Influence of planting conditions, nutrient sources and intercropping patterns on *Capsicum annum* in mid-hills of Himachal Pradesh

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© Society for Advancement of Human and Nature (SADHNA) *Received: 11.07.2023/Accepted: 5.08.2023*

ABSTRACT

A field experiment was conducted during 2020 at the experimental farm of Department of Silviculture and Agroforestry, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh to study the influence of planting conditions, nutrient sources and intercropping patterns on production of *Capsicum annum* in mid-hill conditions of Himachal Pradesh. The experiment was laid out in randomized block design having crops *C annuum* and *Glycine max* in kharif season with three factors viz two planting conditions, five intercropping patterns and three nutrient sources. The results revealed that among the planting conditions, maximum yield of *C annum* was recorded in open condition. In case of intercropping patterns and nutrient sources, higher fruit diameter, length and yield of *C annum* were recorded in sole cropping on application of RDF along with FYM while minimum were recorded in intercropping with control where no manure was applied.

Keywords: *Capsicum annum*; *Glycine max*; planting conditions; nutrient sources; intercropping patterns

INTRODUCTION

The pepper species (*Capsicum annuum* L var *grossum* Sendt) are important group of fruit vegetables and are ranked second among important vegetable crops in the Solanaceae family after tomato. It is grown worldwide for its delicate taste, pleasant flavour and colour and is also the most leading crop under protected structures. Improving food production at the national level requires best crop production practices such as intercropping. The advantages of intercropping are risk minimization, effective use of available resources, efficient use of labour, increased crop productivity, erosion control and food security (Addo-Quaye et al 2011).

It is observed that continuous use of inorganic fertilizers leads to deterioration in soil chemical, physical and biological properties and soil health (Mahajan et al 2008). The negative impacts of chemical fertilizers, coupled with escalating prices, have led to growing interests in the use of organic fertilizers as a source of nutrients (Satyanarayana et al 2002). The use of organic liquid products such as Jeevamrit and Panchagavya results in higher growth, yield and quality of crops.

MATERIAL and METHODS

The experimental farm of Department of Silviculture and Agroforestry, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh falls in sub-tropical, sub-humid agro-climatic zone of Himachal Pradesh. There is a considerable variation in the seasonal and diurnal temperature of the experimental site. In general, May and June are the hottest months, whereas, December and January are the coldest ones and experience severe frost during winter. The area receives an average annual rainfall of approximately 1,400 mm, about 75 per cent of which is received during the months of July to September. The average annual temperature is 17.4°C. The experiment was laid out in randomized block design having crops *C annuum* and *Glycine max* in kharif season with three factors viz two planting conditions (*Grewia*-based agroforestry system and open

condition), five intercropping patterns (I_1: One row of capsicum and one row of soybean, I_2: One row of capsicum and two rows of soybean, I_3: Two rows of capsicum and one row of soybean, I_4: Two rows of capsicum and two rows of soybean, I_5: Rows of sole capsicum) and three nutrient sources (N_1: RDF ie NPK 100:76:54 kg/ha with FYM, N_2: Jeevamrit 5% @ 500 l/ha and N_3: No manure). The capsicum seeds were sown in nursery beds during the last week of January, during both the cropping seasons. One hundred eight plots of dimension 3 m × 3 m were made and different nutrient doses were applied as per treatments to each unit plot in accordance with the experimental design. Twenty fruits were randomly selected from each plot for observations. Fruit diameter was measured horizontally at equatorial part of fruit by using Vernier calliper. Fruit length was measured longitudinally from the peduncle end to the tip of fruit by using a digital Vernier calliper. On the basis of yield obtained per plot, yield per hectare was calculated. The data were analysed as suggested by Gomez and Gomez (1984).

RESULTS and DISCUSSION

The data given in Table 1 show the mean fruit diameter and length of *C annum* as influenced by planting conditions (P), intercropping patterns (I) and nutrient sources (N). Significantly, higher fruit diameter and length of 4.96 and 6.13 cm respectively were recorded under open condition, whereas, lowest of 4.63 and 5.89 cm respectively under *Grewia*-based agroforestry system. Maximum fruit diameter and length of 5.33 of 6.36 cm respectively were recorded in sole cropping of *C annum.* Minimum fruit diameter (4.54 cm) was recorded in I_1 (One row of capsicum and one row of soybean) and minimum fruit length (5.68 cm) in I_2 (One row of capsicum and two rows of soybean). The fruit diameter and length of *C annum* were significantly influenced by different types of nutrient sources. Maximum fruit diameter and length (5.38 and 6.38 cm respectively) were recorded on application of RDF followed by Jeevamrit (4.88 and 6.09 cm respectively), whereas, minimum (4.13 and 5.55 cm respectively) in control, where no manure was applied.

Mean fruit yield of *C annum* was significantly higher under open condition (101.52 q/ha), whereas, lower (78.74 q/ha) was recorded under *Grewia*-based agroforestry system (Table 2). Maximum (107.86 q/ha) fruit yield was recorded in I_5 (Rows of sole capsicum) followed by I_1 (101.84 q/ha), I_3 (Two rows of capsicum and one row of soybean) (94.22 q/ha) and minimum in I_4 (Two rows of capsicum and two rows of soybean) (69.58 q/ha). Data also exhibited that different nutrient sources (N) exerted a significant impact on fruit yield. The mean maximum fruit yield (107.65 q/ha) was observed in N_1 followed by N_2 (93.29 q/ha) as compared to N_3 (69.44 q/ha).

Findings of the present study are in agreement with the earlier results obtained by Narayanamma et al (2010), Ghayal et al (2018) and Kharga et al (2019). Taychasinpitak and Taywiya (2003) reported that fruit length was positively correlated with fruit diameter. Maximum yield of *C annum* in sole cropping might be attributed to efficient utilization of space and light interception along with nutrient uptake and availability of applied nutrients which ultimately increased the production of assimilates and the rate of biosynthesis of various metabolic activities leading to increased rate of growth and development. Similar results were reported by Singh and Sharma (2007), West and Griffith (1992) and Ghaffarzadeh et al (1994).

CONCLUSION

From the comparative studies on the influence of planting conditions, nutrient sources and intercropping on the production of *C annum*, it was concluded that among the planting conditions, the yield parameters of capsicum under capsicum-soybean intercropping system were higher under open condition while minimum under *Grewia*-based agroforestry system. Among the intercropping and nutrient sources, the higher fruit diameter, length and yield parameters of capsicum were recorded in sole cropping on application of RDF.

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Table 1. Effect of intercropping patterns and nutrient sources on fruit diameter and length of *C annum* under *G optiva* and open conditions

Intercropping pattern (I)	Planting condition (P)											
	P_1 (Under *G optiva*)				P_2 (Open condition)				Intercropping × Fertilizer			
	N_1 (RDF)	N_2 (Jeevamrit)	N_3 (Control)	Mean	N_1 (RDF)	N_2 (Jeevamrit)	N_3 (Control)	Mean	N_1 (RDF)	N_2 (Jeevamrit)	N_3 (Control)	Mean
Fruit diameter of *C annum*(cm)												
I_1	4.97	4.80	3.34	4.37	5.75	5.09	3.30	4.71	5.36	4.95	3.32	4.54
I_2	4.77	4.87	4.13	4.59	5.03	4.58	4.01	4.54	4.90	4.73	4.07	4.56
I_3	4.61	4.69	4.18	4.49	5.17	4.72	4.58	4.82	4.89	4.71	4.38	4.66
I_4	4.65	4.38	4.58	4.54	5.98	5.19	4.53	5.23	5.32	4.79	4.55	4.88
I_5	6.18	5.17	4.11	5.15	6.68	5.32	4.53	5.51	6.43	5.25	4.32	5.33
Mean	5.04	4.78	4.07	4.63	5.72	4.98	4.19	4.96	5.38	4.88	4.13	
Fruit length of *C annum*(cm)												
I_1	5.91	5.50	5.17	5.53	6.28	6.22	5.71	6.07	6.09	5.86	5.44	5.80
I_2	5.83	5.55	5.28	5.55	6.04	5.84	5.53	5.80	5.93	5.70	5.40	5.68
I_3	6.38	6.31	5.40	6.03	6.67	5.93	5.56	6.05	6.52	6.12	5.48	6.04
I_4	6.41	6.27	5.48	6.05	6.71	6.25	5.83	6.27	6.56	6.26	5.66	6.16
I_5	6.62	6.35	5.85	6.28	6.95	6.70	5.69	6.44	6.78	6.53	5.77	6.36
Mean	6.23	6.00	5.44	5.89	6.53	6.19	5.66	6.13	6.38	6.09	5.55	

$CD_{0.05}$

	Fruit diameter	Fruit length
P (Planting condition)	0.235	0.203
I (Intercropping pattern)	0.372	0.321
N (Nutrient treatment)	0.288	0.248
P × I	NS	NS
P × N	NS	NS
I × N	NS	NS
P × I × N	NS	NS

I_1: One row of capsicum and one row of soybean, I_2: One row of capsicum and two rows of soybean, I_3: Two rows of capsicum and one row of soybean, I_4: Two rows of capsicum and two rows of soybean, I_5: Rows of sole capsicum; N_1: RDF (NPK 100:76:54 kg/ha with FYM), N_2: Jeevamrit (5% @ 500 l/ha), N_3: No manure; P_1 (Under *G optiva*), P_2 (Open condition), P_3 (Intercropping × Fertilizer)

Table 2. Effect of intercropping patterns and nutrient sources on fruit yield of *C annum* under *G optiva* and open conditions

Intercropping pattern (I)	Fruit yield (q/ha)											
	P_1 (Under *G optiva*)				P_2 (Open condition)				Intercropping × Fertilizer			
	N_1 (RDF)	N_2 (Jeevamrit)	N_3 (Control)	Mean	N_1 (RDF)	N_2 (Jeevamrit)	N_3 (Control)	Mean	N_1 (RDF)	N_2 (Jeevamrit)	N_3 (Control)	Mean
I_1	100.01	94.01	65.22	86.41	151.25	119.99	80.57	117.27	125.63	107.00	72.90	101.84
I_2	77.84	73.30	52.54	67.89	92.58	88.40	78.17	86.38	85.21	80.85	65.35	77.14
I_3	94.11	88.36	64.88	82.45	118.54	109.82	89.60	105.99	106.32	99.09	77.24	94.22
I_4	89.23	61.75	49.94	66.97	92.90	67.47	56.18	72.18	91.06	64.61	53.06	69.58
I_5	103.47	96.36	70.08	89.97	156.55	133.45	87.27	125.76	130.01	114.91	78.67	107.86
Mean	92.93	82.76	60.53	78.74	122.36	103.83	78.36	101.52	107.65	93.29	69.44	

$CD_{0.05}$

P (Planting condition)	15.55
I (Intercropping pattern)	24.49
N (Nutrient treatment)	19.05
P × I	NS
P × N	NS
I × N	NS
P × I × N	NS

I_1: One row of capsicum and one row of soybean, I_2: One row of capsicum and two rows of soybean, I_3: Two rows of capsicum and one row of soybean, I_4: Two rows of capsicum and two rows of soybean, I_5: Rows of sole capsicum; N_1: RDF (NPK 100:76:54 kg/ha with FYM), N_2: Jeevamrit (5% @ 500 l/ha), N_3: No manure; P_1 (Under *G optiva*), P_2 (Open condition), P_3 (Intercropping × Fertilizer)

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