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STUDY ON GROWTH, YIELD AND QUALITY PARAMETERS OF DIFFERENT VEGETABLES UNDER FENUGREEK BASED INTERCROPPING SYSTEM WITH SOLE CROPPING SYSTEM

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ABSTRACT

A field experiment entitled "Study on intercropping of fenugreek (*Trigonella foenumgraecum* L.) with different short duration vegetables" was conducted at the vegetable farm, Department of Vegetable Science, College of Horticulture and Forestry, Jhalrapatan City, Jhalawar during rabi season 2019-20. The experiment comprised of four sole crops (fenugreek, carrot, cabbage and radish) and fenugreek intercropped with carrot, cabbage and radish with three ratios 1:1, 1:2 and 2:2 with a total of thirteen treatments each replicated thrice and laid out in randomized block design. The result shows that the sole crops viz., carrot, cabbage and radish had significant effect on growth, yield and quality over different intercropping system with fenugreek. The maximum plant height (35.78 cm, 25.67 cm and 30.57 cm), number of leaves (9.33, 10.07 and 16.47) and chlorophyll content in leaves (1.40, 1.54 and 0.68 mg/100 g) were recorded in sole crops viz., carrot (T₂), cabbage (T₃) and radish (T₄) respectively over different intercropping system. However, treatment T₅ (fenugreek + carrot 1:1), T₈ (fenugreek + cabbage 1:1) and T₁₁ (fenugreek + radish 1:1) were found at par with treatment T₂, T₃ and T₄. Further the maximum root length (26.40 cm), root diameter (3.20 cm), core diameter (1.15 cm), root weight per plant (67.12 g), root weight per plot (8.05 kg), estimated yield (223.61 q/ha) and percent crude protein content (4.90), TSS (8.10 °Brix), ascorbic acid content (14.92 mg/100 g) of carrot, head diameter (14.71 cm), head weight per plant (340.48 g), head weight per plot (13.62 kg), estimated yield (378.33 q/ha) and per cent crude protein content (17.16), TSS (7.77 °Brix) ascorbic acid content (15.33 mg/100 g) of cabbage and root length (29.50 cm), root diameter (2.89 cm), root weight per plant (140 g), root weight per plot (16.80 kg), estimated yield (466.66 q/ha) and per cent crude protein content (4.91), TSS (6.80 °Brix) and ascorbic acid content (13.80 mg/100 g) were found in treatment T₂ (carrot sole), T₃ (cabbage sole) and T₄ (radish sole) respectively. Further the treatment T₅ (fenugreek + carrot 1:1), T₈ (fenugreek + cabbage 1:1) and T₁₁ (fenugreek + radish 1:1) with respect to root length, root diameter of carrot and radish, core diameter of carrot and head diameter of cabbage was found at par with treatment T₂, T₃ and T₄.

Keywords : Equivalent yield, intercropping

Introduction

Intercropping is a ways to enhance diversity in an agricultural ecosystem. Intercropping as an example of sustainable agricultural systems following objectives such as: ecological balance, more utilization of resources, increasing the quantity and quality and reduce yield damage to pests, diseases and weeds. Success of intercrops in comparison with a pure cropping can be determined by a series of agronomic operations that interactions between the species will be affected by them. These operations are including ultimate density, planting date, resources availability and intercropping models (Mazaheri et al., 2006; Gliessman, 1997; Hatfield and Karlen, 1993). Owing to the importance of intercropping of vegetables and doubling the farmers income as it is an urgent need for today's demand and fenugreek being the major crop of Rajasthan, a study on fenugreek based intercropping with vegetables is necessary to be taken up. Intercropping with legumes makes effective use of land and other resources and results in reduced cost of production. Increased agricultural production through

intercropping with minimal cost is need of time to feed increasing population.

Vegetables are an important food crops playing a greater role in food trade in India. Cabbage (*Brassica oleracea* L. var. capitata F.) is an important cole crop, belonging to family cruciferae, is rich in phyto nutrients and antioxidants. An attempt was made to incorporate some short duration winter vegetables of different rooting depth with fenugreek for additional return with more cropping intensity. Due to different growth habit and rooting depth the intercrops viz., carrot, cabbage and radish did not compete for vertical and horizontal resources with the main crop i.e. Fenugreek. Radish (*Raphanus sativus* L.) is one of the most popular root crop of Rabi season and is widely acclaimed for its excellent nutritive and medicinal values. It belongs to family Cruciferae. It is popular in both tropical and temperate countries. Radish is grown throughout the country and throughout the year. It is easily grown as a companion crop or intercrop between the rows of other vegetable. Therefore, the present study entitled "Study on intercropping of

fenugreek (*Trigonella foenum graecum* L.) with different short duration vegetable crops" was carried out with an object to compare the growth, yield and quality of intercrops viz., carrot, cabbage and radish under intercropping system with sole cropping system.

Materials and Methods

The field experiment on growth, yield and quality of fenugreek as influenced by different intercropping ratios was conducted at the vegetable farm, Department of Vegetable Science, College of Horticulture and Forestry, Jhalrapatan City, Jhalawar during rabi season 2019-20. The experiment comprising of thirteen treatments viz., sole fenugreek, sole carrot, sole cabbage, sole radish, fenugreek + carrot (1:1), fenugreek + carrot (1:2), fenugreek + carrot (2:2), fenugreek + cabbage(1:1), fenugreek + cabbage (1:2), fenugreek + cabbage (2:2), fenugreek + radish (1:1), fenugreek + radish (1:2) and fenugreek + radish (2:2) was laid in randomized block design with three replications. Ajmer Fenugreek-3 was sown using 25 kg seeds at row to row spacing of 30 cm. The carrot (Pusa Yamdagini), cabbage (Pusa Mukta) and radish (Japanese White) were sown at row spacing of 30 cm. A uniform recommended doses of 30 Kg N and 20 kg P₂O₅ ha⁻¹ and 20 kg K₂O for sole fenugreek, 90 kg N, 50 kg P₂O₅ and 40 kg K₂O for sole carrot, 100 kg N, 125 kg P₂O₅ and 25 kg K₂O for sole cabbage and 50 kg N, 100 kg P₂O₅ and 50 kg K₂O for sole radish was applied. In intercropping 100 % and 50 % of recommended RDF of intercrops were applied along with RDF of base crop. 1/3 N and full dose of P and K was applied as basal dose at the time of sowing and remaining 2/3 N was applied in two equal split at 30 and 60 DAS. The standard agronomic practices were followed for raising healthy crop of fenugreek as well as carrot, cabbage and radish. Irrigation was applied as per requirement of fenugreek, which met the demand of intercrops also. The observation on growth, yield and quality parameters was recorded. Harvesting of carrot, cabbage and radish was done in stages keeping in view the maturity of crop.

Results and Discussion

Growth parameters of different vegetables

The results of present investigation showed that intercropping of fenugreek with different intercrops viz. carrot, cabbage and radish significantly affected the sole intercrops over different intercropping system with fenugreek. The maximum plant height (35.77 cm), number of leaves (9.33) and chlorophyll content in leaves (1.40 mg/100 g) of carrot were found in treatment T₂ (carrot sole) and minimum plant height (29.71 cm), number of leaves (8.47) and chlorophyll content in leaves (0.73 mg/100 g) were found in treatment T₆ (fenugreek +carrot 1:2). However, treatment T₅ (fenugreek +carrot 1:1) was found at par with T₂. The maximum plant height (25.67 cm), number of leaves (10.07) and chlorophyll content in leaves (1.54 mg/100 g) of cabbage were found in treatment T₃(cabbage sole) and minimum plant height (18.25 cm), number of leaves (8.13) and chlorophyll content in leaves (1.38 mg/100 g) were found in treatment T₉ (fenugreek +cabbage 1:2). However, treatment T₈ (fenugreek + cabbage 1:1) was found at par with T₃. The maximum plant height (30.57 cm), number of leaves (16.47) and chlorophyll content in leaves (0.68 mg/100 g) of radish were found in treatment T₄ (radish sole) and minimum plant height (26.01 cm), number of leaves (14.07) and chlorophyll content in leaves (0.57 mg/100 g) were found in

treatment T₁₂ (fenugreek + radish 1:2). However, treatment T₁₁ (fenugreek + radish 1:1) was found at par with T₄. These results are conformity with the research of Singh and Singh (2014) under gladiolus with different vegetables intercropping system, Choudhary *et al.* (2016) in cabbage intercropping system, Mehta *et al.* (2015) in fennel based intercropping system and Kumar *et al.* (2018) in coriander intercropping system. The higher plant height, number of leaves and chlorophyll content in leaves of different vegetable crops in respective sole crops and 1:1 ratio was due to less competition for sunlight, space, nutrients and water as compare to other ratio (Mehta *et al.*, 2010).

Yield and yield attributes of different vegetables

The result of present study showed that the sole cropping of different vegetables viz. carrot, cabbage and radish had significant effect on yield and yield attributes like root length (cm), root diameter (cm), root weight per plant (g), root weight per plot (kg) and estimated yield (q/ha) of carrot and radish, core diameter (cm) of carrot, head diameter (cm), head weight per plant, head weight per plot and estimated yield of cabbage with fenugreek based intercropping system. The sole crop of carrot had maximum yield attributes i.e. root length (26.40 cm), root diameter (3.20 cm), core diameter (1.15 cm), root weight per plant (67.12 g), root weight per plot (8.05 kg) and estimated yield (223.61 q/ha) and minimum yield attributes i.e. root length (19.49 cm), root diameter (2.40 cm), core diameter (0.85 cm) and root weight per plant (62.16 g) were found in treatment T₆. While, lower yield of carrot i.e., root weight per plot (3.10 kg) and estimated yield (86.11 q/ha) of carrot were found in treatment T₇. However, 1:1 intercropping ratio was found at par with sole crop of carrot. The sole crop of cabbage had maximum head diameter (14.71 cm), head weight per plant (340.48 g), head weight per plot (13.62 kg) and estimated yield (378.33 q/ha) of cabbage and minimum head diameter (12.98 cm) and head weight per plant (330.87 g) was found in treatment T₉, while minimum head weight per plot (5.36 kg) and estimated yield (148.88 q/ha) of cabbage were found in treatment T₁₀. However, 1:1 intercropping ratio was found at par with sole cabbage. The sole radish had maximum root length i.e. (29.50 cm), root diameter (2.89 cm), root weight per plant (140 g), root weight per plot (16.80 kg) and estimated yield (466.66 q/ha) of radish and minimum root length (22.64 cm), root diameter (2.52 cm) and root weight per plant (135.39 g) of radish were found in treatment T₁₂, while minimum root weight per plot (6.60 kg) and estimated yield (183.33 q/ha) of radish were found in treatment T₁₃. However, 1:1 intercropping ratio was found at par with sole radish i.e. treatment T₄. These results are in conformity with the research of Hussain *et al.* (2008) in intercropping of tomato with summer vegetables, Mehta *et al.* (2010) in coriander intercropping system, Kumar *et al.* (2018) in coriander intercropping and Parsoya *et al.* (2019) in ajwain intercropping system. The higher yield attributes of intercrops in sole cropping was on account of less competition for space, sunlight, water and nutrient with other crops resulting better availability of nutrients, water and space to facilitate growth and development of these crops independently. The higher yield in sole and 1:2 intercropping ratio was on account of higher plant population due to accommodation of more number of rows in between interspaces as compare to 1:1 and 2:2 ratio in intercrops (Mehta *et al.*, 2015).

Quality parameters of different vegetables

The result of present study showed that the sole cropping of different vegetables viz. carrot, cabbage and radish had significant effect on quality parameters like per cent crude protein content, TSS ($^{\circ}$ Brix) content and ascorbic acid content (mg/100 g) of different vegetables. The sole crop (T_2) of carrot had maximum value for quality attributes i.e. per cent crude protein content (4.90), and TSS (8.10 $^{\circ}$ Brix), ascorbic acid content (14.92 mg/100 g) and carotene content (7.20 mg/100 g) and minimum per cent crude protein content (3.89), TSS (6.77 $^{\circ}$ Brix), ascorbic acid content (13.40 mg/100 g) and carotene content (6.17 mg/100 g) were found in treatment T_6 (fenugreek + carrot 1:2). However, treatment T_5 (fenugreek + carrot 1:1) was found at par with treatment T_2 . The sole crop of cabbage had maximum i.e. per cent crude protein content (17.16), and TSS (7.77 $^{\circ}$ Brix) and ascorbic acid content (15.33 mg/100 g) and minimum per cent crude protein content (14.39), TSS (6.57 $^{\circ}$ Brix) and

ascorbic acid content (14.40 mg/100 g) were found in treatment T_9 (fenugreek + cabbage 1:2). However, treatment T_8 (fenugreek + cabbage 1:1) was found at par with T_3 . The sole crop of radish had maximum i.e. per cent crude protein content (4.91), and TSS (6.80 $^{\circ}$ Brix) and ascorbic acid content (13.80 mg/100 g) and minimum per cent crude protein content (4.01), TSS (5.43 $^{\circ}$ Brix) and ascorbic acid content (12.60 mg/100 g) were found in treatment T_{12} (fenugreek + radish 1:2). However, treatment T_{11} (fenugreek + radish 1:1) was found at par with T_4 . These results are in conformity with the results of Choudhuri and Jana (2015) in intercropping of potato. The increase in quality parameters with sole cropping of carrot, cabbage and radish may be attributed to increased availability of nutrients in the soil that might lead to synthesis and accumulation of more photosynthates which could have mobilized the biosynthesis (Choudhuri, 2016).

Table 1 : Effect of intercropping system on growth parameters of different intercrops.

Treatment notation	Treatments	Plant height (cm)	Number of leaves	Total Chlorophyll content (mg/100 g)
T_1	Fenugreek	-	-	-
T_2	Carrot	35.78	9.33	1.40
T_3	Cabbage	25.67	10.07	1.54
T_4	Radish	30.57	16.47	0.68
T_5	Fenugreek + Carrot (1:1)	34.94	8.93	1.36
T_6	Fenugreek + Carrot (1:2)	29.71	8.47	1.20
T_7	Fenugreek + Carrot (2:2)	33.65	8.63	1.33
T_8	Fenugreek + Cabbage (1:1)	24.14	9.60	1.50
T_9	Fenugreek + Cabbage (1:2)	18.25	8.13	1.38
T_{10}	Fenugreek + Cabbage (2:2)	22.71	8.87	1.46
T_{11}	Fenugreek + Radish (1:1)	28.63	15.93	0.65
T_{12}	Fenugreek + Radish (1:2)	26.01	14.07	0.57
T_{13}	Fenugreek + Radish (2:2)	27.27	15.47	0.64
S.Em \pm	-	0.60	0.57	-
CD 5%	-	1.78	1.68	-

Table 2 : Effect of intercropping system on yield parameters of different intercrops

Treatment notation	Treatments	Root length (cm)	Root diameter (cm)	Core diameter (cm)	Root weight/plant (g)	Root weight/pot (kg)	Head diameter (cm)	Head weight/plant (g)	Head weight/plot (kg)	Estimated yield (q/ha)
T_1	Fenugreek	-	-	-	-	-	-	-	-	-
T_2	Carrot	28.03	3.02	1.15	68.00	8.16	-	-	-	223.61
T_3	Cabbage	-	-	-	-	-	14.71	340.48	13.62	378.33
T_4	Radish	29.50	2.89	-	144.00	16.80	-	-	-	466.66
T_5	Fenugreek + Carrot (1:1)	26.40	2.88	1.11	42.00	2.52	-	-	-	19.44
T_6	Fenugreek + Carrot (1:2)	19.49	2.40	0.85	48.00	3.45	-	-	-	124.17
T_7	Fenugreek + Carrot (2:2)	24.83	2.74	0.98	33.70	1.65	-	-	-	86.11
T_8	Fenugreek + Cabbage (1:1)	-	-	-	-	-	14.55	335.55	6.71	186.33
T_9	Fenugreek + Cabbage (1:2)	-	-	-	-	-	12.98	330.87	7.94	220.55
T_{10}	Fenugreek + Cabbage (2:2)	-	-	-	-	-	13.72	334.76	5.36	148.88
T_{11}	Fenugreek + Radish (1:1)	27.82	2.74	-	70.60	8.30	-	-	-	230.55
T_{12}	Fenugreek + Radish (1:2)	22.64	2.52	-	83.00	9.75	-	-	-	270.82
T_{13}	Fenugreek + Radish (2:2)	26.61	2.58	-	55.67	6.60	-	-	-	183.33
S.Em \pm	-	0.38	0.64	0.03	9.13	0.43	0.17	2.48	0.25	0.49
CD 5%	-	1.12	1.88	0.10	26.81	1.27	0.51	7.28	0.74	1.45

Table 3 : Effect of intercropping system on quality parameters of different intercrops

Treatment notation	Treatments	Per cent crude protein content	TSS (°Brix)	Ascorbic acid content (mg/100 g)	Carotene content (mg/100 g)
T ₁	Fenugreek	-	-	-	-
T ₂	Carrot	4.90	8.10	14.92	7.20
T ₃	Cabbage	17.16	7.77	15.33	-
T ₄	Radish	4.91	6.80	13.80	-
T ₅	Fenugreek + Carrot (1:1)	4.63	7.71	14.49	7.09
T ₆	Fenugreek + Carrot (1:2)	3.89	6.77	13.40	6.17
T ₇	Fenugreek + Carrot (2:2)	4.25	7.56	14.32	6.96
T ₈	Fenugreek + Cabbage (1:1)	16.49	7.63	14.98	-
T ₉	Fenugreek + Cabbage (1:2)	14.39	6.57	14.40	-
T ₁₀	Fenugreek + Cabbage (2:2)	15.65	7.30	14.55	-
T ₁₁	Fenugreek + Radish (1:1)	4.70	6.40	13.41	-
T ₁₂	Fenugreek + Radish (1:2)	4.01	5.43	12.60	-
T ₁₃	Fenugreek + Radish (2:2)	4.51	6.00	13.26	-
S.Em±	-	0.57	0.57	0.57	0.08
CD at 5%	-	1.67	1.67	1.67	0.24

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