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RESEARCH ARTICLE

Economic potential of *Angelica glauca* Edgew: an endangered plant of western Himalaya

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ABSTRACT

The present study was carried out to assess the economic viability of *Angelica glauca*. Cost benefit ratio tool was used to assess the net benefit that could lure the local farm community to bring this important species in farm cultivation and thus promote the ex-situ conservation of species. To observe the economic yield of plants, underground parts of the plant from treatments were uprooted at the end of growing season. Cost benefit analysis was calculated on the basis of total output in the form of cash and total investment on various development activities. The cost of cultivation including all the inputs among different treatments varied from Rs. 76606.47 (F_0) to Rs. 114544.28 (F_6). Similarly, while calculating the return, the total dry plant biomass obtained was multiplied by the average of prevailing market rate of *Angelica glauca*. The Benefit Cost Ratio (BCR) among the various treatments varied from 1.91 (F_2) to 2.49 (F_7) and the highest benefit-cost ratio of 2.49 was observed when FYM @ 10t/ha along with *Azotobacter* @ 5 kg/ha and PSB @ 5 kg/ha were applied.

1) INTRODUCTION

Indian Himalayan is represented by more than 1784 plant species, of which several are economically very important [1]. In India, 814 plant species have been identified as threatened and over 113 taxa occur in Indian Himalaya alone [2, 3, 4, 5]. The list includes *Angelica glauca* Edgew (Choru in hindi) which is considered critically endangered species [6]. The root of *A. glauca* are used as a stimulant, cardioactive, carminative, sudorific and expectorant, and yield a pale to brownish yellow essential oil (0.4-1.3% dry basis) [7]. The roots are also useful in stomach related problems (gas, constipation, etc.) and bronchitis. The powdered root along with milk is used to treat bronchitis [8], for curing rheumatism and urinary disorders. Whole herb is reported to be useful to cure stomach troubles, bilious complaints, menorrhagia, infantile atrophy and as a stimulant [7]. In the temperate and alpine zone of the Himalaya, increasing intensity of harvesting of medicinal plants have adversely affected the habitats of many species leading to gradual loss in regeneration potential and diversity of many economically valuable species. Large- scale cultivation of threatened and economically important wild plants is the most effective way to sustainable utilization and conservation. Since cultivation of medicinal and aromatic plants is a relatively recent phenomenon, very few studies have been undertaken to evaluate the relative crop economics of medicinal plants the cultivation of certain high altitude Himalayan herbs could yield products priced anywhere between Rs. 7,150 to 55,000 per hectare although it is not clear at which point in the marketing chain these prices are paid [9]. Considering the increasing demand for herbal drugs in general and Himalayan medicinal plants in particular and consequent depletion of several species, it is imperative to initiate urgent steps for conservation [10]. Based these facts, the existing information especially with regard to cost benefit analysis and economics in Himachal Pradesh is limited. Although lot of studies have been conducted based on seed germination, taxonomy, distribution, uses and phytochemical properties [8, 11] for *Angelica glauca*. The current study was devised to make an attempt to provide economics overview of *A. glauca*. The current study was conducted in experimental farm situated at Department of Forest Products (Dr Y S Parmar University of Horticulture and Forestry, Solan) Himachal Pradesh. The climate of the site was temperate and having sandy loam soil. The geographical location of the farm is at Latitude: 30^0 52' N and Longitude: 70^0 11' E. The soil pH was 7.73, with electrical conductivity (mmhos/cm) 0.42 and it contained 315.00 kg/ha N, 12.80 kg/ha P, 284.86 kg/ha K and 0.99 % organic carbon (C). To observe the economic yield of plants, underground parts of the plant from treatments were uprooted at the end of growing season. These plants were brought to the laboratory, washed with running water; surface dried and fresh weight was recorded. Further all the samples were dried to measure dry weight (g/plant). The analysis was

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done by using OPSTAT. Total investment on infrastructure development, land preparation, manure cost, irrigation facilities, harvesting, post harvesting cost etc were calculated for 2 years. Yield was estimated on per hectare basis. Cost benefit analysis was calculated on the basis of total output in the form of cash and total investment on various development activities. The cost of cultivation and the cost of production include all the inputs like seedling costs, labour involved in bed preparation, intercultural operations till final harvesting of the crop which were taken into consideration in terms of money involved in rupees. Similarly, while calculating the return, the total dry plant biomass obtained was multiplied by the average of prevailing market rate of *Angelica glauca*. *Angelica glauca* was raised through both organic and biofertilizers (FYM, Vermicompost, *Azotobacter*, VAM and PSB).

2) MATERIALS AND METHODS

The plants were uprooted from the nursery in the experimental farm in Rahla of Dr Y S Parmar University of Horticulture and Forestry. The plants were then brought to the laboratory, washed with running water; surface dried and fresh weight was recorded. Further all the samples were dried at to measure dry weight (g/plant). The analysis was done by using OPSTAT. Total investment on infrastructure development was calculated. Cost benefit analysis was calculated on the basis of total output in the form of cash and total investment on various development activities. Benefit: cost ratio was calculated by dividing the total returns obtained with the total cost involved during the production.

3) RESULTS AND DISCUSSION

Cost of cultivation

Angelica glauca was raised through organic and biofertilizers (FYM, Vermicompost, *Azotobacter*, VAM and PSB). Cost and return are two most important indicators to evaluate the economic feasibility of an activity. It can be inferred from the table that the cost of cultivation among different treatments varied from Rs. 76606.47 (F_0) to Rs. 114544.28 (F_6). The table further showed that cost of production varied from Rs. 100.37 (F_9) to Rs 130.81 per kg (F_2). The cost analysis showed varied differences among different treatments. Treatment-wise yield of dry roots varied from 711.00 kg/ha (F_0) to 1032.60 kg/ha (F_6) among different treatments. An average price of Rs 250 per kg [12] was assumed for the present study. Increase in yield with addition of manure was due to low mineral nutrients in soil, needed for proper growth and development of plants. Addition of FYM @ 10 tons/ha + *Azotobacter* @ 5 kg / ha + PSB@ 5 kg / ha has also suggested rectifying nutritional problems of various hill crops and deteriorating physical condition of soil [13, 14]. Addition of FYM increased moisture content of soil, physical, chemical and microbial properties and thereby its productivity. Increased soil fertility increases growth of plants and also promote the growth germination of the seeds. Several workers [15, 16, 17] have also supported addition of biofertilizer for improvement of soil quality.

Table 1. Economics of production of *Angelica glauca* under different treatments.

Treatments	Cost of cultivation (Rs./ha)	Total Cost of Production (Rs./ha)	Cost of Production (Rs./kg)
Control (F_0)	76606.47	92578.12	130.21
FYM @ 20 t / ha (F_1)	81750.21	94759.12	129.77
Vermicompost @ 20 t/ha (F_2)	109274.3	129893.2	130.81
Azotobacter @ 10 kg / ha (F_3)	83627.45	100636.4	109.06
VAM @ 10 kg / ha (F_4)	83627.45	100636.4	114.18
PSB @ 10 kg / ha (F_5)	83627.45	100636.4	108.07
Vermicompost @ 10 t / ha + *Azotobacter* @ 5kg / ha + PSB @ 5kg / ha (F_6)	114544.3	131553.2	127.4
FYM @10t/ ha + *Azotobacter* @5kg/ha+PSB @ 5kg / ha (F_7)	85851.85	102860.8	100.37

*Calculated over variable cost only

Table 2: Yield, Average price, gross return and benefit cost ratio for *A. glauca* under different treatments

Treatments	Estimated Dry root yield (Kg/ha)	Average Price (Rs./kg)	Gross Return (Rs./ha)	Benefit Cost Ratio
Control (F_0)	711	250	177750	1.92
FYM @ 20 t / ha (F_1)	730.2	250	182550	1.93
Vermicompost @ 20 t/ha (F_2)	993	250	248250	1.91
Azotobacter @ 10 kg / ha (F_3)	922.8	250	230700	2.29
VAM @ 10 kg / ha (F_4)	881.4	250	220350	2.19
PSB @ 10 kg / ha (F_5)	931.2	250	232800	2.31
Vermicompost @ 10 t / ha + *Azotobacter* @ 5 kg / ha + PSB @ 5 kg / ha (F_6)	1032.6	250	258150	1.96
FYM@10 t/ha + *Azotobacter* @5kg/ha+PSB@ 5 kg / ha (F_7)	1024.8	250	256200	2.49

Butola et al., [12] while working on the same species have pointed out that the yield varies from place to place depending upon the agro-practices and climatic conditions. Same results were found for the present study as the yield varied by applying different doses of media.

Benefit: cost ratio (BCR)

The Benefit Cost Ratio (BCR) among the various treatments varied from 1.91 (F_2) to 2.49 (F_7). The lowest benefit: cost ratio (1.91) was obtained with application of Vermicompost due to its higher rate @ Rs. 10/kg followed by control conditions (1.92, Fig: 1). Hence, if farmers make their own vermicompost then they can get the better returns. Highest benefit-cost ratio of 2.49 was observed when FYM @ 10t/ha along with *Azotobacter* @ 5 kg/ha and PSB @ 5 kg/ha were applied. It was followed by treatment F_5 where PSB was applied @ 10 kg/ha with a BCR of 2.31.

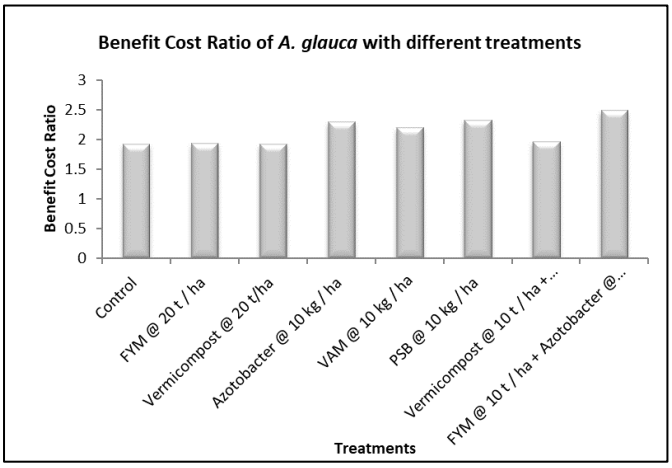

Figure:1 Benefit Cost Ratio of *A. glauca* with different treatments

4) CONCLUSION

It is quite evident from the returns and benefit: cost ratio that farmers can opt for the cultivation of medicinal plants like *Angelica glauca* as an alternate source of income. Like other agricultural crops cultivating medicinal plants on profitable basis can improve the economy of farmers by diversification of cropping system/pattern. If the market of medicinal plants is well organized then farmers can get better benefits than some of the agricultural crops which are grown by them traditionally.

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