Economics of Various Treatments of Vermicompost on Growth and Yield Attributes of Pea (*Pisum sativum*L.) based Intercropping System

ABSTRACT

Intercropping is an ecologically friendly technique that can increase the sustainability of farming systems, whilst considered as low input systems. An experiment was conducted at the vegetable farm, Department of Vegetable Science, College of Horticulture and Forestry, Jhalrapatan City, Jhalawar during the rabi season from November, 2022 to April 2023. The experiment comprisedfifteen treatment combinations having three levels each of vermicompost (0, 2.5, and 5 ton/ha) and five levels of different intercropping system (Sole Pea, Sole Garlic, Pea + Garlic 1:1, 2:1, 2:2) in Factorial Randomized Block Design with three replications. The result of the present investigation showed that the effect of vermicompost and intercropping system on individually and combined had significant effect on the economic related attributes. The interaction effect of the Vermicompost and Intercropping system significantly increased the economic attributes such as maximum gross return (361172 ₹ ha^{-1}), net profit (272244 ₹ ha^{-1}) and B:C ratio (4.06) was recorded under treatment V_2I_5 (Vermicompost @5ton/ha+ Pea+ Garlic 2:2) as compared to other treatment, respectively. The interaction effect of vermicompost and Intercropping system also significantly increased pea equivalent yield (166.040 q/ha), land equivalent ratio (1.25) under treatment V_2I_5 (Vermicompost@5ton/ha+ Pea+ Garlic 2:2), respectively.

Keywords: Economics, Equivalent yield, Intercropping, Gross return, Net return,vermicompost,cultivation

INTRODUCTION

Pisum sativum L. is a member of the Leguminosae family. This herbaceous annual plant can grow up to 20 cm in dwarf size and up to 1.25 meters in height. It is a crop that self-pollinates and produces pods, or edible fruit. Peas are a major crop that is cultivated all over the world. As a leguminous crop, peas have a low nitrogen need because they fix atmospheric nitrogen in symbiosis with nitrogen-fixing bacteria in the root nodules.

As a member of the Alliaceae family, garlic (*Allium sativum* L) is one of the most aromatic herbaceous annual spices. With a distinct strong aroma, it is the second most extensively

grown spice crop among allium crops after onion. Originating in central Asia, garlic was later brought to the Mediterranean region during prehistoric times. [1].

Vermicompost is aamazing natural fertilizer that contains growth regulators and hormones that boost plant output. It also makes a substantial contribution to the enhancement of soil structure and is a rich source of minerals, such as potassium, phosphate, and nitrogen that are essential for plant growth [2]. The best way to stabilize crop production is by intercropping, particularly when it comes to vegetable production. Farmers use intercropping because it lowers the incidence of pests and diseases, helps enhance total crop production per unit area, and offers insurance against total crop failure [3].

Growing two or more crops concurrently on the same field for a duration long enough to encompass the vegetative stage is known as intercropping [4]. Among the top 10 vegetable crops in the world, peas (*Pisum sativum* L.) are in the top 10. Peas are used in human diets all over the world and are high in the amino acids tryptophan and lysin, as well as rich in carbs, vitamin A and C, calcium, phosphorus, and protein (21–25%) [5].

In India and Rajasthan, garlic (*Allium sativum* L.) and peas (*Pisum sativum* L.) are two of the most significant vegetable crops. They are grown as garlic bulbs, dry seeds, or pea green pods for both domestic and international markets. Small farmers are the ones who use intercropping systems the most since they maximize unit production and are widely used in third-world nations. Intercropping with legume crops is also a great way to reduce soil erosion and maintain crop productivity. The current study, "Economics of Various Treatments of Vermicompost on Growth and Yield Attributes of Pea (*Pisum sativum*L.) based Intercropping System," was conducted in light of the previously mentioned facts and in recognition of the significance of vermicompost and intercropping systems.

MATERIALS AND METHODS

A field experiment was carried out onavegetable farm at the Department of Vegetable Science, College of Horticulture and Forestry, Jhalrapatan, Jhalawar fromNovember, 2022to April 2023. Treatments were arranged in a Factorial Randomized Block Design with three replications. The experiment was carried out in Total of 45 plots and thearea of each plot was 12 m^2 (3 m x 4 m). The experiment consisted of two factors and with 3 levels of each factors Vermicompost 3 level (0, 2.5, 5 t/ha) and factors two Intercropping system 5 level (Sole Pea, Sole Garlic, Pea+ Garlic 1:1, 2:1, 2:2) with a total of 15 number of treatments. The spacing followed in the pea and garlic R×P (3 m x 4 m).TheEconomics of the treatments is the most

important consideration for making any recommendation to the farmers for its wide adoption. For calculating economics, the average treatment yield along with prevailing market rates for inputs and output were used. The net return was calculated by subtracting the cost of cultivation for each treatment from gross returns gained from the economic yield. TheB: C ratio was computed by dividing gross returns bythecost of cultivation for each treatment.For Pea Equivalent Yield (q/ha),thepod yield of pea crop in different intercropping systems was converted into pea yield using prevailing rates of produce in the following expression:

$$\text{Equivalent yield} = \text{Yield of main crop} + \frac{(\text{Yield of inter} \times \text{Price of intercrop})}{\text{Price of main crop}}$$

Land equivalent ratio is the relative land area under crops that is requiredto produce the yields achieved in intercropping. Land equivalent ratio can bemathematicallyrepresented as follows:

$$LER = \frac{\text{Yield of main crop under the system}}{\text{Yield of main crop assole crop}} + \frac{\text{Yield of inter crop under the system}}{\text{Yield of inter crop assole crop}}$$

List 1 :Treatment combinations

S. No.	Treatment notation	Treatment combination
1.	V_0I_1	Vermicompost @0t/ha+ Sole Pea
2.	V_0I_2	Vermicompost @0t/ha+ Sole Garlic
3.	V_0I_3	Vermicompost @0t/ha + Pea + Garlic (1:1)
4.	V_0I_4	Vermicompost @0t/ha +Pea +Garlic (2:1)
5.	V_0I_5	Vermicompost @0t/ha+ Pea + Garlic (2:2)
6.	V_1I_1	Vermicompost @2.5t/ha +Sole Pea
7.	V_1I_2	Vermicompost @2.5t/ha+ Sole Garlic
8.	V_1I_3	Vermicompost @2.5t/ha + Pea + Garlic (1:1)
9.	V_1I_4	Vermicompost @2.5t/ha +Pea +Garlic (2:1)
10.	V_1I_5	Vermicompost @2.5t/ha+ Pea + Garlic (2:2)
11.	V_2I_1	Vermicompost @5t/ha +Sole Pea
12.	V_2I_2	Vermicompost @5t/ha+ Sole Garlic
13.	V_2I_3	Vermicompost @5t/ha +Pea+ Garlic (1:1)
14.	V_2I_4	Vermicompost @5t/ha +Pea+ Garlic (2:1)
15.	V_2I_5	Vermicompost @5t/ha +Pea+ Garlic (2:2)

RESULTS AND DISCUSSION

The result of thepresent investigation showed that the effect of vermicompost and intercropping system individually and combined had a significant effect on the total cost of cultivation, gross income, net profit and B:C ratio(Table 1). Interaction effect of Vermicompost and Intercropping system significantly increased the economics attributes as maximum gross return (361172 ₹ ha^{-1}), net profit (272244 ₹ ha^{-1}) and B:C ratio (4.06) was recorded under treatment V_2I_5 (Vermicompost @5ton/ha+ Pea+ Garlic 2:2) while minimum gross return (79670₹ ha^{-1}), net profit (32059 ₹ ha^{-1}) and B:C ratio (1.67) was recorded under treatment V_0I_1 (Vermicompost @0t/ha+ Sole Pea). This might bedue to the results conformity withthe research of Cheng [6] in tomato-garlic based intercropping system, Qasim [7]in pea andWasaya [8]in wheat and fenugreek. Pea grown with Garlic was found most remunerative which might be due to higher market price of pea and comparatively lower cost for cultivation than all other treatment.

The result of a present investigation that is mentioned in Table 2reflected that of vermicompost and intercropping system had a significant effect on pea equivalent yield and LER.The maximum equivalent yield (166.040 q/ha), and land equivalent ratio (1.25) were found in treatment V_2I_5 (Vermicompost @5ton/ha + Pea + Garlic 2:2) as compared to the minimum pea equivalent yield (46.320 q/ha) and LER (1.00) was found in treatment V_0I_2 (Sole Garlic). This might be due to proportionately less reduction in yield of pea as compared with sole resulting in better yield of component crop leading to higher PEY. The findings confirm with the research of Adhikary[9] in baby corn-based vegetable intercropping systems, Abdelkader[10]in onion, fennel and coriander plants, Wartha[11]in intercropping indices of groundnut and cowpea with mustard, Habtamu [12]in intercropping of wheat with faba bean, Chongloi[13]in oat and pea based intercropping system,Kumar [14]in coriander intercropping system and Parsoya [15]in intercropping of ajwain.

Table 1. Economics of vermicompost and Pea based intercropping system

Treatment notation	Treatment combination	Total cost of cultivation	Gross return (Rs ha^{-1})	Net return (Rs ha^{-1})	B:C ratio
V_0I_1	Vermicompost @0t/ha+ Sole Pea	47611	79670	32059	1.67
V_0I_2	Vermicompost @0t/ha+ Sole Garlic	69825	83376	13551	1.19
V_0I_3	Vermicompost @0t/ha + Pea + Garlic (1:1)	63928	206920	142992	3.24
V_0I_4	Vermicompost @0t/ha +Pea +Garlic (2:1)	57769	186144	128375	3.22
V_0I_5	Vermicompost @0t/ha+ Pea + Garlic (2:2)	63928	216496	152568	3.39
V_1I_1	Vermicompost @2.5t/ha + Sole Pea	60111	102100	41989	1.70
V_1I_2	Vermicompost @2.5t/ha+ Sole Garlic	82325	101106	18781	1.23
V_1I_3	Vermicompost @2.5t/ha + Pea + Garlic (1:1)	76428	267120	190692	3.50
V_1I_4	Vermicompost @2.5t/ha +Pea +Garlic (2:1)	70269	239120	168851	3.40
V_1I_5	Vermicompost @2.5t/ha+ Pea + Garlic (2:2)	76428	269724	193296	3.53
V_2I_1	Vermicompost @5t/ha + Sole Pea	72611	125000	52389	1.72
V_2I_2	Vermicompost @5t/ha+ Sole Garlic	94825	145080	50255	1.53
V_2I_3	Vermicompost @5t/ha +Pea+ Garlic (1:1)	88928	337932	249004	3.80
V_2I_4	Vermicompost @5t/ha +Pea +Garlic (2:1)	82769	308252	225483	3.72
V_2I_5	Vermicompost @5t/ha+ Pea + Garlic (2:2)	88928	361172	272244	4.06

Table 2. Effect of vermicompost and intercropping system on pea equivalent yield (q/ha) and land equivalent ratio (LER)

Treatment notation	Treatment combination	Pea equivalent yield (q/ha)	Land equivalent ratio (LER)
V_0I_1	Vermicompost @0t/ha+ Sole Pea	79.67	1.00
V_0I_2	Vermicompost @0t/ha+ Sole Garlic	46.32	1.00
V_0I_3	Vermicompost @0t/ha + Pea + Garlic (1:1)	92.15	1.13
V_0I_4	Vermicompost @0t/ha +Pea +Garlic (2:1)	82.78	1.02
V_0I_5	Vermicompost @0t/ha+ Pea + Garlic (2:2)	96.42	1.18
V_1I_1	Vermicompost @2.5t/ha + Sole Pea	102	1.00
V_1I_2	Vermicompost @2.5t/ha+ Sole Garlic	56.17	1.00
V_1I_3	Vermicompost @2.5t/ha + Pea + Garlic (1:1)	93.4	1.14
V_1I_4	Vermicompost @2.5t/ha +Pea +Garlic (2:1)	85.4	1.05
V_1I_5	Vermicompost @2.5t/ha+ Pea + Garlic (2:2)	97.33	1.23
V_2I_1	Vermicompost @5t/ha + Sole Pea	123	1.00
V_2I_2	Vermicompost @5t/ha+ Sole Garlic	80.6	1.00
V_2I_3	Vermicompost @5t/ha +Pea+ Garlic (1:1)	153.01	1.16
V_2I_4	Vermicompost @5t/ha +Pea +Garlic (2:1)	144.09	1.09
V_2I_5	Vermicompost @5t/ha+ Pea + Garlic (2:2)	166.04	1.25
	S.E. (m) ±	1.57	0.01
	C.D. (P=0.05)	4.57	0.03

CONCLUSION

Based on the results obtained in the present investigation, the following conclusion may be drawn.TheInteraction effect of the Vermicompost and Intercropping system significantly increased the economic attributes i.e., maximum gross return (361172 ₹ ha-^{1}), net profit (272244 ₹ ha-^{1}) and B:C ratio (4.06), pea equivalent yield (166.040 q/ha), land equivalent ratio (1.25)was recorded under treatment V_2I_5 (Vermicompost @5ton/ha+ Pea+ Garlic 2:2) as compared to other treatment, respectively.

REFERENCES

1. Thompson HC, Kelly WC. Vegetable crops. Mc Grew Hill Book Co., New York, 1957; 368-370.
2. Mohamed HE, Badawy AS, Abdel-Aziz SM, El-Gepaly HM. Effect of Peas and Garlic Intercropping on Population Density of Some Pests in Sohag Governorate. Journal of Plant Production. 2021;12(2):179-86.
3. Lyocks SWJ, Tanimu J, Dauji LZ. Growth and yield parameters of ginger as influenced by varying populations of maize intercrop. Journal of Agriculture Crop Research.2013;1(2):24-29.
4. Gomez AA, Gomez KA. Multiple Cropping in the Humid Tropics of Asia. Ottawa. 1983;32p.
5. Bhat TA, Gupta M, Ganai MA, Ahanger RA, Bhat HA. Yield, soil health and nutrient utilization of field pea (Pisum sativum L.) as affected by phosphorus and Biofertilizers under subtropical conditions of Jammu. International Journal of Modern Plant and Animal Science. 2013;1(1): 1-8.
6. Cheng TL, Zhihui MH, Ahmad I, Zhao H. Growth, yield and quality of spring tomato and physicochemical properties of medium in a tomato/garlic intercropping system under plastic tunnel organic medium cultivation. Scientia Horticulture. 2014;170:(7) 159-168.
7. Qasim SA, Anjum MA, Hussain S, Ahmad S. Effect of pea intercropping on biological efficiencies and economics of some non-legume winter vegetables. Pakistan Journal of Agricultural Sciences. 2013;50(3): 399-406.
8. Wasaya A, Ahmad R, Hassan FU, Ansar M, Manaf A, Ser A. Enhancing crop productivity through wheat (Triticum aestivum L.) and fenugreek intercropping system. Journal Animal Plant Science.2013;23(1):210-215.
9. Adhikary S, Pandit MK, Koundinya AVV, Bairagi S, Das A. Examination of system productivity and profitability of baby corn-based vegetable intercropping systems. Journal Crop and Weed. 2015;11(1):220-224.
10. Abdelkader MA, Mohsen AA. Effect of intercropping patterns on growth, yield components, chemical constituents and comptation indices of onion, fennel and coriander plants. Zagazig Journal of Agricultural Research. 2016;43(1):67-83.

11. Wartha SR, Bhagat SB, Dhaiphale AV, Dhakale JS, Mardane RG, Puri MG. Evaluation of intercropping indices of groundnut and cowpea with mustard (Brassica juncea L.) in red lateritic soils of western costal region. Journal of Pharmacognosy and Phytochemistry. 2020;9(1):1303-06.
12. Habtamu M, Elias E, Argaw M, Feleke G. Intercropping wheat (Triticum aestivum) with faba bean (Vicia faba) combined with vermicompost and NPS fertilizer application increases crop yields and agronomic efficiency in the humid mid-highlands of Ethiopia. Cogent Food & Agriculture. 2024;10(1):01-18.
13. Chongloi KL, Sharma KK. Productivity of food-forage intercropping system as influenced by integrated nutrient management. Forage Research. 2019;45:206-211.
14. Kumar V, Mehta RS, Meena SS, Parsoya M, Sidh CN. Study on coriander (Coriandarum sativum L.) based intercropping system for enhancing system productivity. International Journal of Current Microbiology and Applied Sciences. 2018;7(6):3509-3514
15. Parsoya M, Mehta RS, Ameta RHK, Kumar V, Kumar P. Effect of different inter cropping systems on nutrient uptake, yield and profitability in ajwain (Trachyspermumammi Sprague) production. Journal of Pharmacognosy.2019;8(2): 10-12.