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Effect of Different (Onion + Palak) Intercropping Combinations on Growth and Leaf Yield of Palak (*Beta vulgaris* var. *bengalensis*)

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ABSTRACT

Background: The present investigation entitled "Effect of Different Onion + Palak Intercropping Combinations on Leaf Yield of Palak (*Beta vulgaris* var. *bengalensis*)" was carried out at Research Farm of the Department of Vegetable Science, CCS Haryana Agricultural University, Hisar during season of 2018-19.

Methods: The experimental treatments *viz*., T_1- palak (sole) 15×5 cm, T_2- onion + palak (one row) T_3- onion + palak (two rows), T_4- onion + palak (three rows), T_5- onion + palak (broadcasting), were laid out in a randomized block design (RBD) with three replications.

Result: Based on the research investigation it was found that Longest length of palak leaf was observed in sole palak crop (16.20, 17.13 and 17.20 cm) at 1st, 2nd and 3rd harvesting respectively, which was significantly higher than other intercropping combinations. Palak sole crop showed maximum petiole length (12.53, 13.27 and 13.86 cm) at every harvest. Within the intercropping system, the maximum petiole length (12.27, 12.78 and 13.28 cm) was observed in treatment onion + palak (one row), which was at par with onion + palak (two rows). The leaf yield ranged from 22.10 q ha^{-1} at first harvesting in onion + palak (Broadcast) to 47.15 q ha^{-1} in palak sole crop at third harvesting. The leaf yield significantly varied among various intercropping system at first, second and third harvesting. Palak sole crop produced highest leaf yield at all the harvesting stages.

Key words: Intercropping, Leaf yield, Onion, Palak, Randomized block design.

INTRODUCTION

Beet leaf or palak (*Beta vulgaris* var. *bengalensis*) is one of the major leafy vegetable grown and consumed in India and can be grown in tropical and subtropical regions. It is native of Indo-Chinese region. It was known in China as early as 647 AD (Bharad *et al*., 2013). In India this leafy vegetable commonly known as Palak and it is popular due to its high nutritive value. The Palak growing states are Uttar Pradesh, West-Bengal, Haryana, Punjab, Delhi, Madhya-Pradesh, Bihar, Maharashtra, Rajasthanand Gujarat. However, this crop is now gaining popularity in southern states like Karnataka also. Palak leaves are valued for their medicinal properties and are used in inflammation, paralysis, headache and remedy for diseases of spleen and liver, it also acts as mild lacerative besides other medicinal value, it supplies most of the nutrients in which other foods are deficient. Indian spinach is used as fresh vegetable for cooking and also in salad form. Palak is short duration and widely grown leafy vegetable and can be grown throughout the year but main crop is taken as winter crop, mainly sown in October-November at spacing of 15×5 cm. Its leaves become ready for first cutting in about 35 days after sowing and subsequent cuttings are taken at 15-20 days interval. (Mishra *et al*., 2003). The demand of vegetables is increasing day by day among people due to high income and awareness about their nutritional value vegetables being rich source of nutrients, vitamins, minerals, antioxidants, fibers, carbohydrates, *etc*. and medicinal value. Presently, availability of vegetables per day per capita is about 200 g, below the required quantity of 3 vegetables (300 g per head per day). Land holding is decreasing day by day due to urbanization, high population growth and industrialization across the country. Hence, the challenges are to produce more vegetables per unit area to fetch up the demand. Therefore, strategies should be to produce higher quantity of vegetables from less land with optimum use of water, fertilizers and by adopting suitable agronomical management practices like intercropping, mixed cropping, relay cropping, *etc*. are the options, which can be followed for higher production in per unit area. Intercropping refers to growing two or more dissimilar crops simultaneously on the same piece of land. Crop intensification is in both time and space dimensions. It also helps the farmers for getting stable production and maintaining the soil fertility level. Intercropping system results in yield advantage because the component crops differ in their use of growth resources. When they are grown in combination, they are able to complement each other and per se make better overall use

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of resources than when grown separately. Many studies have indicated that intercropping with different vegetable was more productive and profitable than sole cropping because of complementary effects of intercrop (Varghese, 2000).

MATERIALS AND METHODS

The present study was carried out on onion sole crop and in intercrop combinations at the Vegetable Research Farm, Department of Vegetable Science, CCS Haryana Agricultural University, Hisar during *rabi* season, 2018-19. Hisar is located at 29°10′ latitude north, 75°46′ longitude east and 215.2 m above mean sea level with semi-arid subtropical climate. A "randomized block design" with five treatments *viz*., T_1- palak (sole) 15 × 5 cm, T_2- onion + palak (one row) T_3- onion + palak (two rows), T_4- onion + palak (three rows), T_5- onion + palak (broadcasting), were laid out in a randomized block design (RBD) and the treatments were replicated three times randomly with a plot size of 3.6×2.4 m. All plants received normal agricultural practices whenever they needed. In case of onion sole crop and in intercrop combinations, full recommended doses of P_2O_5 (50 kg/ha), K_2O (25 kg/ha) and ½ Nitrogen (62.5 kg/ha) were applied as basal dose and remaining quantity of nitrogen was applied as top dressing in two split doses at 30 and 60 days after transplanting. The first cutting of palak leaves was done at 30 days after sowing and another two subsequent cuttings were taken at 20-25 days interval. The observations on leaf parameters *i.e*., leaf length (cm), leaf width (cm) and petiole length (cm) of randomly selected five leaves was measured in centimeter with the help of meter scale and then average value was calculated. Fresh leaf yield at first, second and third cuttings were recorded in kg/plot and computed in q/ha treatment wise separately. Total leaf yield of each treatment was calculated as the average yield of first, second and final cutting.

Statistical analysis

In order to test the significance of result, standard statistical method based on the analysis of variance technique as suggested by Panse and Sukhatme (2000) were employed. The treatments differences were compared with the critical difference (CD) at 5% level of significance to ascertain their significance; all the results have been summarized in the suitable tables presented under "Experimental Findings" given the means of treatments. Suitable Illustrations of the data have also been made at appropriate places. The critical difference (C.D.) was calculated with the help of following formula:

$$\text{Standard error of mean (SEm } \pm) = \sqrt{VE/r}$$

$$\text{Critical difference (C.D.)} = \sqrt{2VE/r} \times \text{'t' value at 5\% level of significance for error df.}$$

Where

C.D. = Critical difference.

VE = MSS of error (Error variance).

r = Number of observations averaged.

't' = 't' value from fisher's table for error degree of freedom at 5% level of probability.

Analysis of variance

Source	Degrees of freedom	Sum of squares	Mean sum of squares	F calculated value
Replication	r-1	SSr	MSr	MSr/MSe
Treatment	t-1	SSt	MSt	MSt/MSe
Error	(r-1) (t-1)	SSe	MSe	
Total	n-1	TSS		

Where,

r = Number of replications.

t = Number of treatments.

MSr, MSt and MSe Mean sum of square due to replication, treatment and error, respectively.

RESULTS AND DISCUSSION

The leaf attributes such as, leaf length, petiole length and leaf width was found significantly better in treatment palak sole crop as compared to intercrop. The leaf length continued to increase with the advancement of crop age *i.e* from 1st harvesting to 3rd harvesting. Leaf length decreased with the increase in number of rows of palak as intercrop with onion at each harvest. Longest length of palak leaf was observed in sole palak crop (16.20, 17.13 and 17.20 cm) at 1st, 2nd and 3rd harvesting respectively, which was significantly higher than other intercropping combinations. The leaf length of palak in treatment onion + palak (one row) (15.42, 16.05 and 16.45 cm) at 1st, 2nd and 3rd harvesting respectively was recorded significantly longer than other intercropping system (Table 1). Petiole length continued to increase with the decrease in plant population and advancement of crop age. The petiole length was found maximum (13.86 cm) in sole palak in third harvesting and minimum (9.57 cm) in onion + palak (Broadcast) combination. The petiole length in intercropping system increased gradually with the decreased of plant population. Gaharwar (2014) mentioned that length of leaf, petiole and diameter of leaf increased with the increase in number of cuttings. The petiole length significantly varied among various intercropping treatments at first, second and third harvesting. Palak sole crop showed maximum petiole length (12.53, 13.27 and 13.86 cm) at every harvest. Within the intercropping system, the maximum petiole length (12.27, 12.78 and 13.28 cm) was observed in treatment onion + palak (one row), which was at par with onion + palak (two rows) (Table 2). Similar results were found by Islam *et al*. (2016) for garlic crop when intercropped with brinjal. The leaf width continued to increase with the advancement of crop age. From 1st harvest to 3rd harvest the leaf width of palak ranged from 6.82 cm in onion + palak (Broadcast) at 1st harvest to 9.23 cm in sole crop at third harvest. There was non-significant difference among different intercropping combinations for leaf width at first, second and third harvesting (Table 3).

The data indicated that leaf yield of palak continued to increase with advancement of crop age. The leaf yield ranged from 22.10 q ha^{-1} in onion + palak (Broadcast) at first harvesting to 47.15 q ha^{-1} in palak sole crop at third

harvesting. Leaf yield of palak under different intercropping combinations increased gradually with the increase in number of rows of palak (1 to 3 rows). The leaf yield significantly varied among various intercropping system at first, second and third harvesting. Palak sole crop produced highest leaf yield at all the harvesting stages. Leaf yield decreased appreciably due to the competition among the crops, lands for moisture, nutrients, space and light. These findings confirm with the results of Abdel-gaic *et al*. (2014) regarding the bean yield in tomato-bean intercropping system. Within the treatment of intercropping the maximum leaf yield was obtained from onion + palak three rows, which was at par with sole palak. The minimum leaf yield was obtained from onion + palak (Broadcasting) followed by intercropping of single row of palak with onion. Similarly, the total leaf yield was recorded maximum for sole palak (114.5 q ha^{-1}) and onion + palak three rows (110.93 q ha^{-1}). Among the different intercropping treatments, the lowest leaf

Table 1: Effect of different onion + palak intercropping combinations on length of leaf (cm) of palak at different harvesting.

Treatments	Leaf length of palak (cm)		
	1st harvesting	2nd harvesting	3rd harvesting
T_1- Palak (Sole crop)	16.20	17.13	17.20
T_2- Onion + palak (One row)	15.42	16.05	16.45
T_3- Onion + palak (Two rows)	14.82	15.38	15.70
T_4- Onion + palak (Three rows)	14.25	14.72	14.95
T_5- Onion + palak (Broadcast)	13.67	14.07	14.17
SEm ±	0.17	0.19	0.22
CD (P=0.05)	0.55	0.63	0.72

Table 2: Effect of different onion + palak intercropping combinations on petiole length (cm) of palak at different harvesting.

Treatments	Petiole length (cm)		
	1st harvesting	2nd harvesting	3rd harvesting
T_1 - Palak (Sole crop)	12.53	13.27	13.86
T_2- Onion + palak (One row)	12.27	12.78	13.28
T_3- Onion + palak (Two rows)	12.13	12.70	13.25
T_4- Onion + palak (Three rows)	9.93	10.74	10.94
T_5- Onion + palak (Broadcast)	9.57	10.23	10.94
SEm ±	0.16	0.18	0.20
CD (P=0.05)	0.53	0.58	0.66

Table 3: Effect of different onion + palak intercropping combinations on leaf width (cm) of palak at different harvesting.

Treatments	Leaf width (cm)		
	1st harvesting	2nd harvesting	3rd harvesting
T_1 - Palak (Sole crop)	7.13	9.07	9.23
T_2- Onion + palak (One row)	7.03	9.00	9.07
T_3- Onion + palak (Two rows)	6.98	8.76	8.83
T_4- Onion + palak (Three rows)	6.92	8.68	8.73
T_5- Onion + palak (Broadcast)	6.82	8.67	8.68
SEm ±	0.35	0.42	0.45
CD (P=0.05)	NS	NS	NS

Table 4: Effect of different onion + palak intercropping combinations on leaf yield (q ha^{-1}) of palak at different harvesting and total leaf yield.

Treatments	Leaf yield (q ha^{-1})			
	1st harvesting	2nd harvesting	3rd harvesting	Total leaf yield
T_1 - Palak (Sole crop)	31.62	35.28	47.15	114.5
T_2 - Onion + palak (One row)	24.28	29.37	41.42	95.07
T_3 - Onion + palak (Two rows)	25.35	30.56	42.38	98.29
T_4 - Onion + palak (Three rows)	30.72	34.15	46.05	110.93
T_5 - Onion + palak (Broadcast)	22.10	27.32	39.50	88.92
SEm ±	0.34	0.50	0.66	1.50
CD (P=0.05)	1.12	1.62	2.14	4.90

yield (88.92 q ha^{-1}) was obtained from onion + palak (Broadcast) treatment (Table 4). Paul *et al*. (2015) also reported the similar findings in brinjal-coriander intercropping system.

CONCLUSION

The results of the experiment show that palak sole crop had significantly higher leaf length and petiole length than intercropping treatments, whereas, leaf width did not influence significantly. In Intercropping combination, onion + palak (one row) gave significantly higher leaf length than onion + palak (two and three rows) and onion + palak (broadcasting). Palak sole crop in intercropping was at par with onion + palak one, two and three rows, but they were significantly superior to onion + palak broadcasting. The leaf yield of palak was significantly higher with palak sole crop than intercropping treatments.

Conflict of interest: None.

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