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Prospects of turmeric as intercrop in fruit and plantation crops: A comparative study

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Abstract
Turmeric (Curcuma longa) is used as dry spice, condiment, dye, drug and cosmetic in addition to its use in religious ceremonies. It belongs to the family Zingiberaceae. Commercial part is rhizome or underground stem. India leads highest producer and exporter of turmeric in the world and accounts for 78% of world's total production. Turmeric growing upto a height of about one meter, pairs of lance shaped leaves originated from alternate sides of the stem. Turmeric covered only in 6% of the total area under spices and condiments and it is also second largest foreign exchange earner among Indian spices. India consumes nearly 80% of turmeric. In India more than 80% farmers belongs to small and marginal group. Intercrop encourages better utilization of land, labour and capital to increase the production per unit time and space and also gives additional yield and income per unit area. it also insure crop failure against abnormal year. fruits and plantation crops, such perennial species invites growth of intercrops as they are growing through three to six years of juvenile period which accounts as lag phase in economy to farmer with additional benefits to main crop or than sole crop.

Keywords: turmeric; intercrop; additional yield

Introduction

In India around 70% of livelihood depends on agriculture, these circumstances also influenced by rapid expansion of irrigation infrastructure, since independence, despite in the large scale expansion, only about one third of total cropped area is irrigated today. Resultantly two third of cropped areas is still dependent upon monsoon, but monsoon in India is uncertain and unreliable. This has become even more untrustworthy due to cursed of climate change. This Global climate change squeezes the farmer's particularly poor and marginal farmers in developing countries resulting in agricultural stress. To cope with the situations farmers have many indigenous technologies, which are emerged over the years of observation and experience. Intercropping is one such technique of multiple cropping systems that protect the farmers from vagaries of weather/pest and diseases/ market fluctuation. When two or more crops grown along with main crop, under unforeseen situations, even one crop fails, some income or produce could be obtained from other crops in the inter cropping system. Under favourable conditions farmers will get additional income and other valuable products like fodder, green manure etc. Spices are important group of crops grown and used from time immemorial; Although 105 species are grown in the world, we cultivate around 50 species. The choice of crops for intercropping mainly depends on farmer's need. There is more cooperation in nature than competition. Cooperation is epitomized by mutually beneficial relationships that occur between species within genera. When two or more crops are growing together, each should occupy adequate space to contribute and maximize cooperation and reduce competition between them. This is exercised by the four following factors namely: spatial arrangement, plant density, maturity dates of the crops grown, plant architecture. Spices are highly amenable for intercropping owing to their ecological niche. Zingiberaceae crops like cardamom, ginger, turmeric and galangal are also ideal crops under tall growing trees that permits partial light. In this paper we have summarized the results of experiments on intercropping of turmeric in fruit and plantation crops conducted in different parts of India.

Table 1: Production share of turmeric

State	Production (000 tonnes)	Share (%)
Telangana	294.56	31.12
Maharashtra	190.09	20.08
Tamil Nadu	116.00	12.25
Gujarat	78.91	8.34
Orissa	54.50	5.76
West Bengal	45.50	4.81
Madhya paradesh	39.05	4.13
Mizoram	29.82	3.15
Haryana	22.00	2.32
Assam	19.17	2.03

Source: National Horticulture Board (NHB), 2017-18

Medicinal uses of turmeric

It is taken as the blood purifier and is very useful in the common cold, leprosy, intermittent, affections of the liver, dropsy, inflammation and wound healing. The rhizome of the turmeric plant is packed with aroma and antiseptic properties.

It is even advocated for production of contraception, swelling, insect stings, wounds, whooping cough, inflammation, internal injuries, pimples, injuries, as a skin tonic. Sweetened milk boiled with the turmeric is a effective remedy for cold and cough. It is given in liver ailments and jaundice.

Other uses

The powered rhizome of the sacred spice of India also known as "Indian Saffron", is used as an condiment and also as an yellow dye. It is used to impart colour and flavour to the foodstuff. It is used in the preparation of medicinal oils, ointments and poultice for industrial purpose. It is even used in the cosmetics.

Reasons for choosing turmeric as intercrop

Turmeric is a tropical perennial plant also called as "Golden Spice of life", one of the most essential spices used as multidisciplinary ingredient in culinary and other worldwide. Curcumin, the main ingredient of turmeric functions as medicine with anti-inflammatory, anti-mutagenic, anti-carcinogenic, anti-tumor, anti-bacterial, anti-oxidant, anti-fungal, anti-parasitic and detoxifying properties [1]. But crops like turmeric and ginger are planted in raised beds of convenient size and are recommended for the particular locality.

Turmeric as Inter Crop in Fruit Crops

Aonla based intercropping system

Inter cropping of horticulturul crops like turmeric, ginger were studied in 10 years old aonla orchard. The system was found to be remenurative as the B: C ratio among different agri- horticultural system varied from 3.40 (aonla + ginger) to 5.92 (aonla + turmeric) which were higher than that of pure stand**.**

Table 2: Economic analysis of aonla based turmeric intercropping system

Treatment	Yield of intercrop(q/ha)	Yield of aonla (kg/tree)	Net return/ ha	B:C
Aonla (alone)	-	53.6	1,33,348	9.29
Aonla+turmeric	227.1	61.6	4,36,766	5.92
Aonla+ginger	114.4	56.2	3,29,973	3.40

Table 3: Turmeric intercropping system with tree species

State	Station/Location	Experiment	Technology	Reference
Uttar Pradesh	-	Mango+wheat+turmeric+ peas+ radishes	Mango planted with turmeric recorded higher fruit volume and higher yields of turmeric (30 kg/ha)	[2]
Uttarakhand	Dehradun	Mango+ turmeric and colocasia	Mean maximum fruit yield (13.71 t/ha) from mango tree was obtained in turmeric block.	[3]
West Bengal	Bidhan Candra Krishi Viswavidyalaya Mohanpur	Tamarind+ ginger+ turmeric+ chilli+elephant foot yam	Tamarind intercropped with turmeric, the plant height of tamarind was best and weight of mother rhizome was highest.	[4]

Turmeric as Inter Crop in Plantation crops

Crops like Coconut and Areca nut have shallow root zones and it allows the root space for the intercrops. [5] Established that intercropping in Arecanut not adding any harmful effect to the main crop. In turmeric yield increased with narrower spacing [6].

Coconut based intercropping system

Coconut garden with a spacing of 7.5 x 7.5m, calculation suggest only 12.57 m^2/ palm (22.24%) and 50% of solar radiation is utilized by the sole crop. Root and tuber crop such as elephant foot yam, greater yam, cassava, spice crop like turmeric, ginger and medicinal and aromatic plants can profitably grown both at the young and old stages.

Table 4: Plantation crop based turmeric intercropping system

State	Station/Location	Experiment	Technology	Reference
Goa	ICAR complex, Goae management in May	Coconut+Ginger+ Turmeric+Pine apple	Turmeric variety Krishna/PCT-13 for intensive management with May-June planting	[7]
Karnataka	Gandhi Krishi Vigyana Kendra	12 lines tested under coconut garden	Acc. No. 10/8, Rajapuri and PCT 8 are best	[8]
Kerala	Agricultural Research Station, Mannuthy	14 lines tested under coconut garden	Amruthapani, Kothapeta, Chayapa-subha, Amalapuram, Kasthurithanka, Kodur type, Kuchupudi, Mannuthy local are best.	[9]
	Regional Agricultural Research Station, Pilicode	15 lines tested under coconut garden	VK-11, VK-77, VK-114, VK-116, PTS-10, Vontimitta are the best	[10]
	College of Agriculture, Vellayani	Turmeric under coconut	Application of 120:120 kg N:K_2O along with boron (2kg) and zinc (10kg/ha) for turmeric recorded maximum economic economic yield. P application as per soil status.	-
West Bengal	Bidhan Chandra Krishi Viswavidyalaya, Mohanpur	Turmeric cv. Suguna under arecanut cv. Mohitnagar	Combined application of biofertilizers and inorganic fertilizers (NPK 75%+ *Azospirillum* + AMF) recorded maximum yield	[11]

Besides these, turmeric found to conserve soil in agroforestry and an ideal component in agri-silvi-horti system experimented at Punjab and Uttaranchal respectively [12, 13].

It requires partial shade for the best performance. Under poor soil fertility conditions intercropping may not be profitable unless additional nutrition is added. Leguminous crop is advantageous that would enrich soil fertility.

Conclusion

From the above reviews it can be significantly concluded that turmeric can be grown as best intercrop under partial shade in fruit crops like mango and plantation crops like coconut and arecanut. It also aid to annual income of farmer. Intercrops are mostly beneficial to the perennial species as there juvenile period stretch to more than three years, resultantly intercrop's yield compensate the economics during these periods.

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