



E-ISSN: 2663-1067
P-ISSN: 2663-1075
<https://www.hortijournal.com>
IJHFS 2023; 5(2): 07-10
Received: 07-06-2023
Accepted: 15-07-2023

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Effect of intercropping system on yield, economics and land equivalent ratio of cabbage in the trans-gangetic plains of Punjab

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DOI: <https://doi.org/10.33545/26631067.2023.v5.i2a.170>

Abstract

A field experiment was conducted during the winter season of 2022-2023 at vegetable experimental farm, Department of Agriculture, Khalsa College, Amritsar, Punjab to study the effect of intercropping system on yield, economics and Land equivalent ratio of cabbage in the trans-Gangetic plains of Punjab. The investigation was laid out in RBD with seven treatments replicated thrice with sole cabbage having a spacing of 60×45 cm. Sole cropping of cabbage recorded significantly maximum values for most of the yield characters like plant height, head circumference, marketable heads per plot, head weight, maximum head diameter, head height, cabbage yield per plot and yield per hectare. Economically, cabbage + radish intercropping B: C ratio (5.20) was adjudged as the best followed by sole cabbage cropping having B: C ratio (4.83). Also, the Land equivalent ratio (LER) was maximum in cabbage+radish intercropping 1.74 followed by cabbage + palak intercropping 1.43. Therefore, intercropping in cabbage results to maximize the yield and economics of cabbage farmers under Amritsar conditions. Inclusion of garden pea or radish in cabbage inter rows may be adopted by cabbage growers.

Keywords: Economics, LER, intercropping, yield characters

Introduction

India ranks second in vegetable production in the world. Vegetable crops occupy a prominent role in diversification of agriculture and ensuring timely income of farmers and has played a pivotal role in food and nutritional security of ever-growing population of India. The vegetable requirement of our country is estimated 225 million tones by 2020 [Anon, 2011] ^[1]. But it is also alarming that per capita land resources in India are very limited (0.12 ha) which will further be decreased by the turn of the century due to ever-increasing population. Punjab state is ideally suitable for cultivation of different vegetable crops due to the presence of fertile land, suitable soil available and preferably climatic conditions favouring high vegetable production. On the other hand, due to continuous application of chemical fertilizers, amount of soil nutrient reserve is gradually depleting. Hence, effective land utilization through intensive cropping is urgently needed. Realizing all these, intercropping of compatible crops can be of great value in achieving the improved productivity with sustain soil health. The farmers generally prefer the intercropping system because it produces higher total crop yield per unit area, provides insurance against total crop failure, and also reduces incidences of pests and diseases [Lyocks *et al.* 2013] ^[2]. The system of intercropping not only improves the yield and returns but also reduces the risk of complete crop failure as compared to the sole cropping system [Rao and Singh, 2000] ^[3]. Hence, an attempt was made to blend some winter duration vegetables of different rooting depth with the cabbage for increased return with more cropping intensity. Considering all these facts, the present study has been undertaken to study the influence of different crops of cabbage based intercropping system.

Materials and Methods

The experiment was conducted in vegetable farm of post graduate Department of Agriculture, Khalsa College, Amritsar during Rabi season 2022-23 by combining seven treatments replicated thrice laid out in RBD with sole cabbage having spacing of 60×45 cm

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and the additive intercropping series being followed in the intercrops. The treatments were T₁- sole cabbage, T₂ sole pea, T₃- sole palak, T₄ sole radish, T₅ - cabbage + pea, T₆- cabbage + palak and T₇ - cabbage + radish. The recommended dose of organic manure (8 t ha⁻¹) and inorganic fertilizers (50:25:25 kg N:P:K ha⁻¹) were applied in cabbage. Thirty days old seedlings of cabbage cv. Golden Acre were transplanted at a spacing of 60 cm x 45 cm during 1st fortnight of October. Seeds of the intercrops were

sown as additive series between rows of cabbage. Recommended package of practices was followed for all the intercrops.

Cultivar used in the experiment

The variety Golden Acre was used for the experiment. Golden Acre is prized for its compact size and plant heads are exceptionally firm.

Treatment Detail

Treatments	Crops Combination	Spacing (cm)
T ₁	Cabbage (sole)	60 x 45
T ₂	Pea (sole)	45 x 10
T ₃	Palak (sole)	20 x 5
T ₄	Radish (sole)	45 x 7.5
T ₅	Cabbage + Pea	60 x 45 + one row of pea between two Cabbage rows.
T ₆	Cabbage + Palak	60 x 45 + two rows of Palak between two Cabbage rows.
T ₇	Cabbage + Radish	60 x 45 + one row of radish between two Cabbage rows.

Results and Discussion

The results pertaining to yield parameters of cabbage showed that sole cropping of cabbage recorded maximum values for head diameter (16.93 cm), head height (19.23 cm), head weight (1475 g), head circumference (35.43 cm), number of marketable heads per plot (17.5), yield per hectare (62.03 t). Cabbage + pea intercropping combination was found second best treatment after sole cropping of cabbage as it recorded next best values for head diameter (15.80 cm), head height (18.30 cm), head weight (1203 g), head circumference (31.46 cm), number of marketable heads per plot (16.16), yield per hectare (50.93 t). The other intercropping system of cabbage + palak and cabbage + radish projected lower values from above treatments due to higher competition between crops for light, nutrients and space for growth and yield values. Maximum values for most of the yield parameters in sole cabbage plots may 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, which is expressed in higher head weight. Among intercropping treatments, cabbage + pea system of intercropping recorded next best values for these yield attributes. Similar type of observations were also recorded in cabbage intercropping system where highest head yield of cabbage (37.11 t ha⁻¹) was recorded in sole cropping of cabbage followed by the same with pea but radish or Palak affected the yield of cabbage and by Giri (2002) [7] in cabbage based intercropping system where it was noticed that highest head diameter (19.80 cm) was obtained in cabbage sole cropping followed by cabbage + french bean intercropping treatment (18.52 cm). Nayek (2001) [13] observed the same trend in cabbage based intercropping system.

After perusal of data related to economics of production, it was observed that cabbage + radish intercropping system was most remunerative as it recorded highest net return and B:C ratio (₹ 3,14,110 and 5.2 respectively) followed by sole cropping of cabbage (₹ 2,73,555 and 4.83). Sole cropping of pea was least economical (₹ 40,000 and 1.23 respectively). The cabbage + pea as well as cabbage + palak intercropping system showed similar results in net return and B:C ratio (₹ 2,71,830 and 4.44, ₹2,640,30, and 4.42 respectively). Although sole palak and sole radish resulted at par B:C ratio (3.67 and 3.7 respectively) but the net return showed difference between these two sole treatments resulting in net return of ₹55,000 and ₹93,490 respectively. Among the different intercropping treatment combinations cabbage grown with radish found to be most remunerative which might be due to less cost of cultivation and higher rate of returns from the market. The cabbage and pea intercropping also found to be remunerative due to higher market price of pea and lower cost of cultivation. The pea intercropping also improves soil health and ultimately return from market. Based on the present experiment intercropping of cabbage with radish and pea was found to be the best combination along with sole cabbage cultivation which resulted in maximum remuneration in the markets of Punjab. The data on land equivalent ratio showed values higher than 1 which signifies the efficiency of intercrops in using the environmental resources over mono cropping. Highest LER values of 1.74 were obtained in cabbage intercropped with radish followed by cabbage + palak and cabbage+ pea having values of 1.43 and 1.30 respectively. Based on the present experiment intercropping of cabbage was found positive and can be used by farmers of Punjab as well as neighboring states to increase their income and improve their livelihood.

Tables

Table 1: Effect of intercropping on yield characters of cabbage

Treatment	Head diameter (cm)	Head Circumference (cm)	Head Height (cm)
T ₁ (Cabbage sole)	16.93	35.43	19.23
T ₅ (Cabbage + Pea)	15.80	31.46	18.30
T ₆ (Cabbage + Palak)	14.86	30.26	17.53
T ₇ (Cabbage + Radish)	14.03	26.90	16.66
C.D.	0.9	2.2	0.8

Table 2: Effect of intercropping on yield characters of cabbage

Treatment	Head weight (g)	Cabbage heads per plot
T ₁ (Cabbage sole)	1475	17.5
T ₅ (Cabbage + Pea)	1203	16.16
T ₆ (Cabbage + Palak)	1166	15.83
T ₇ (Cabbage + Radish)	1138	15.33
C.D.	82	0.7

Table 3: Effect of intercropping on yield characters of cabbage

Treatment	Yield of cabbage (kg)	Yield per hectare (t)
T ₁ (Cabbage sole)	25.13	62.03
T ₅ (Cabbage + Pea)	20.76	50.93
T ₆ (Cabbage + Palak)	19.36	47.33
T ₇ (Cabbage + Radish)	18.36	43.86
C.D.	2.10	5.08

Table 4: Economics of cabbage-based intercropping

S No.	Treatments	Total yield (T/Hac)	Intercrop yield (T/Hac)	Cost of cultivation (Rs/Hac)	Gross return (Rs/Hac)	Net return (Rs/Hac)	B:C Ratio
1	T ₁ Cabbage (sole)	55.03	—	56625	330180	273555	4.83
2	T ₂ Pea (sole)	7.25	—	32500	72500	40000	1.23
3	T ₃ Palak (sole)	17.5	—	15000	70000	55000	3.67
4	T ₄ Radish (sole)	29.56	—	24750	118240	93490	3.78
5	T ₅ (Cabbage + Pea)	50.93	2.75	61250	333080	271830	4.44
6	T ₆ (Cabbage + Palak)	47.33	9.95	59750	323780	264030	4.42
7	T ₇ (Cabbage + Radish)	43.86	27.85	60450	374560	314110	5.20

Note: Sale price of cabbage head @ ₹ 6 kg⁻¹, pea @ ₹ 10 kg⁻¹, palak @ ₹ 4 kg⁻¹, radish @ ₹ 4 kg⁻¹

Table 5: Land equivalent ratio (LER) of cabbage-based intercropping.

S. No.	Treatments	LER
1	T ₁ (Cabbage sole)	1.00
2	T ₂ (Pea sole)	1.00
3	T ₃ (Palak sole)	1.00
4	T ₄ (Radish sole)	1.00
5	T ₅ (Cabbage + Pea)	1.30
6	T ₆ (Cabbage + Palak)	1.43
7	T ₇ (Cabbage + Radish)	1.74

Conclusion

The results pertaining to yield parameters of cabbage showed that sole cropping of cabbage recorded maximum values followed by cabbage + pea intercropping combination. Based on the present experiment intercropping of cabbage with radish and pea was found to be the best combination along with sole cabbage cultivation which resulted in maximum remuneration in the markets of Punjab. The data on land equivalent ratio showed highest LER values were obtained in cabbage intercropped with radish followed by cabbage + palak and cabbage + pea respectively. Based on the present experiment intercropping of cabbage was found positive and can be used by farmers of Punjab as well as neighboring states to increase their income and improve their livelihood.

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