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Performances of *Lepidium sativum* under peach based Horti medicinal system agroforestry

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Abstract

The present investigation entitled 'Performance of *Lepidium sativum* under peach based medicinal agroforestry system' was carryout in the field of peach block Department of Fruit Science and field of medicinal and aromatic plants, Department of Forest products, Dr. YSP UHF Nauni, Solan. (HP) during 2016 to 2018. *Lepidium sativum* commonly known as Chandrshoor is a medicinal plant. The traditional agroforestry systems in the Himachal Pradesh have shown that farmers are aware of the benefits of mixed cultures. Mid hills are the bowl of stone fruits and peach is one of the important stone fruit of Himachal Pradesh. The experiment composed with 9 treatments as Peach + *Lepidium sativum* + FYM 2t/ha., Peach + *Lepidium sativum* + FYM 4t/ha., Peach + *Lepidium sativum* + Vermicompost 2t/ha, Peach + *Lepidium sativum* + Vermicompost 4t/ha, Peach + *Lepidium sativum* + Jivamarutha 500 l/ha, Peach + *Lepidium sativum* + RDF (60:30:30 kg/ha NPK), Peach + *Lepidium sativum*, *Lepidium sativum* + RDF (60:30:30 kg/ha NPK) and *Lepidium sativum*. From the experiments results Vermicompost @ 4t/ha was the most effective dose of organic manure, *Lepidium sativum* maximum straw yield (13.74 q/ha and 11.20 q/ha) and seed yield per plant (2.98 g and 2.37 g) and seed yield (9.93 q/ha and 7.90 q/ha) was recorded in T₆ (Peach + *Lepidium sativum* + RDF NPK 60:30:30 kg/ha) during both the years. The maximum cost of cultivation (Rs. 1, 17, 624.2 /ha and Rs. 1, 16, 124.2 /ha) was recorded in vermicompost (4t/ha), where *Lepidium sativum* was grown under peach tree. Maximum net return (Rs. 1, 52, 166/ha and Rs. 1, 27, 556 /ha) was obtained in T₆ (Peach + *Lepidium sativum* + RDF NPK 60:30:30 kg/ha). Highest B:C ratio (2.46) and (2.12) was found under peach tree during both the years. The results obtained from the present investigations showed that the performance of *Lepidium sativum* was well under horti medicinal system of agroforestry as compared to sole crop. The growth, yield and physiological attributes of medicinal herbs were not adversely affected by the presence of peach tree.

Keywords: Seed yield, straw yield, jeevamrutha, net income and benefit cost ratio

Introduction

Medicinal plants play an important role in the healthcare of people around the world, especially in developing countries. Until the advent of modern medicine, man depended on plants for treating human and livestock diseases. *Lepidium sativum* is an edible underutilized medicinal plant belonging to the family Brassicacea commonly known as a salio, garden cress, halo or halim, chandrshoor etc. It is a winter season annual cultivated as salad throughout India (Anonymous, 1962) [2]. It is a good source of protein (24%) vitamin A, C, iron, calcium and folic acid, amino and galactanic acid (19.3%) leucine (8.21%). The alpha linolenic acid (30.2%), while low amount of erucic acid (3.9%). Its bran has high dietary fibre (74.3%) with very good value holding capacity (Anonymous, 1962) [2]. *Lepidium* is believed to have originated primarily in the high land region of Ethiopia and Eritrea. The Europe and western Asia are regarded as secondary centers of origin (Stchenkova, 1932) [15]. The seeds are known to contain a light yellow colored fixed oil and alkaloids such as lepidin, glucotropeolin, besides sinapin and sinapic acid. Seeds, leaves and roots are the economic parts of this crop. The seeds are good source to enhance the milk percentage in cattle as well as in nursing mothers. Seeds are mainly used in Ayurveda, Unani and Siddha systems of medicine as thermo genic, depurative, galactagogue, tonic, aphrodisiac, ophthalmic, antiscorbutic, antiasthmatic, diuretic etc. Fresh leaves and young seedlings are mainly used as spice and are rich source of glucosinolates and also used as salads. Roots are bitter, acrid and are useful in treatment of secondary syphilis (Eddouts *et al.*, 2005 and Maghrani *et al.*, 2005) [4, 7]. Mucilage present in the seed coat is used to irritation of the mucous membrane of intestine in diarrhea and dysentery (Maiti, 2008) [8]. Chandrasur is also used against insect-bite and as an insect-repellent in the form of fumigant (Maurice, 1993) [10]. It is useful as traditional tonic to increase height of children and also increase the milk production in women and for curing chronic bronchial asthma (Paranjape and Mehta, 2004) [12]. The traditional agroforestry systems in the Himachal Pradesh have shown that farmers are aware of the benefits of mixed

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cultures and grow at least three to six layer of trees in and around their fields. Mid hills are the bowl of stone fruits and peach is one of the important stone fruit of Himachal Pradesh farmers are raising the orchards. In India, it is grown mainly in Uttar Pradesh, Madhya Pradesh, Rajasthan, Gujarat and Maharashtra. Apart from India, it is also cultivated in North America and parts of Europe. Agroforestry offers convenient strategy for promoting their cultivation and conservation. In horti-medicinal system, inter planting of medicinal and aromatic plants with stone fruit crops provide a better alternative to growers for acquiring income as well as ameliorating environment.

Material and Methods

The present study was conducted at Department of Fruit Science, College of Horticulture and Medicinal and Aromatic Plant Research Farm and Laboratory of Department of Forest Products, College of Forestry, YSP University of Horticulture and Forestry, Nauni, Solan (HP) during 2016 to 2018. The experimental farm of department of fruit science and department of forest products are located at an altitude of 1270 m in the mid hills of Himachal Pradesh. This is situated 15km away from Solan town towards south east direction. This is the transitional zone between sub-tropical and sub temperate region.

Experimental methodology

The study consisted of two structural and functional components viz., Peach (*Prunus persica* L. var. July Elberta), fruit tree as woody perennial and medicinal and aromatic plants as intercrop. Besides this, the impact of three organic manures and fertilizers on the growth and productivity of these medicinal and aromatic plants, growing along with and without peach was also studied.

Treatments: The experiment comprised of nine treatments viz. T₁ (Peach + *Lepidium sativum* + Peach + FYM 2t/ha), T₂ (Peach + *Lepidium sativum* + FYM 4t/ha), T₃ (Peach + *Lepidium sativum* + Vermicompost 2t/ha), T₄ (Peach + *Lepidium sativum* + Vermicompost 4t/ha), T₅ (Peach + *Lepidium sativum* + Jeevamarutha 500 l/ha), T₆ (Peach + *Lepidium sativum* + RDF 60:30:30 NPK kg/ha), T₇ (Peach + *Lepidium sativum*), T₈ (*Lepidium sativum* + RDF 60:30:30 NPK kg/ha) and T₉ (Control). Sowing of seeds was done during last fortnight of October month in lines and a spacing of 30 x 20 cm for two consecutive years. Data on growth and yield was recorded. The data recorded was subjected to statistical analysis under Randomized Block Design. Analysis of variance was worked out and critical difference at 5 per cent level of significance was calculated with the help of latest computer software.

Result and Discussion

The perusal of data presented in Table 1 and Fig. 1 showed

that the plant height of *Lepidium sativum* at harvesting stages was significantly influenced by different doses of organic manures and fertilizers. During 2016-2017, maximum plant height (69.42 cm) at harvesting stage was observed in T₆. Minimum average plant height (45.18 cm) was recorded in T₉ (control) at harvesting stage. In 2017-18 maximum average plant height (64.12 cm) was found in T₆ (Peach + *Lepidium sativum* + RDF (NPK 60:30:30 kg/ha) at harvesting stage. Average minimum plant height (40.15 cm) was recorded in T₉ (control) i.e. without peach, fertilizers and organic manures at harvesting stage. Higher plant height was found in 2016-17 as compared to 2017-18. T₆ Treatment was statistically superior during both the years. The number of branches per plant in *L. sativum* were significantly different under different treatments. The maximum number of branches per plant (14.76) were recorded in T₆ (Peach + *Lepidium sativum* + RDF (NPK 60:30:30 kg/ha), whereas the minimum (8.46) in T₉ (control), where no fertilizers as well as no manures was given during 2016-17. During 2017-18, also maximum number of branches/plant (11.46) was recorded in T₆. The similar results were obtained by Akhtar *et al.* (2003) [1] in *Pisum sativum* and Suresh *et al.* (2004) [16] in *Achyranthes aspera* under *Peltophorum petrocarpum* and *Prosopis cineraria*. The findings get support from the current Lakra *et al.* (2017) [6] who represented maximum number of branches when NPK @ 100% was applied in tomato.

The maximum estimated straw yield was observed T₆ (Peach + *Lepidium sativum* + RDF NPK 60:30:30 kg/ha) (13.74 q/ha) that was statistically superior in 2016-17. The minimum average estimated straw yield found (8.09 q/ha) in T₉ (control) which was without peach, without organic manures and without fertilizers. In 2017-18, maximum average estimated straw yield was found in T₆ (Peach + *Lepidium sativum* + RDF NPK 60:30:30 kg/ha) (11.20 q/ha) that was statistically superior to other treatments. The minimum average estimated straw yield was found T₉ (control) (6.32 q/ha). 1000 seed weight of *Lepidium sativum* was statistically different under different treatments (Table 2 and Fig. 1). Maximum 1000 seed weight (1.86 g) was recorded in T₆ (Peach + *Lepidium sativum* + RDF NPK 60:30:30 kg/ha) that was statistically superior to all other treatments. The minimum 1000 seed weight (1.70 g) was in T₉ (control) during 2016-17.

Similar observations for 1000 seed weight were found during 2017-18, where T₆ recorded maximum 1000 seed weight (1.84 g) and it was also statistically superior to other treatments. The minimum 1000 seed weight (1.60 g) was recorded in T₉ (control) (Fig. 2). The 1000 seed weight was higher during first year of study (1.78 g) as compared to second year (1.76 g). The table indicated that fertilizers and organic manures resulted higher straw yield under peach as compare to sole crop. Similar results were reported by Paturde *et al.* (2002) [13] who reported that yield of safed musli increased with the application of organic manures.

Table 1: The data recorded of *Lepidium sativum* under peach based agroforestry system in 2016-17

Characters Treatments	Plant height (cm)	Number of branches/plant	Straw yield/ha (q)	1000 Seed wt (g)	Seed yield/plant (g)	Seed yield/ha (q)
T ₁	57.27	11.13	11.22	1.79	2.46	8.20
T ₂	64.81	12.75	12.12	1.82	2.61	8.70
T ₃	61.60	11.49	11.73	1.81	2.49	8.30
T ₄	66.19	13.80	12.87	1.83	2.76	9.20
T ₅	55.72	10.56	10.62	1.74	2.37	7.90
T ₆	69.42	14.76	13.74	1.86	2.98	9.93
T ₇	50.95	9.23	9.36	1.71	2.31	7.70

T ₈	52.74	9.89	10.04	1.76	2.49	8.30
T ₉	45.18	8.46	8.09	1.70	1.85	6.17
Mean	58.21	11.34	11.09	1.78	2.48	8.27
CD at 5%	0.69	0.22	0.18	0.01	0.03	0.11

L. sativum maximum seed yield/plant (2.98 g) was recorded in T₆ and it was statistically superior to other treatments and minimum seed yield/plant (1.85 g) in T₉ (control) where plants were cultivated without peach and without application of organic manures and fertilizers during 2016-17. In 2017-18, higher seed yield/plant (2.37 g) was observed in T₆ (Peach + *Lepidium sativum* + RDF NPK 60:30:30 kg/ha) that was statistically superior and minimum seed yield/plant in (1.19 g) in T₉ (no peach + no fertilizers + no organic manures).

The seed yield of *L. sativum* under different treatments showed that the maximum average estimated seed yield (9.93 q/ha) was found in T₆ that was statistically superior, followed by T₄ (9.2 q/ha) and T₂ (8.7 q/ha), T₃ (8.3 q/ha) which is statistically at par with T₁ (8.2 q/ha), whereas in treatment T₈ (8.30 q/ha) it was best as compare to T₅ (7.90 q/ha). The minimum seed yield (6.17 q/ha) was recorded in T₉ (control), where no fertilizers and manures were given during 2016-17 and it was not intercropped with peach. Similar observations for seed yield were recorded during 2017-18, where T₆ recorded maximum seed yield (7.90 q/ha) that was statistically superior value, followed by T₄ (7.20 q/ha) and T₂ (6.77 q/ha), T₃ (6.34 q/ha) which was statistically at par with T₁ (6.22 q/ha). Treatment T₈ (6.33 q/ha) was better than T₅ (5.93 q/ha) similarly minimum seed yield (3.97 q/ha) was recorded in T₉ (control). The table indicated that the use of

fertilizers and organic manures with peach helped in *L. sativum* to get higher estimated seed yield/ha as compared to control (where *L. sativum* without peach, no fertilizers and no manures were applied). The estimated seed yield/ha was also significantly higher during first year of study as compared to second year. Fashina *et al.* (2002) [5] also reported improved cell activities, enhanced cell multiplication and enlargement, and luxuriant growth with the availability of sufficient growth nutrients from inorganic fertilizers. Olaniyi (2006) [11] stated that plant would display its potential genetic capacity by supplying the plants with adequate amount and types of fertilizer at the right time, the findings in this experiment also corroborated with the findings of Makinde *et al.* (2016) [9] who reported that yield parameters maximum height obtained with NPK. The enhancement of plant height with 100% inorganic fertilizers may be due to the direct effect of higher amount of inorganic nitrogen, which is an integral part of protein and chlorophyll molecules. Paul and Driscoll (1997) [14] observed that the primary target of N limitation is the growing meristem of the plant and decreased rate of photosynthetic activity, which can be attributed to reduction in plant heights under N deficiency. This may be reason for the lowest values recorded throughout the period with no fertilizer input.

Table 2: The data recorded of *Lepidium sativum* under peach based agroforestry system in 2017-2018

Characters Treatments	Plant height (cm)	Number of branches/plant	Straw yield/ha (q)	1000 Seed wt (g)	Seed yield/plant (g)	Seed yield/ha (q)
T ₁	52.16	8.99	8.75	1.78	1.87	6.22
T ₂	59.92	10.35	9.64	1.81	2.03	6.77
T ₃	56.74	9.43	9.23	1.80	1.90	6.34
T ₄	61.23	11.15	10.42	1.81	2.16	7.20
T ₅	48.10	7.65	8.28	1.74	1.78	5.93
T ₆	64.12	11.46	11.20	1.84	2.37	7.90
T ₇	46.81	6.72	7.13	1.71	1.72	5.73
T ₈	49.27	7.30	7.45	1.76	1.90	6.33
T ₉	40.15	5.46	6.32	1.60	1.19	3.97
Mean	53.17	8.72	8.71	1.76	1.88	6.27
CD at 5%	0.82	0.22	0.17	0.01	0.03	0.11

The economics of returns under peach based horti medicinal system of agroforestry, consisting of medicinal plants as intercrop was calculated. The cost of cultivation, gross returns and net returns of *L. sativum* were determined separately in the presence and absence of peach to know the economic profitability of tree- crop combination.

The highest gross return (Rs. 1, 29, 090) for *Lepidium sativum* was recorded under T₆ in horti medicinal system of

agroforestry. Among different treatments the minimum gross return (Rs 80, 210) was found in T₉ in 2016-17. During 2017-18, also the maximum gross return (Rs.1, 10,600) was recorded in T₆ and minimum (Rs. 55,580) in T₉ (control). The average gross return from *L. sativum* was observed significantly higher in first year of experimentation as compared to second year of study.

Table 3: Economic analysis of *Lepidium sativum* under peach based under agroforestry system on gross income, cost of cultivation, net income and B:C ratio in 2016-17

Characters Treatments	Gross return from intercrop (Rs/ha)	Cost of cultivation (Rs/ha)	Net return from intercrop (Rs/ha)	Average net return from Peach (Rs/ha)	Total net return from AF system (Rs/ha)	B:C Ratio
T ₁	106600	61124.15	45475.85	84450	129,926	2.13
T ₂	113100	64624.15	48475.85	84450	132,926	2.06
T ₃	107900	87624.15	20275.85	84450	104,726	1.20
T ₄	119600	117624.2	1975.85	84450	86,426	0.73
T ₅	102700	58624.15	44075.85	84450	128,526	2.19
T ₆	129090	61374.15	67715.85	84450	152,166	2.46
T ₇	100100	57624.15	42475.85	84450	126,926	2.20

T ₈	107900	56374.15	51525.85	-	-	1.91
T ₉	80210	52624.15	27585.85	-	-	1.52
Mean	107466.7	68624.15	38842.52			1.82

The total net return from agroforestry was calculated by adding net return obtained from intercrops and from tree component growing under peach based agroforestry system. Among different treatments maximum total net return from agroforestry system (Rs.1,52,166) and (Rs.1, 27,556) maximum were recorded in T₆ during 2016-17 and 2017-18,

respectively where, plants were cultivated under peach with fertilizers (NPK 60:30:30 kg/ha) and minimum net return was in (Rs.27,585.85) and (Rs. 3,955.85) was recorded during T₉ in 2016-17 and (2017-18), respectively where plants were grow without peach, no fertilizers and organic manure.

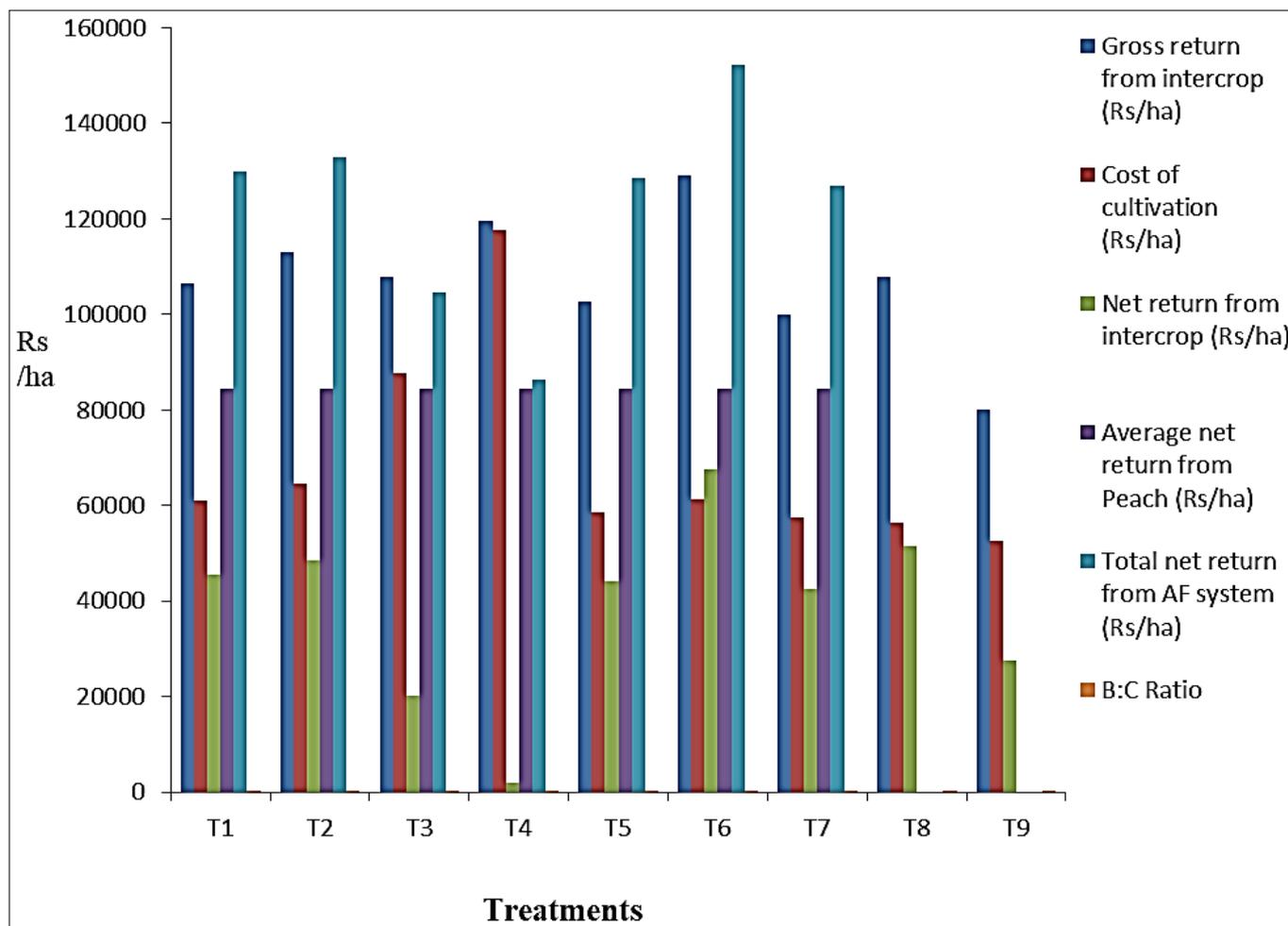


Fig 1: Showed that the plant height of *Lepidium sativum* at harvesting stages was significantly influenced by different doses of organic manures and fertilizer

The total net return was recorded higher during first year compared to second year of study.

Table 4: Economic analysis of *Lepidium sativum* under peach based under agroforestry system on gross income, cost of cultivation, net income and B:C ratio in 2017-18

Characters Treatments	Gross return from intercrop (Rs/ha)	Cost of cultivation (Rs/ha)	Net return from intercrop (Rs/ha)	Average net return from peach (Rs/ha)	Total net return from AF system (Rs/ha)	B:C ratio
T ₁	87080	59624.15	27455.85	76,830	104,286	1.75
T ₂	94780	63124.15	31655.85	76,830	108,486	1.72
T ₃	88760	86124.15	2635.85	76,830	79,466	0.92
T ₄	100800	116124.2	-15324.2	76,830	61,506	0.53
T ₅	83020	57124.15	25895.85	76,830	102,726	1.80
T ₆	110600	59874.15	50725.85	76,830	127,556	2.12
T ₇	80220	56124.15	24095.85	76,830	100,926	1.80
T ₈	88620	55374.15	33245.85	-	-	1.60
T ₉	55580	51624.15	3955.85	-	-	1.08
Mean	87717.78	67235.26	20482.52			1.48

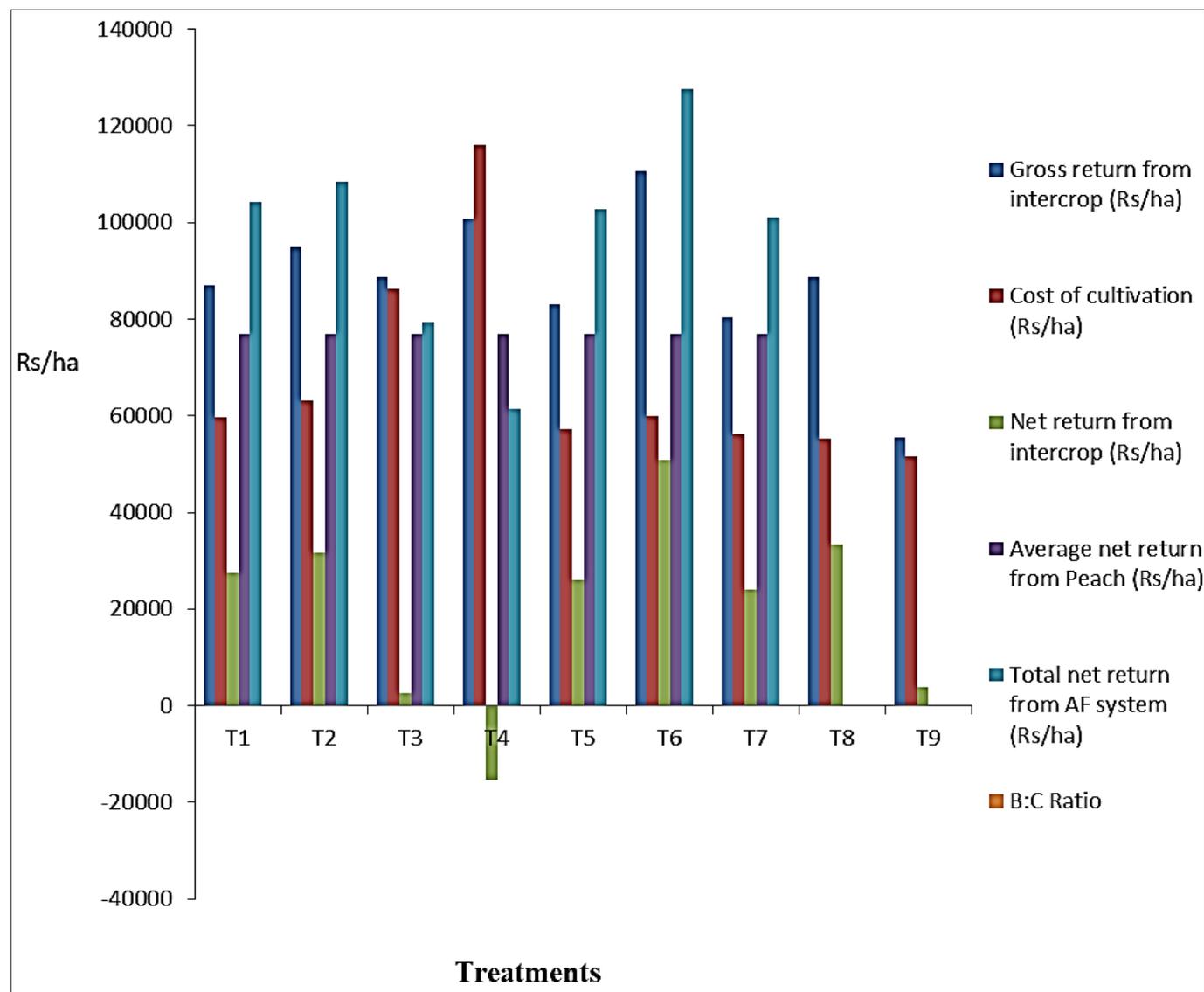


Fig 2: Show the gross return form intercrop

The data related to benefit cost ratio of *L. sativum* plants. In *L. sativum* cultivated under peach maximum benefit cost ratio (2.46 and 2.12) was recorded in T₆ during 2016-17 and 2017-18, respectively. However, minimum (0.73 and 0.53) was recorded in T₄ in 2016-17 and 2017-18, respectively. The data showed that fertilizers and organic manures under peach were profitable as compared to sole crop. Similar results were reported by Thakur and Raj Kumar (2006)^[17, 18] in *Tagetes minuta* and *Ocimum basilicum* under *Leucaena leucocephala* and *Morus alba*, Chauhan *et al.* (1997)^[3] in *Citronella java* under *Eucalyptus*, Suresh *et al.* (2004)^[16] in *Achyranthes aspera* and Yu Guangming *et al.* (1998)^[19] in Peony. *Lepidium sativum* was grown under peach based agroforestry system (Peach + *Lepidium sativum*) higher yield and returns were recorded as compared to sole crop. Similar results were reported by Thakur *et al.* (2016)^[17, 18] in *Ocimum* species under teak based silvi medicinal systems.

Conclusion

The investigations were conducted for two consecutive years (2016-17 and 2017-18) on the effect of organic manures and fertilizers under peach on the growth and productivity of *Lepidium sativum* along with economic appraisal of the system. The aim of this studies were to evaluate the possibilities of growing medicinal and aromatic plants as intercrops under fruit based agroforestry system for

diversification and boosting the economy of the farmers. The results indicated that the growth parameters of *Lepidium sativum* like plant height, number of branches per plant differed significantly with the application of fertilizers followed by organic manures under horti-medicinal system of agroforestry. The studies revealed that the application of fertilizers were effective in improving the growth of medicinal and aromatic plants with tree and without tree. *Lepidium sativum* maximum straw yield (13.74 q/ha and 11.20 q/ha) and seed yield per plant (2.98 g and 2.37 g) and seed yield (9.93 q/ha and 7.90 q/ha) was recorded in T₆ (Peach + *Lepidium sativum* + RDF NPK 60:30:30 kg/ha) during both the years. The maximum cost of cultivation (Rs. 1, 17, 624.2 /ha and Rs. 1, 16, 124.2 /ha) was recorded in vermicompost (4t/ha), where *Lepidium sativum* was grown under peach tree. Maximum net return (Rs. 1, 52, 166/ha and Rs. 1, 27, 556 /ha) was obtained in T₆ (Peach + *Lepidium sativum* + RDF NPK 60:30:30 kg/ha). Highest B:C ratio (2.46) and (2.12) was found under peach tree during both the years. The results obtained from the present investigations showed that the performance of *Lepidium sativum* was well under horti medicinal system of agroforestry as compared to sole crop. The growth, yield and physiological attributes of medicinal herbs were not adversely affected by the presence of peach tree. The intercropping of medicinal and aromatic plants (MAP's) with peach was found more beneficial as compared

to sole crop. The result revealed that horti-medicinal system of agroforestry is more profitable and the use of fertilizers and organic manures gear up the growth by improving soil physicochemical properties, enhancing microbial activity and increasing nutrient availability to plants which helped in enhancing the yield of medicinal herbs under horti medicinal system of agroforestry. Uses of NPK increased the availability of nutrients to the plant. Based on present findings, this can be concluded that *Lepidium sativum* can be successfully grown under peach based agroforestry system for getting more economic returns.

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