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Performance of planting material on growth and yield of turmeric under guava based Agri-horti system

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Abstract

For utilization of interspaces of guava orchards for turmeric production, the present investigation was conducted to find out the effect of different planting materials of turmeric cv. Erode Selection-1 on plant growth, yield and economics. Intercropping systems showed significant enhancement in the height of the tree varying from 1.25 to 3.40 over the sole tree. Better growth of the guava tree was observed with intercropping of mother rhizome followed by primary, secondary and tertiary fingers treatments. Mother rhizome gave maximum survival (98.45%), plant height (96.68 cm), number of tillers (4.03), and number of fingers per plant (13.64) with finger size (9.06 cm) and yield (389.47 g /plant) under shade of establishing guava orchard.

Keywords: Guava, Intercropping, Mother rhizome, Primary fingers, Secondary fingers, Tertiary finger, Turmeric

Introduction

Turmeric (*Curcurma longa* L.) is one of the important spice crops that can be grown successfully under shade of orchards (Singh, 2001). It is used as a spice, food preservative, pickles, colouring agent in cosmetic and medicine. Turmeric possesses a thick underground stem rhizome with short blunt fingers. The primary round shape tuber at the base of the aerial stem is ñmother rhizomeò which bears primary fingers, secondary finger and further gives rise to tertiary fingers, thus as a whole dense clump is formed (Rao *et al.,* 2007). Guava is a popular fruit tree. About 204 thousands hectare area under guava orchards are in Rajasthan with 2270 thousand metric tons production. In established orchards monoculture is practiced by the farmerôs due to shading effect on intercrop. Some shade loving plants like turmeric (*Curcurma longa* L.), ginger *(Zingiber officinalis)* and Colocassia (*Colocasia esculanta*) *etc.* can be grown successfully as an intercrop in orchards (Haque, 2004). Turmeric, being a sterile triploid, is vegetatively propagated by mother rhizome, primary fingers, secondary finger and tertiary fingers. The variable size of planting material significantly influenced the seedling vigour, early growth yield and seed requirement of turmeric (Singh *et al*., 2000; Dhatt *et al.,* 2008; Meenakshi *et al.,* 2001). Therefore, present investigation was planned to standardize the planting material for utilization of interspaces of guava orchard for turmeric (*cv* Erode Selection-1 production as seed of turmeric variety under the shade of guava orchards.

Materials and Method

The experiment was conducted at Krishi Vigyan Kendra, Anta, Baran, (Rajasthan), during 2009-10. The district Baran comes under zone V (Humid South Eastern Plain) of Rajasthan which covers a geographical area of about 2.7million hectare. The average rainfall varies from 650 ï 1000 mm. The maximum mean daily temperature ranges from 24.5°C in the month of January and 42.6° C in May and minimum 10°C in January & 19.7°C in month of May. The experimental sites soil was black alluvial origin with good drainage system and soil pH varied from 7.42-8.55 and EC 0.543-0.892 dSm^{-1}. Soils were low in nitrogen, medium in phosphorus and high in potassium content. The experiment consisted of four types of planting materials *i.e*. mother rhizome, primary finger, secondary finger and tertiary fingers of turmeric was laid out in randomized block design with three replications. All these were planted separately in open condition as well as under the periphery of 8 years guava variety L-49 on ridges spaced 45 cm apart with plant to plant distance of 20 cm in last week of June. Recommended cultural operations and plant protection measures were followed to raise a healthy crop (Anonymous, 1999). The observations were recorded for plant height (cm), number of tiller/plant, number of leaves per plant, leaf length (cm), leaf width

(cm), yield per plant(g), yield per hectare (q), length, girth, weight of mother rhizome, primary, secondary and tertiary fingers. Ten plants were selected randomly and morphological and yield contributing characters were recorded for statistical analysis. Economics was done for each treatment on hectare basis taking into account the market value of each crop (2010) to find out the maximum rate of return to investment. For this purpose, cost of ploughing, seed, fertilization, irrigation, human labour were considered in calculation. The wholesale prices of turmeric and guava fruit were 15 and 7 Rs per kg respectively in local market. The data was analyzed as per statistical procedure given by Panse and Sukhatme (1985).

Results and Discussion

Guava plant growth: Growth attributes like plant height, plant periphery and trunk thickness of guava trees increased significantly with tree age and their percentage increased over the year 2008 was 7.76, 5.18 and 3.23% respectively (Table 1). Irrespective of the year, all the intercropping systems showed significant enhancement in the height of the tree varying from 1.25 to 3.40 over the sole tree. Among the different intercrops, better growth of the guava tree was observed with mother rhizome grown as intercrop followed by primary, secondary and tertiary fingers treatments. Similar trend was also recorded with respect to plant periphery and trunk thickness. On the other hand, the increase in plant periphery due to intercropping did not show any significant difference. Better growth of guava plants in association with intercrops may be attributed to the improved aeration from frequent soil working and to the better response of inputs applied to the intercrops than in sole plantation, where the inter spaces were left uncultivated and did not receive any additional inputs like manures, fertilizers and irrigation *etc*. Maximum tree growth in association with mother rhizome treatment was due to coverage of orchards soil to better growth of turmeric plant than other treatments. As black cotton soils are having hard pan below soil surface and are low in nitrogen, even a minimal application of inputs and cultural operations helps in better growth and development of plants. Positive influence of intercrops on growth and vigour of trees has been also reported in guava and mango (*Mangifera indica* L.) in past studies in other places (Awasthi *et al*., 2009; Awasthi and Saroj, 2004).

Growth of turmeric: The results of the experiment indicated that vegetative and vegetative contributing characters of different planting materials significantly influenced the growth of plants (Table 2). Plant height, number of tillers per plants and number of leaves per plants, number of roots, length of roots and survival percentage were significantly influenced by different type of planting material of turmeric but leaf size were not found significant. Intercropping of different type of turmeric planting material under shade of guava orchards performed better than sole crop. Plant height and number of tillers per plants of different type of planting material were enhanced in intercrop and highest plant height and number of tiller per plant was recorded in mother rhizome of turmeric (96.68) and (4.03) under shade of guava plant. Plant height of ginger gradually increased in intercrop of guava than sole cropping due to partial shading. Similar increase of plant height of ginger in intercropping of mango was reported by Chaudhary *et al*., 1998. Number of leaves per plant was highest in mother rhizome of turmeric in intercrop (16.16) as well as in sole crop (14.34) in comparison of primary finger, secondary finger and tertiary fingers respectively of turmeric *cv*. Erode Selection-1**.** The highest number of roots (13.11) and length of root (10.45cm) was obtained in mother turmeric grown in guava intercrop. The leaves of tertiary fingers were smallest (29.24cm x 7.14cm) and its overall growth was found poor in sole as well as in intercropping system. Haque *et al.,* (2004) also reported that the vegetative growths of ginger, turmeric and *Colocasia esculanta* were performing well under the juvenile orchards of mango. The survival percentage of plants generated from mother rhizomes were maximum (98.45%) in intercropping of guava than sole crop (98.45%) and its growth and performance was better than other planting materials. Better growth of mother rhizome of turmeric was due to the presence of maximum food materials stored at initial stage.

Turmeric yield: The turmeric yield and yield contributing performance of different planting materials of turmeric clearly indicated that the yield of all the planting materials were performing better in shade of guava tree (Table 3). The yield of turmeric in open conditions was reduced in comparison of intercrop due to the less number of fingers per plant, weight of finger, finger size and poor growth and development. Turmeric leaves become white in open condition and is very sensitive to sun light. Similar to turmeric the ginger plants produced moderate plant height and higher yield under partial shade than open sunshine (Singh, 2001). The highest number of fingers per plant (13.64), finger length (9.06), finger weight (36.14) and yield (389.47g/plant and 235.41q/ha) were recorded when turmeric were grown under eight years old guava orchard, which was significantly higher than all other planting materials.

Table 1. Response of different turmeric planting materials on vegetative growth of guava *cv*. L-49

Treatment	Plant height (m)			Plant Periphery (m)			Trunk thickness (cm)		
	2009	2010	Mean	2009	2010	Mean	2009	2010	Mean
Guava (sole)	7.34	7.59	7.46	13.81	13.97	13.89	45.43	45.69	45.56
Guava + Mother rhizome	7.99	8.09	8.04	14.52	14.71	14.61	46.78	46.91	46.84
Guava + Primary finger	7.92	7.98	7.95	14.17	14.23	14.20	46.72	46.82	46.77
Guava + Secondary finger	7.84	7.91	7.87	13.94	13.99	13.96	46.61	46.73	46.67
Guava + Tertiary finger	7.76	7.81	7.78	13.87	13.91	13.89	46.59	46.58	46.58
Mean	7.77	7.87	7.82	14.06	14.16	14.11	46.43	46.55	46.49
CD (P = 0.05)	0.63	0.74	0.59	NS	0.94	0.93	1.01	1.06	1.03

Table 2. Effect of planting materials on growth characteristics of turmeric planted in sole and under shade of guava plant (pooled over year).

Planting material (Rhizome)	Plant height (cm)	No. of tillers / plant	No. of leaves / plant	Leaves size (cm)		Root parameter		Survival (%)
				length	width	No. of roots / plant	Length (cm)	
Mother (sole)	91.54	3.72	14.34	42.42	10.43	11.43	9.31	98.45
Primary (sole)	87.18	3.01	14.31	41.78	10.43	9.87	8.93	94.78
Secondary (sole)	68.12	2.14	13.11	37.33	9.23	7.98	4.21	94.11
Tertiary (sole)	42.73	2.01	8.70	29.24	7.14	4.21	2.40	89.12
Mother + JGT	96.68	4.03	16.16	51.36	12.11	13.11	10.45	98.45
Primary + JGT	92.78	3.68	16.63	51.35	12.10	10.24	9.45	95.47
Secondary + JGT	72.62	2.72	14.32	44.57	9.96	7.89	5.81	95.56
Tertiary + JGT	45.84	2.17	9.74	31.43	8.18	5.76	2.68	91.10
CD (P = 0.05)	7.84	2.14	7.01	NS	NS	8.25	7.98	6.74

Table 3. Effect of planting materials on yield and yield attributes of turmeric planted in sole and under shade of guava plant (pooled over year).

Planting material (Rhizome)	No. of fingers / plant	Length of finger (cm)	Weight of fingers (g)	Yield / plant (g)	Yield / ha (Q)
Mother (sole)	12.45	8.96	34.56	384.12	234.13
Primary (sole)	10.13	8.41	32.15	319.13	232.17
Secondary (sole)	8.14	7.83	28.34	289.73	228.78
Tertiary (sole)	4.79	4.21	21.04	192.24	221.22
Mother + JGT	13.64	9.06	36.14	389.47	235.41
Primary + JGT	11.25	8.82	33.24	326.35	232.89
Secondary + JGT	9.16	8.13	29.13	296.93	229.16
Tertiary + JGT	5.14	4.57	22.41	197.14	221.94
CD (P = 0.05)	6.25	5.62	7.34	9.47	3.96

Table 4. Economic performances of sole and intercrop of different planting material of turmeric in sole and under shade of guava orchards

Planting material (Rhizome)	Yield (q/ha)		Mean yield (q /ha)	guava (q/ha)	Total Income (Rs)	TVC* (Rs)	Net Income (Rs)	BCR**
	2009	2010						
Mother (sole)	232.58	235.68	234.13	-	289000	60000	229000	4.81
Primary (sole)	231.33	233.01	232.17	-	286000	60000	226000	4.76
Secondary (sole)	227.47	230.09	228.78	-	280000	60000	220000	4.66
Tertiary (sole)	221.01	221.43	221.22	-	268000	60000	208000	4.46
Mother +JGT	233.81	237.41	235.41	89.78	358500	60000	298500	5.97
Primary +JGT	231.94	233.84	232.89	89.58	292000	60000	232000	4.86
Secondary +JGT	228.47	229.85	229.16	89.78	286500	60000	226500	4.77
Tertiary +JGT	221.41	222.47	221.94	89.80	274000	60000	214000	4.56

*Total variable cost (include cost of ploughing, seed, fertilizer, irrigation and labour cost) ** Benefit Cost Ratio

System economics: Cultivation of turmeric in eight year old guava orchards was more beneficial than other crops (Table 4). Yield of turmeric was reduced in second year in the guava orchard in all the planting material treatment due to the emergence of maximum shoots and branches of guava orchards. The highest cost benefit ratio (5.97) was obtained from mother turmeric rhizome crop grown under guava plant followed by primary finger (4.86), secondary finger (4.77) and tertiary finger (4.56) respectively. Total variable cost of all the planting material was similar to each other due to the application of same intercultural operations. The wholesale prices of turmeric and guava fruit were 15 and 7 Rs per kg respectively in local market.

The present study concluded that planting materials exhibited significant differences on plant growth, rhizome size, yield and net return of turmeric. Mother rhizome and primary fingers are significantly better planting material than secondary and tertiary fingers in terms of plant growth, yield and rhizome size. Therefore, mother rhizome or primary fingers can be used as planting material for raising turmeric crop. Since, primary fingers possesses better storage, more tolerance to wet soil and lower seed requirement (Rao *et al.,* 2007) therefore, use of primary fingers as seed material will be immense benefit to the growers without reduction in yield. The result showed that all the turmeric planting materials grown under shade of juvenile guava orchards were found most desirable in terms of vegetative growth, yield, gross return, net return and benefit cost ratio than sole crop. This gave a positive indication of the prospects of using the space under the juvenile guava tree as commercial proposition. So, our farmers should be motivated to grow turmeric intercropped with guava at juvenile age level in *Haroti* region of Rajasthan.

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