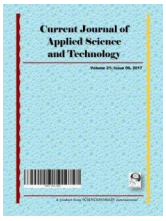

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Effect of Monocropping and Intercropping of Vegetable-Flower Components on Production, Economics and Land Use Efficiency under Sub-Tropical Zone of West Bengal, India

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Authors' contributions

This work was carried out in collaboration between all authors. Author SM designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors MMS and TG managed the analyses of the study and also helped in the writing of the protocol. Author TKM managed the literature searches and gave the research idea. All authors read and approved the final manuscript.

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ABSTRACT

Intercropping is a common practice which allows for better resource use efficiency, increases yield stability as compared to monocropping. The present research work was conducted at Horticultural Research Station, Mondouri, Faculty of Horticulture, Bidhan Chandra Krishi Viswavidyalaya, Nadia, West Bengal, India from July-December, 2017. The experiment was laid out in Randomised Block Design (RBD) with five treatments and four replications. The treatments were as follows: T_0 =cauliflower as monocrop, T_1=cauliflower intercropped with marigold, T_2= cauliflower intercropped

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with Balsam, T_3= marigold monocrop, T_4= balsam monocrop. When cauliflower intercropped with balsam (T_2), cauliflower size and quality, balsam flower number and overall yield attributes were significantly increased. Land resource was properly utilized. So, cauliflower intercropped with balsam is the best treatment. This technique will help the marginal farmers for more profit.

Keywords: Monocropping; intercropping; cauliflower; balsam; marigold; yield.

1. INTRODUCTION

Intercropping is a common practice throughout the world because it has better resource use efficiency as compared to monocropping, minimizes the risk of crop failure due to adverse effects of pests, reduces soil erosion, increases yield stability [1] and also cost effective [2,3]. Crops and cropping systems in the sub-tropical zones of West Bengal are diverse due to large agro-ecological and cultural diversity, which has led to variable cropping patterns.

Cultivation of several plant species side by side removes negative traits of a monoculture. This kind of cultivation is pro-ecological; it supports bio-diversity and is compliant with the rules of balanced agriculture [4,5].

With the growing population pressure and the need to produce diverse products from ever shrinking land holdings, farmers of West Bengal have been involved in intercropping of flowers with different types of vegetables like cauliflower, cabbage etc. Intercropping of a vegetable with flowers would be more valuable because of the advantage of increasing yield per unit area, more income, and more land-use-efficiency. Furthermore, two crops differing in height, canopy, adaptation and growth habits grow simultaneously with least competition [6]; better use of land resources; possibility of better control of weeds, pests and diseases [7,8]. The intercropped species that differ in sowing and harvesting times, and their maximum demands on environmental resources, extend the duration of resource use [9,10,11].

The aim of the present study was to assess the yield stability, land-use, and profitability during the months of September-October (beginning of the festival season) as a means of sustainable intensification of farming systems in the sub-tropical zones of West Bengal. The specific objectives were to compare the productivity of marigold/ balsam/ cauliflower intercropping with monocropping and to examine the competitive interactions of balsam, marigold and cauliflower as intercrops.

2. MATERIALS AND METHODS

The experiment was carried out at Horticultural Research Station, Mondouri, Faculty of Horticulture, Bidhan Chandra Krishi Viswavidyalaya, Nadia, West Bengal, India from July-December, 2017. The soil of the experimental site is sandy-loam in texture, acidic in reaction with soil pH 6.6. The experiment was laid out in Randomised Block Design (RBD) with five treatments and four replications. The treatments were as follows: T_0 =cauliflower as monocrop, T_1=cauliflower intercropped with marigold, T_2= cauliflower intercropped with Balsam, T_3= marigold monocrop, T_4= balsam monocrop. Size of the individual plot was 9 m^2. Cauliflower was planted at a spacing of 50 x 50 cm during mid-July. Balsam and marigold were planted with a spacing of 45x40 cm, during mid-August. In plots where cauliflower was intercropped with balsam and marigold planting were done with quincunx system. Recommended cultural practices were followed. Ten plants were selected randomly from each plot and tagged to record the observations. The data regarding various characters were statistically analysed according to the Fischer's analysis of variance techniques as given by Panse and Sukhatme [12].

3. RESULTS AND DISCUSSION

The represented data in Table 1 revealed that balsam as monocrop (T_4) and intercropped with cauliflower (T_2) showed a proper difference in flowering aspects. Balsam flower weight (Fig. 1), flower size (Fig. 2), number of flowers per plant (Fig. 3) were maximum (1.16 g/flower, 5.65 cm, 766.45 flowers per plant respectively) in T_2 as compared to T_4. The observation is in conformity with the result of Lithourgidis et al. [13]. The resultant effect may be caused by reduced competition between the crops due to the growing habit of balsam taking advantage of the peak resources. While in monocrop the plants undergo in a competition among them due to more density of planting in same area.

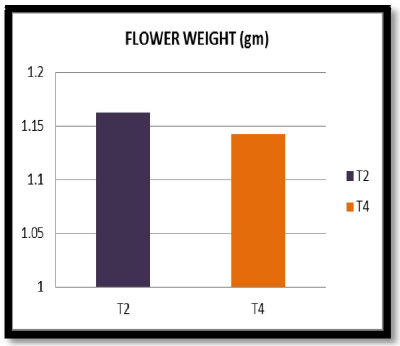

Fig. 1. Effect on flower weight of balsam as monocropping and intercropping with cauliflower

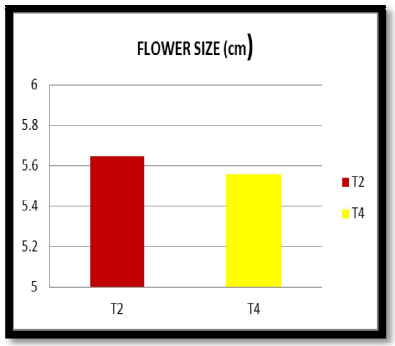

Fig. 2. Effect on flower size of balsam as monocropping and intercropping with cauliflower

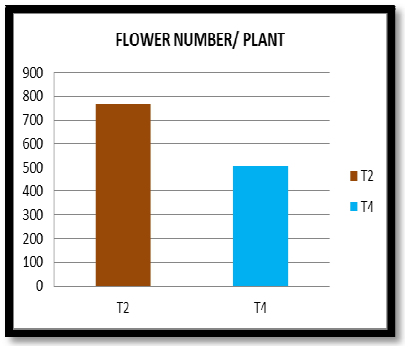

Fig. 3. Effect on flower number/ plant of balsam as monocropping and intercropping with cauliflower

Fig. 4. Effect on flower weight of balsam as monocropping and intercropping with cauliflower

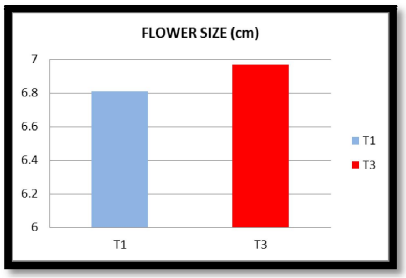

Fig. 5. Effect on flower size of balsam as monocropping and intercropping with cauliflower

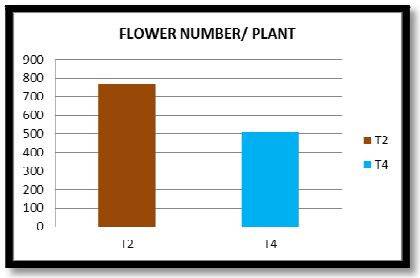

Fig. 6. Effect on flower number/ plant of balsam as monocropping and intercropping with cauliflower

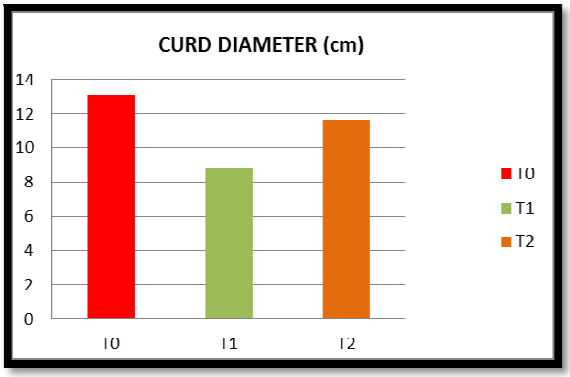

Fig. 7. Effect curd diameter of cauliflower as monocropping and intercropping with marigold and balsam

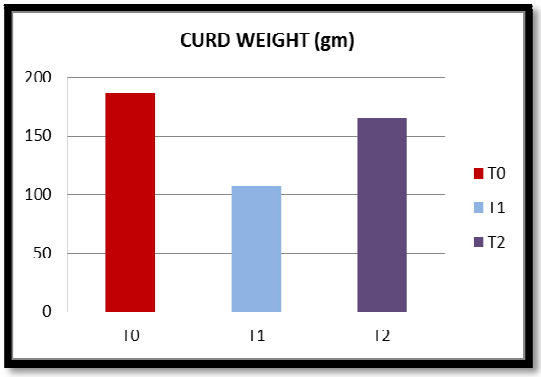

Fig. 8. Effect on curd weight of cauliflower as monocropping and intercropping with marigold and balsam

An inquisition of data in Table 2 revealed that the marigold monocropping (T_3) and intercropping with cauliflower (T_1) showed negligible differences regarding flowering aspects i.e. flower weight and flower size (Figs. 4 & 5) were maximum (10.95 g/flower, 6.97 cm respectively) in T_3 as compared to T_1. However, T_1 yielded maximum (63.28) number of flowers per plants (fig. 6) as compared to T_3 (46.28).

Maximum curd diameter (13.09 cm) and curd weight (186.65 g) were showed (Table 3 and Figs. 7, 8) in cauliflower monocropping (T_0) as compared to cauliflower intercropped with marigold and balsam. The readings revealed that cauliflower intercropped with balsam resulted satisfactory curd diameter (11.69 cm) and curd weight (165.0 g). Cauliflower intercropped with marigold (T_1) showed lowest curd diameter (8.83 cm) and weight (107.40 g). The result was in accordance with Yildirim and Guvenc [14] in cauliflower intercropped with lettuce, radish, onion and snap bean as intercrop. Smaller curd size and less curd weight in cauliflower intercropped with marigold may be due to bushy growth and heavy feeding root system of marigold, created a reduced environment for cauliflower.

Table 1. Effect on flowering parameters of balsam as monocropping and intercropping with cauliflower

Treatment	Flower weight (g/flower)	Flower size (cm)	Number of flowers /plant
T_2	1.16	5.65	766.45
T_4	1.14	5.56	506.50

Table 2. Effect on flowering parameters of marigold as monocropping and intercropping with cauliflower

Treatment	Flower weight (g/flower)	Flower size (cm)	Number of flowers /plant
T_1	10.93	6.81	63.28
T_3	10.95	6.97	46.28

Table 3. Effect on reproductive parameters of cauliflower as monocropping and intercropping with marigold or balsam

Treatment	Curd Diameter (cm)	Curd weight (g)
T_0	13.09	186.65
T_1	8.83	107.40
T_2	11.69	165.00

The represented data in Table 4 revealed that cauliflower intercropped with balsam (T_2) showed highest (1.66) land equivalent ratio (LER). The monocrops gave lowest LER i.e. 1. The results were in agreement with the findings of Verma et al. [15] in rose-scented geranium (*Pelargonium graveolens* L.) intercropped with vegetables (cauliflower, cabbage and vegetable pea) and Yildirim and Guvenc [14] in cauliflower intercropped with lettuce, radish, onion and snap bean as intercrop. The cauliflower intercropped with balsam (T_2) showed highest (₹ 828,393.80/ ha) value of yield per hector. The monocropping of cauliflower (T_1) exhibited the lowest value of yield (₹ 373,080.00/ ha) per hector.

Table 4. Effect of monocropping and intercropping of cauliflower with marigold or balsam on LER and total value of yield/ hector (₹)

Treatment	LER	Total value of Yield/ha (₹)
T_0	1	373,080.00
T_1	1.29	714,478.80
T_2	1.66	828,393.80
T_3	1	707,498.80
T_4	1	641,301.30
C.D. at 5%	0.16	31,931.65
SEm ±	0.05	10,249.51

The represented data in Table 5 revealed that among the different treatments maximum nitrogen (264.35 kg/ ha) and phosphorus content (21.04 kg/ ha) were presented in monocropping of cauliflower (T_0). The lowest nitrogen (215.53 kg/ ha) and phosphorus content (17.24 kg/ ha) were presented in monocropping of marigold (T_3). Maximum potassium content (190.47 kg/ ha) was found in cauliflower intercropped with marigold (T_0) and minimum (170.41 kg/ ha) in monocropping of marigold (T_3). From the above data it can be stated that monocropping of marigold absorbed more major nutrients than the other crops due to busy appearance and bigger size flowers.

Table 5. NPK analysis of soil

Treatment	N(kg/ha)	P(kg/ha)	K(kg/ha)
T_0	265.35	21.04	184.11
T_1	236.33	18.06	190.47
T_2	223.36	17.58	175.45
T_3	215.53	17.24	170.41
T_4	247.52	19.21	180.58
C.D. at 5%	7.98	2.386	5.71
SEm ±	2.56	0.766	1.83

The tabular representation (Table 6) and Fig. 9 showed that maximum leaf NPK percentage (5.09%, 1.09% and 1.95% respectively) found in monocropping of cauliflower (T_0) and minimum (4.73%, 0.79% and 1.38% respectively) when cauliflower intercropped with marigold (T_1). So it can be stated that in case of monocropping of cauliflower NPK intake was more, that's why yield was highest in these plots.

The tabular representation (Table 7) and fig. 10 showed that maximum leaf NPK percentage (4.75%, 0.90% and 2.82% respectively) found in marigold leaves of T_1. So it can be stated that in case of marigold leaves NPK intake was more in treatment T_1, that's why yield was higher in these plots.

Table 6. NPK analysis of Cauliflower leaf

Treatment	N(%)	P(%)	K(%)
T_0	5.09	1.09	1.95
T_1	4.73	0.79	1.38
T_2	5.01	0.85	1.79

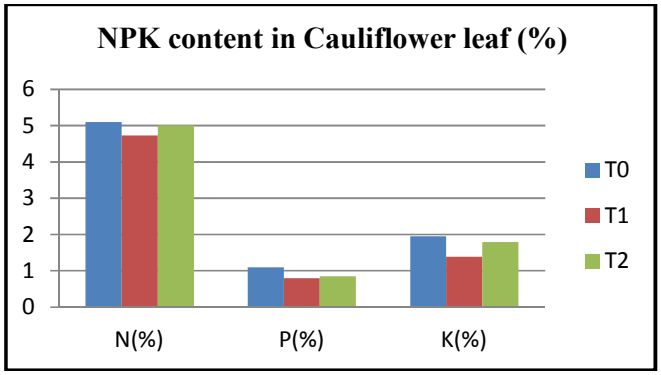

Fig. 9. NPK analysis of Cauliflower leaf

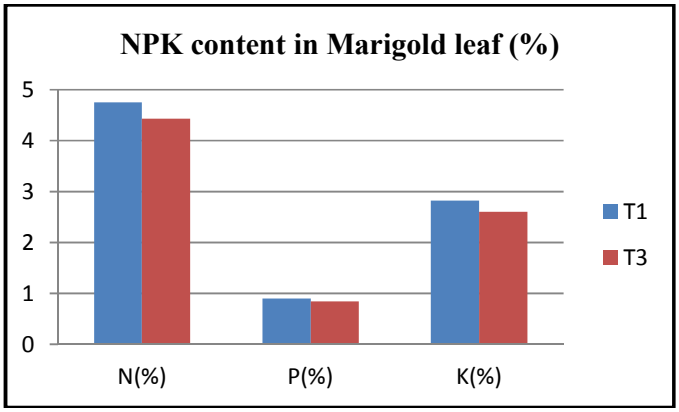

Fig. 10. NPK analysis of Marigold leaf

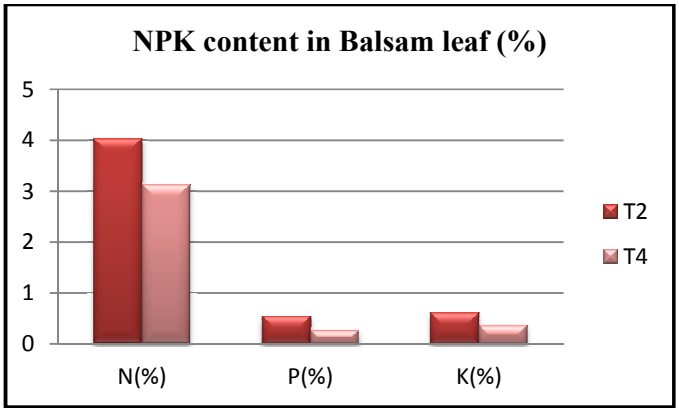

Fig. 11. NPK analysis of Balsam leaf

Table 7. NPK analysis of Marigold leaf

Treatment	N(%)	P(%)	K(%)
T_1	4.75	0.90	2.82
T_3	4.43	0.84	2.60

The tabular representation (Table 8) and Fig. 11 showed that maximum leaf NPK percentage (4.04%, 0.55% and 0.62% respectively) found in balsam leaves of T_2. So it can be stated that in case of balsam leaves NPK intake was more in treatment T_2, that's why yield was higher in these plots.

Table 8. NPK analysis of Balsam leaf

Treatment	N(%)	P(%)	K(%)
T_2	4.04	0.55	0.62
T_4	3.13	0.27	0.37

4. CONCLUSION

From the above study it can be concluded that when cauliflower intercropped with balsam (T_2), cauliflower size and quality, balsam flower number and overall yield attributes were significantly increased. So, cauliflower intercropped with balsam is the best treatment because balsam has high demand as loose flower during the months of September-October (beginning of the festival season). Besides, cauliflower as companion crop can add onto the income of the growers. Ultimately farmers' income will be increased.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Lithourgidis AS, Vasilakoglou IB, Dhima KV, Dordas CA, Yiakoulaki MD. Forage yield and quality of common vetch mixtures with oat and triticale in two seeding ratios. Field Crop Res. 2006;99:106-113.

2. Dapaah HK, Asafu-Agyei JN, Ennin SA, Yamoah CY. Yield stability of cassava, maize, soybean and cowpea intercrops. The J. Agri. Sci. Cambridge. 2003;140:73–82.
3. Chandra A, Sharmila P, Pardha Saradhi P, Rao KS, Saxena KG, Kandari LS, Payal KC, Maikhuri RK. Assessment of biological yield of some selected *Vigna sps*. with native rhizobial strain in traditional agro ecosystem of Central Himalaya. Proceeding of International Conference on Changing Environmental Trends and Sustainable Development, Hisar. 2009;217-221.
4. Suresha BA, Allolli TB, Patil MG, Desai BK, Syed AH. Yield and economics of chilli based intercropping system. Karnataka J. Agri. Sci. 2007;20(4):807–809.
5. Ouma G, Jeruto P. Sustainable horticultural crop production through intercropping: The case of fruits and vegetable crops: A review. Agri. Biol. J. North America. 2010;1(5):1098–1105.
6. Bhatti IH, Ahmad R, Jabbar A, Nazir MS, Mahmood T. Competitive behaviour of component crops in different sesame-legume intercropping systems. International J. Agri. Biol. 2006;8(2):165–167.
7. Jensen ES. Grain yield, symbiotic N_2 fixation and interspecific competition for inorganic N in pea-barley intercrops. Plant and Soil. 1996;182:25–38.
8. Chu GX, Shen QR, Cao JL. Nitrogen fixation and N transfer from peanut to rice cultivated in aerobic soil in intercropping system and its effect on soil N-fertility. Plant and Soil. 2004;263:17–27.
9. Li L, Sun JH, Zhang FS, Li XL, Yang SC, Rengel Z. Wheat/maize or wheat/soybean strip intercropping I. Yield advantage and interspecific interactions on nutrients. Field Crop Res. 2006;71:123-137.
10. Maikhuri RK, Semwal RL, Rao KS, Nautiyal S, Saxena KG. Eroding traditional crop diversity imperils the sustainability of agricultural systems in Central Himalaya. Current Sci. 1997;73:777–782.
11. Chandra A, Pardha Saradhi P, Rao KS, Saxena KG, Maikhuri RK. An investigation into the energy use in relation to yield of traditional crops in Central Himalayas, India. Biomass and Bioenergy. 2011;35: 2044-2052.
12. Panse VG, Sukhatme PV. Statistical methods for agricultural workers. Publication and Information Division, Indian Council of Agricultural Research, New Delhi; 1989.
13. Lithourgidis AS, Dordas CA, Damalas CA, Vlachostergios DN. Annual intercrops: An alternative pathway for sustainable agri-culture. Australian J. Crop Sci. 2011;5(4): 396-410.
14. Yildirim E, Guvenc I. Intercropping based on cauliflower: More productive, profitable and highly sustainable. European J. Agro. 2005;22(1):11-18.
15. Verma RK, Verma RS, Amit C, Anand S, Rahman L, Alok K. Biomass yield, essential oil yield and oil quality of rose-scented geranium (*Pelargonium graveolens* L.), intercropped with vegetables. Int. J. Agri. Res. 2011;6(12): 830-839.

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