compost treatment whereas the lowest (1.8) found with farm yard manure treatment. A on-farm verification study is needed to recommend vermi-compost as an alternatives for organic cauliflower production for eastern mid hill of Nepal.

Key words: curd, leaf, maturity, root, stem, weight, yield.

INTRODUCTION

Cauliflower (Brassica oleracae var. botrytis L.), a crop from Brassicaceae family known to be originated in Mediterranean region (Bose and Som, 1993), is an important commercial vegetable crop in the world. It is usually a temperate biennial crop and requires low temperature for flower induction. The edible part of the cauliflower is a cluster of flower buds called curds.It contains diverse nutrients, vitamins and minerals comprised of vitamin A, vitamin B1, vitamin C, protein, fat, carbohydrates, potassium, phosphorus, sulphur, iron, copper, carotenoids and β-carotene. Moreover, it has also medicinal values and therapeutic effects as it contains high concentration of glucothiocyanate, which is effective in the inhibition of carcinogenesis.

In Nepal, cauliflower ranks the second most important vegetable crop with the total production of352,535 mt whereas the cabbage and radish rank first and third with the total production of 370,660mt and 222,152mt respectively (MoAD, 2014).

Cauliflower requires 200:120:80 kg NPK per hectare (Singh and Bhandari, 2015). Thus, the nutrient requirement of the cauliflower has been met with heavy use of chemical fertilizer in many commercial farms. This excessive and unbalanced use of chemical fertilizers has lead to health and ecological hazards, depletion of physio-chemical properties of the soil and ultimately gives poor yield. Furthermore, the occurrence of nutrient deficiency and overall decline in the soil fertility due to continuous use of chemical fertilizers has been widely reported in Nepal (Tripathi, 2002). Eventually, productivity of vegetables including cauliflower has come down to 12 tha-1 as compared to world productivity of 17.07 t ha-1 (Budathoki, 2006).

Environmental pollution and food safety issues due to chemical contamination become a great concern worldwide. Increasing use of agro-chemicals, higher production cost and deteriorating ecosystem health have advocated the need to change the external and chemical use in agriculture towards safe and sustainable organic production (Aryal, 2006). Under such situation, initiative toward organic vegetable production is obligatory to boost the vegetable sector. In the same manner, Nepal has been spending billions of rupees every year to import chemical fertilizers (Bhattarai et al., 2006) and the cost of chemical fertilizers will imply higher to small and marginal farmers(Joshi and Singh, 2004). .

Organic production is global concern since consumption of organic vegetables has high growth in the developed countries (Lampkin, 1990). However, growing awareness of organic production in terms of soil health, sustainable production and environmental hazards, and healthy food consumption is also quite appreciable in Nepal (Sharma, 2005). Apart from this, Nepal has tremendous opportunity of organic vegetable production for the increased farm income because of growing demand of organic vegetables to health-conscious elite consumers in the country and export to its neighbor international markets (Bhatta et al., 2008 and Bhandari, 2006).

In Nepal, the area under organic production system is far low as compared to other countries as the growth of organic sector is quite slow and facing tremendous challenges (Bhatta et al., 2008).On the other hand, Nepalese agriculture characterizes equally of low input for the soil nutrients, and poor investment for costly external inputs (K.C., 2006). Similarly, farmyard manure is commonly being used for organic vegetable production in Nepal. However, now days, different organic manures such as poultry manure, mustard oil cake, vermi-compost, bansoon and many others have been come into the practice. Poultry manure contains 1.9% N, 0.5% P and 1.1% K and farm yard manure contains 2.4% N, 1% P and 2% K (Tennakoon and Bandara, 2003). According to Reddy (2005), mustard oil cake contains 3.2% N, 1.8% P and 1.2% K. while vermi-compost contains 2% N, 1.25% P and 1.2% K (Sinha, 2003). In addition, bonsoon contains 2% N, 2% P and 1.5% K (Personal communication with the traders). Present practice of organic farming with existing organic resources is not enough to meet the effective organic production in term of yield and profit (Bajracharya, 2001).Therefore, Nepalese farmers are looking appropriate alternative to chemical fertilizers.

The scientific information regarding appropriate organic manures for cauliflower production in the specific soil condition and climate of Nepal is limited (Subedi and Regmi, 2006) even though the recent agriculture policy (2062) also realizes the importance of organic agriculture and put emphasis on it. Thus, this study was carried out to identify the response of organic manures on cauliflower production.

METHODOLOGY

The experiment was conducted at Department of Horticulture and Floriculture Management, Fulgaachi, Ilam during Oct, 2013 to April, 2014 with the financial support from Univeristy Grant Commission (UGC)/Tribhuvan University. Five common organic manures i.e. bansoon (14.4 mt ha-1), poultry manure (14.4mt ha-1), mustard oil cake (8.0mt ha-1), farmyard manure (18 t ha-1), and vermi-compost (11.4 mt ha-1) were selected based on the farmer's practices at Ilam district and were laid out in Randomized Complete Block Design (RCBD) with four replications. The crop was planted with the spacing of 60 cm x 60 cm on each plot having five rows with four plants per row on the area of 7.2 m2. Five organic manures were applied as basal dose on the randomly assigned plots. 30 days healthy seedlings were transplanted on the trial plots. Among the 20 total plants of each plot, 14 were taken as boarder plants whereas six inner plants were used for data recording. From the six inner plants stem diameter, stem length, leaf length and leaf width were recorded at 30 and 60 days after transplanting (DAT). Stem diameter is measured by the vernier calliper whereas the stem length, length and width of leaf, root length were measured using measuring tape. Similarly, digital weighing balance was used to measure root weight, biological

yield and curd yield. Root to shoot ratio was calculated by dividing the root weight by shoot weight of the cauliflower crop. Similarly, biological yield of crop was calculated by weighing the total biomass produced during curd harvesting stage.

Root to shoot ratio: Total root weight (gm)/Total shoot weight (gm)

BC ratio: Gross income/Total variable cost

The data obtained were entered into the MS Excel (2007), analyzed through MSTAT C program (Freed and Scott, 1986). Means were compared by using Duncan's Multiple Range Test (DMRT) at 0.05 level of significance (Gomez and Gomez, 1984).

RESULT AND DISCUSSION

Plant height

The response of organic manures on the stem heights at each growth period was found significantly different with the highest plant height 30 DAT(4.60cm) and 60 DAT(12.29 cm)with vermi-compost and lowest with farm yard manure i.e., 3 cm, and9.44 cm respectively at 30 and 60 DAT (table 1).

Vermi-compost might have improved the soil physical properties i.e. soil porosity, water holding capacity and supplied other plant growth promoting substances thus application of vermi-compost significantly increased plant height. Similar result was reported by Gorlitz (1987) and Jahan et al., (2014).The increase in plant height might be due to increased supply of nutrients, which may accelerate synthesis of chlorophyll, amino acids, enzymes and carbohydrate use. Dufault (1988), Wange and Kale (2004), Mohandas (1987), and Singh and Singh (1994) reported similar results of increment on plant height with the application of easily available organic manure on broccoli, brinjal, tomato and cauliflower respectively.

Stem diameter

The results revealed that the vermi-compost treatment gave the highest stem diameter at 30 DAT (2.06 cm) and 60 DAT (3.41cm) while farmyard manure gave the lowest at 30 DAT (1.4 cm) and 60 DAT (2.66 cm) (table 1). Increment in stem diameter might be due to metabolic changes in physiological process of plants as influenced by nutrients. The highest stem diameter with the vermi-compost is associated with the readily available nutrients that are absorbed instantly by the plants for its growth. The lowest stem diameter with other organic manures might be due to the less mineralization and availability of nutrients for plant growth (Kumar et al., 2007). Edwards et al., (2004) and Edwards (1988) also found the similar results of highest stem diameter with the application of vermi-compost.

Table 1. Effect of organic fertilizers on stem height during growing period of cauliflower

Treatment	Plant height (cm)		Stem diameter (cm)	
	30 DAT	60 DAT	30 DAT	60 DAT
Bansoon	3.39c	10.74b	1.91a	2.90bc
Mustard Oil Cake	3.45c	11.30ab	1.43bc	2.66b
Poultry Manure	4.35ab	11.68ab	1.73b	2.98b
Farmyard Manure	3d	9.44c	1.40c	2.54b
Vermi-compost	4.60a	12.29a	2.06a	3.41a
F test	*	**	*	**
LSD 0.05	0.6432	0.75	0.6418	0.22035
SEm±	0.2088	0.243	0.2083	0.0660
CV %	10.4	4.4	25.7	4.6

*, and ** denote significantly different respectively at P≤0.05 and P<.01. Means within column followed by the same letter are non-significantly different at 5 % level. DAT means days after planting.

Leaf length and width

Vermi-compost has significant effect on leaf length and leaf width of cauliflower at different growth stages (table 2). Similarly, the highest leaf length was observed with the vermi-compost during 30 DAT (38.45 cm) and 60 DAT (58.75 cm) whereas; farm yard manure gave the lowest leaf length during 30 DAT (27.60 cm) and 60 DAT (50.20 cm). In addition, the vermi-compost gave the highest leaf width during 30 DAT (20.85 cm) and 60 DAT (31.35 cm) and the lowest was found with farm yard manure during 30 DAT (15.30 cm) and 60 DAT (26.75 cm). The highest leaf length and leaf width was due to the more nutrient content and highest nutrient retention capacity of the vermi-compost as compared to other nutrients in strawberry and cauliflower crop (Arancon et al., 2004; Arancon et al., 2006; and Jahan et al., 2014).

Table 2. Effect of different organic manures on leaf length during growing period of cauliflower

Treatment	Leaf length (cm)		Leaf width (cm)	
	30 DAT	60 DAT	30 DAT	60 DAT
Bansoon	31.20b	51.50b	17.40bc	27.75bc
Mustard oil cake	35.10ab	54.95ab	19.10ab	29.15b
Poultry manure	32.84b	54.22ab	18.79b	28.64b
Farmyard manure	27.60c	50.20b	15.30c	26.75bc
Vermi-compost	38.45a	58.70a	20.85a	31.35a
F test	**	*	*	*
LSD 0.05	3.209	4.29	2.251	2.535
SEm±	1.067	1.393	0.731	0.823
CV %	6.5	5.2	8.0	5.7

*, and ** denote significantly different respectively at P≤0.05 and P<.01. Means within column followed by the same letter are non-significantly different at 5 % level. DAT means days after planting.

Root length, root weight, root to shoot ratio and biological yield

The response of organic manures had highly significant effect on root length, root weight, root to shoot ratio and biological yield of cauliflower (table 3). In addition, vermi-compost showed the highest root length (37.46 cm), root weight (169.3 gm plant-1), root to shoot ratio (0.149) and biological yield (54.06 t ha-1), whereas farm yard manure produced the lowest root length (23.47 cm), root weight (130.30gm plant-1), root to shoot ratio (0.0783) and biological yield (28.73t ha-1). The significant result of vermi-compost was because of its nutritive organic matter (easy and quick mineralization by the microorganisms) which enhanced the soil structure, created conducive conditions for good root development (Arisha et al., 2003; Togunand Akanbi, 2003). Moreover, the highest growth of aerial part and underground part ultimately provided the highest biological yield.

Table 3.Effects of different organic manures on root length, weight, root to shoot ratio and biological yield of cauliflower

Treatments	Root length (cm)	Root weight (g plant^{-1})	Root shoot ratio	Biological yield (t ha^{-1})
Bansoon	29.67cd	151.09c	0.105b	34.80c
Mustard Oil Cake	35.04b	156.47ab	0.097c	40.24b
Poultry Manure	31.65c	160.39b	0.128ab	43.62b
Farmyard Manure	23.47d	130.30d	0.078d	28.73d
Vermi-compost	37.46a	169.13a	0.149a	54.06a
F test	**	**	**	**
LSD 0.05	3.105	4.721	0.019	3.268
SEm±	1.008	1.532	.00627	1.061
CV %	6.5	2.0	11.2	5.3

*, and ** denote significantly different respectively at P≤0.05 and P<.01. Means within column followed by the same letter are non-significantly different at 5 % level. DAT means days after planting.

Days to curd initiation and maturity

The days to curd initiation and curd maturity were found to be earliest with vemi-compost and lastest with farm yard manure treatment (table 4). The curd initiation and maturity were found to be 64 and 89 days respectively with vermi-compost application, whereas, farmyard manure treatment took 78 days for curd initiation and 103 days for curd maturation. The early curd initiation and maturity was found with vermi-compost application as it contains balanced plant nutrient and hormones (Arancon et al., 2004; and Frankenberger and Arshad, 1995).

Curd diameter and yield

The highest curd diameter and yield of 20.99 cm and 12.94 t ha-1 respectively were found with vermi-compost treatment whereas the lowest curd diameter (15.43 cm) and yield (5.64 t ha-1 was found with farmyard manure (table 4). The effect of vermi-compost revealed better impact on both curd diameter and yield as compared to other manures. Gupta and Samnotra (2004) reported highest head diameter and yield in cabbage crop with the application of vermi-compost.

From this study, the leaf length, diameter was found to be maximum with the application of vermi-compost (Table 1). Thus, the curd diameter and yield was highest with the application of vermi-compost as the formation of good curd depends on the number of leaves, their size and ability to store carbohydrates. Leaf growth is a part of total dry matter accumulation and leaf itself is the part of the dry weight of the plant. Leaf provides a platform for photosynthesis. Photosynthesis and dry matter production of a plant are proportional to the amount of leaf area on the plant. Leaf weight and leaf area follows pattern similar to that of total dry weight during the first half of the growing season in strawberry crop with vermin-compost application (Arancon et al., 2004).

The promising results of vermi-compost, poultry manure and mustard oil cake reflected to the higher content of plant nutrients and readily available to the plants within shorter period of application. Similarly, vermi-compost, acomplete organic manure served on improving soil structure and microbial biomass (Dauda et al., 2008 and Jahan et al., 2014).These yield increases is associated with the improvement of soil organic content and nutrients. The earlier workers reported a positive effect of vermi-compost application on growth and yield of vegetables

(Edwards and Burrows, 1988; Atiyeh et al., 2000).

Table 4. Effect of different organic manures on the days to curd initiation and maturity, curd diameter and yield of cauliflower

Treatments	Days to curd initiation	Days to curd maturity	Curd diameter (cm)	Curd yield (t ha^{-1})
Bansoon	76ab	101ab	8.81ab	7.14c
Mustard Oil Cake	74b	99b	18.19b	9.43b
Poultry Manure	69c	93c	18.48ab	9.49b
Farmyard Manure	78a	103a	15.43c	5.64d
Vermi-compost	64d	89d	20.99a	12.94a
F test	**	**	*	**
LSD 0.05	3.259	2.974	2.604	1.501
SEm±	1.058	0.965	0.845	0.487
CV %	2.9	2	9.2	10.2%

*, and ** denote significantly different respectively at P≤0.05 and P<.01. Means within column followed by the same letter are non-significantly different at 5 % level. DAT means days after planting.

Net return and benefit cost ratio

Vermi-compost gave the highest net return (NRS. 397590) and benefit cost ratio (4.31) on cauliflower production whereas, farm yard manure lowest net return (NRs. 101978) and benefit cost ratio of 1.8 (table 5).

Table 5. Detail of cost-benefit analysis of cauliflower production with organic manures

Treatments	Curd Yield ($kg\ ha^{-1}$)	Price ($Rs\ kg^{-1}$)	Gross Income ($Rs\ ha^{-1}$)	Total variable cost ($Rs\ ha^{-1}$)	Net Return	BC ratio
Bansoon	7140	40	285600	136121	149479	2.09
Mustard oil cake	9430	40	377200	122787	254413	3.07
Poultry manure	9490	40	379600	94188	285412	4.03
Farmyard Manure	5640	40	225600	123622	101978	1.8
Vermi-compost	12940	40	517600	120010	397590	4.31

*, and ** denote significantly different respectively at P≤0.05 and P<.01. Means within column followed by the same letter are non-significantly different at 5 % level. DAT means days after planting.

CONCLUSION

It is concluded that vermi-compost has a significant effect on yield and yield components of cauliflower than other manures. Moreover, highest net return and benefit cost ratio of NRs. 397590 and 4.31 ha-1 respectively were found with vermi-compost treatment. An on-farm verification study is needed to recommend vermi-compost as an alternatives for organic cauliflower production for eastern mid hill of Nepal.

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