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Growth and yield performance of bitter gourd (*Momordica charantia*) as intercrop in coconut (*Cocos nucifera*) garden

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Abstract
The field experiment was conducted in the *rabi* season of 2022-23 at Regional Coconut Research Station, Bhatye, Ratnagiri to assess the growth and yield performance of bitter gourd as intercrop has been tested in coconut plantation (Variety West Coast Tall). The vine length was significantly maximum (4.37 m) under coconut plantation (Intercrop) whereas under open condition the vine length was 3.89 m. The early emergence of female flower (At 21.27th node) and lesser days for 50 % flowering (43.80 days after sowing) was noticed under open field condition. Under open condition, the first harvest was at 58.07 days after sowing while under coconut plantation as intercrop, it was delayed by 4.93 days. The average number of fruits per vine and yield was significantly maximum (16.93 per vine and 1.21 kg vine^{-1}, respectively) under open condition which was 12.34 per cent higher than as intercrop where the yield was 15.07 fruits per vine. In open field condition, minimum yield (1.10 kg vine^{-1}) was in intercrop grown in coconut.

Keywords: Coconut, bitter gourd, intercrop, yield

Introduction
Coconut is an important plantation crop in the coastal regions of India. In Maharashtra, the crop is being cultivated particularly in Konkan region in an area of around 28000 ha, owing to suitability of climate and soil. In the traditional coconut growing areas, it is cultivated with a mixed or intercrop systems. The crop is mostly cultivated by small and marginal farmers which is providing livelihood to millions.

Coconut being widely spaced owing to its morphological features provides ample opportunities for cropping in the inter-spaces as it is planted at 7.5 m X 7.5 m spacing. Sahasranaman and Pillai (1976) [4] observed that only 23 per cent of the soil on area basis is effectively utilized by the coconut roots in a coconut plantation. It is estimated that as much as 56 per cent of the sunlight was transmitted through the canopy during peak hours (10-16 hours) in palms aged around 25 years. This diffused sunlight facilitates growing a number of shade tolerant crops in the interspaces. In coconut garden, so many region specific intercrops have been recommended like food crops, vegetables, fodder crops, spices, flower crops, etc. Among the vegetables, solanaceous crops, cucurbits can advantageously grown as intercrops in coconut. Nair *et al*. (2000) [1] reported that the growing of cucurbitaceous crop like cucumber, ridge gourd and snake gourd were the suitable intercrops in coconut gardens. Among cucurbitaceous group, bitter gourd is an important crop and has demand in market. Hence, its suitability in terms of growth and yield as intercrop has been tested.

Materials and Methods
The field experiment was conducted in the *rabi* season of 2022-23 in coconut plantation (Variety West Coast Tall) at Regional Coconut Research Station, Bhatye, Ratnagiri. The block of coconut having age of 30 years was selected comprising 35 palms. The bitter gourd was grown as intercrop in two rows at 2.5 m distance from palm and the distance between two successive hills was 1.0 m. and consequently 12 vines were grown in the space of four palms. The bitter gourd was also sown as sole crop in open space to compare the performance with intercrop. The recommended cultural practices were followed in both blocks. The observations on vine growth, flowering and fruiting in bitter gourd were recorded. Their performance was tested with the paired 't' test.

Results and Discussion

The data on comparative performance of bitter gourd in relation to vine length and flowering under open condition and as intercrop in coconut plantation are given in Table 1. From the data, it is inferred that the vine length was significantly maximum (4.37 m) under coconut plantation (Intercrop) whereas under open condition the vine length was 3.89 m. The growth of bitter gourd was higher in coconut plantation which might be due to shade condition. However, the flowering parameters were significantly highest under open condition than grown under the coconut as intercrop. The early emergence of female flower (At 21.27th node) and lesser days for 50 % flowering (43.80 days after sowing) was noticed under open field condition. As against delayed flowering behavior was observed under coconut plantation. The earliness in flowering under open condition might be ascertained with physiological maturity of vine for induction of flowering. Under open condition, adequate sunlight is available for better plant growth. Whereas the partial shade in coconut plantation is possibly reason for delayed flowering. Similarly, the first harvest was at 58.07 days after sowing under open condition while under coconut plantation as intercrop, it was delayed by 4.93 days. Shading has been reported to delay flowering in many vegetables (Ravikrishnan, 1989) [3]. The better growth performance under open condition was also reported in bitter gourd as intercropped in mango (Rahman *et al*., 2018) [2].

The data related to yield presented in Table 2 revealed that the average number of fruits per vine was significantly maximum (16.93 per vine) under open condition which was 12.34 per cent higher than as intercrop where the yield was 15.07 fruits per vine. Similarly, the highest yield (1.21 kg per vine) was also registered in open field condition while minimum (1.10 kg per vine) was in intercrop grown in coconut. The higher yield in the open condition is associated with the favorable climatic condition in terms of sunlight, space, etc. which are relatively insufficient in coconut garden. The more vegetative growth also cause for higher fruit yield. The small reduction in yield of intercrops had been recorded by many authors and has been confirmed by Singh *et al*. (2014) [5] which might be due to reduced solar insulation.

From the present study, it is revealed that the growing of bitter gourd as intercrop in coconut garden is a compatible crop in terms of growth and yield.

Table 1: Comparative performance of bitter gourd under open condition and under coconut plantation (Intercrop) in relation to growth and flowering

Parameter	Open condition			Under coconut plantation (Intercrop)			Paired 't' Test
	Mean	Standard deviation	C. V. (%)	Mean	Standard deviation	C. V. (%)	
Length of vine (m)	3.89	0.31	8.03	4.37	0.41	9.41	5.08*
Nodal position of first female flower	21.27	1.10	5.17	23.33	1.35	5.77	6.55*
Days to 50% flowering	43.80	1.70	3.88	47.07	2.46	5.23	4.49*
Days to first harvest	58.07	2.05	3.53	63.00	2.33	3.70	4.92*

(* Significant at 0.05%)

Table 2: Comparative yield performance of bitter gourd under open condition and under coconut plantation (Intercrop)

Parameter	Number of fruits vine^{-1}			Fruit yield (kg vine^{-1})			Yield acre^{-1} (Q) as intercrop
	Mean	Standard deviation	C. V. (%)	Mean	Standard deviation	C. V. (%)	
Open condition	16.93	2.05	12.12	1.21	0.10	8.68	-
Under coconut plantation (Intercrop)	15.07	2.81	18.68	1.10	0.16	14.46	7.12
Paired 't' Test	2.15*			2.48*			-

Conclusion

Considering the at par growth and yield performance, the bitter gourd is a suitable intercrop in coconut garden.

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