**Effect of integrated weed management practices on Economic Analysis of vegetable pea (*Pisum sativum* L.)**

**Abstract:** The ~~present~~ study was conducted entitled, “**Effect of integrated weed management practices on Economic Analysis of vegetable pea (*Pisum sativum* L.)”** during *rabi* season of 2022-23 and 2023-24 at the Vegetable Research Centre, G. B. Pant University of Agriculture and Technology, Pantnagar, U.S.Nagar, Uttarakhand. The experiments were conducted on vegetable pea, variety **Pant Sabji Matar-3.** The experiment was laid out in a Randomized Block Design with nine treatments and replicated three times during *rabi* season of 2022-23 and 2023-24. T3 (Pre-emergence application of pendimethalin 30 EC @ 0.75 kg a.i./ha + 1 hand weeding at 40 DAS) achieved the highest pod yield of 168.89 q/ha, resulting in a gross income of ₹337,780 and a net profit of ₹241,016. The benefit-cost (B:C) ratio for this treatment was 3.49 during 2022-23. T3 again led to the highest pod yield of 162.67 q/ha, with a gross income of ₹325,340, net profit of ₹228,576, and a B:C ratio of 3.36 during the 2023-24 ~~during2023-24~~. Integrated weed management practices, particularly combining pre-emergence herbicides with hand weeding (as in Treatment T3), significantly enhances the economic returns of vegetable pea cultivation. Therefore, adopting such integrated strategies is crucial for optimizing productivity and profitability in vegetable pea farming.

**Keywords:** Economic Analysis, B:C ratio, Gross income, Net profit, Profitability etc.

**Introduction~~:~~**

Pea (*Pisum sativum* L.) is belongs to family Fabaceae. The garden pea varieties are sweet in taste and mostly wrinkled or dimpled due to high sugar content. In India, pea is grown greater than an area of 567 thousand hectare with the yearly production of 5846 thousand metric tons in 2021 while in Uttarakhand region, it is grown more than an area of 13.62 thousand hectare with an yearly production of 102.98 thousand metric tons (Annon., 2021). It was estimated that the Udham Singh Nagar district of Uttarakhand has the highest area as well as production of pea *i.e*. 3713.50 hectare and 30715.00 metric tons, respectively.

Globally, ~~It~~ it is observed that agricultural crops weeds caused the highest potential loss (34 %) with animal pests and pathogens being less important (losses of 18 % and 16 %, respectively). In India, weeds generally reduce crop yield by 36.5 % in rainy season and 22.7 % during winter season. It was proved that weeds are economically more important than insects, fungi or other pest organisms (Savary *et al*., 1997). In pea, weeds cause 37.3 to 64.4 % reduction in yield (Harker, 2001).

Herbicides contribute effectively and profitably to weed control, environmental protection, and at the same time, saving labour necessary for weed control practices, reducing soil erosion, saving energy, increasing production and reducing the cost of farming. Therefore, herbicides benefit society as a whole. The importance of herbicides in modern weed management is underscored by the estimates that losses in the agricultural sector would increase to about 500 % without the use of herbicides (Bridges, 1992).

The pre-emergence herbicides were eliminating early weed competition. Pre-emergence herbicides are used most frequently in vegetable pea cultivation because they eliminate competition between crop plant and weeds even at the critical early growth stages. Pre-emergence treatment combined with mechanical methods makes unnecessary the post-emergence protection. Herbicides with different mode of action can influence the growth of pea and cause phytotoxic symptom (Wagner and Nasady, 2006).

The ~~present~~ investigation entitled **“Effect of integrated weed management practices on Economic Analysis of vegetable pea (*Pisum sativum* L.)”** was conducted at Vegetable Research Centre, G.B. Pant University of Agriculture and Technology, Pantnagar, U.S. Nagar (Uttarakhand)

**Materials and Methods**

The ~~present~~ study was conducted entitled, “**Effect of integrated weed management practices on Economic Analysis of vegetable pea (*Pisum sativum* L.)”** during *rabi* season of 2022-23 and 2023-24 at the Vegetable Research Centre, G. B. Pant University of Agriculture and Technology, Pantnagar, U.S.Nagar, Uttarakhand. Uttarakhand falls under agro-climatic zone-I and Pantnagar is situated in the southern part of Uttarakhand. The climate in this region is classified as humid subtropical having a significant variation in temperature. The experiments were conducted on vegetable pea, variety **Pant Sabji Matar-3 -** Developed by G.B. Pant University of Agriculture and Technology, Pantnagar. Its yield potential is about 90 q/ha.

**EXPERIMENTAL DESIGN AND DETAILS OF THE LAYOUT**

The experiment was laid out in a Randomized Block Design with nine treatments and replicated three times during *rabi* season of 2022-23 and 2023-24.

**Table-1: Design of Experiment-**

|  |  |
| --- | --- |
| **Design** | **Randomized Block Design** |
| Period of experiment | Rabi season |
| Name of cultivar | Pant Sabji Matar-3 |
| Number of treatments | 9 |
| Number of replications | 3 |
| Total number of plots | 27 |
| Gross plot size | 3.5 m x 3.5 m |
| Net Plot size | 2.90 m x 3.30 m (9.57 m2) |
| Row to row spacing | 30 cm |
| Plant to plant spacing | 10 cm |
| Main irrigation channel | 1 m |
| Sub irrigation channel | 1 m |

**Table-2: Detail of the treatments**

|  |  |
| --- | --- |
| **Symbols**  | **Treatments combination** |
| T1 | Metribuzin 70 WP @ 0.75 kg a.i./ha |
| T2 | Metribuzin 70 WP @ 1.0 kg a.i./ha |
| T3 | Pendimethalin 30 EC @ 0.75 kg a.i./ha + 1 hand weeding at 40 DAS)\* |
| T4 | Pendimethalin 30 EC @ 1.0 kg a.i./ha |
| T5 | Pinoxaden 5.1 EC @ 70 ml/ha |
| T6 | Pinoxaden 5.1 EC @ 100 ml/ha |
| T7 |  Weed Free |
| T8 |  Hand Weeding at 20 and 40 DAS |
| T9 |  Weedy Check |

Note: \*DAS = Days After Sowing

Metribuzin 70 WP @ 0.75 kg a.i./ha (T1), Metribuzin 70 WP @ 1.0 kg a.i./ha(T2), Pendimethalin 30 EC @ 0.75 kg a.i./ha + 1 hand weeding at 40 DAS)\*(T3), Pendimethalin 30 EC @ 1.0 kg a.i./ha(T4), Pinoxaden 5.1 EC @ 70 ml/ha (T5), Pinoxaden 5.1 EC @ 100 ml/ha(T6), Weed Free (T7), Hand Weeding at 20 and 40 DAS(T8) and Weedy Check(T9)

**ECONOMICS**

**Cost of cultivation (Rs):** The cost of cultivation was calculated by considering all the expenses incurred (seed, fertilizer, irrigation, plant protection chemicals, labour) based on the current market rates of inputs.

**Gross Returns (Rs):** For each treatment, the gross return in rupees per hectare was calculated by considering the current market value of seed yield.

**Net Returns (Rs):** The net return for each treatment was determined by subtracting the cost of cultivation from the gross return.

**Benefit: Cost ratio:**

**Benefit: Cost ratio =** $\frac{Gross income(Rs/ha)}{Total expenditure (Rs/ha)}$

**Result and Discussion**

The study evaluated the impact of various integrated weed management (IWM) treatments on the economics of vegetable pea cultivation over two consecutive years (2022-23 and 2023-24). The treatments included combinations of pre-emergence herbicides, hand weeding, and a weed-free control. Table-3 indicated that the comprehensive breakdown of the fixed costs provides a clear understanding of the financial requirements for cultivating vegetable peas without additional weed management interventions. Table also depicted that the largest expense categories are fertilizers and manures (₹34,925), harvesting labor (₹20,440), and seed procurement (₹12,000).

**Table-3: Effect of integrated weed management practices on Cost of cultivation of Vegetable pea**

|  |  |  |  |
| --- | --- | --- | --- |
| **Items** | **Quantity** | **Unit (Rs)** | **Cost (Rs)** |
| **Field preparation** |
| By tractor | 2.5 hr ˟ 2 ploughings | 500/hr | 2500.00 |
| Seed | 100 kg | 120/kg | 12000.00 |
| Channel making and bed preparation by tractor | 1 hr | Rs 500/hr | 500.00 |
| Labour | 04 | 365/labour/day | 1460.00 |
| Irrigation (3 times) | 3X4hr/ha/irrigation | 60/hr  | 720.00 |
| Labour | 4 Labour/irrigation  | 365/labour/day |  4380.00 |
| **Fertilizers and Manures** |
| FYM | 25t | 120/q | 30000.00 |
| DAP | 150kg | 2700/q | 4050.00 |
| MOP | 50 kg | 1750/q | 875.00 |
| Fertilizers placement | 4+4 | 365/day/labour | 2920.00 |
| Sowing of seeds (Tractor) | 1hr + 3 Labours | 365/day/labour | 1595 |
| **Insecticide**  |
| Indoxacarb | 167 ml ˟ 2 spray | 3500/litre | 1169.00 |
| 4 labour/ spray | 365/day/labour | 2920.00 |
| Tractor charge (1hr) | 500/hr | 500.00 |
| **Harvesting** |
| Pickings (4 times) | 14 labour ˟ 4 | 365/day/labour | 20440.00 |
| Land rent | 6 month | 100/year | 50.00 |
| Total | **86079.00** |

**Table-4** depicted that treatment T3 (Pre-emergence application of pendimethalin 30 EC @ 0.75 kg a.i./ha + 1 hand weeding at 40 DAS) achieved the highest pod yield of 168.89 q/ha, resulting in a gross income of ₹337,780 and a net profit of ₹241,016. The benefit-cost (B:C) ratio for this treatment was 3.49 during 2022-23. Treatment T4 (Pre-emergence application of pendimethalin 30 EC @ 1.0 kg a.i./ha) also performed well, with a pod yield of 146.67 q/ha, gross income of ₹293,340, net profit of ₹203,502, and a B:C ratio of 3.27 during 2022-23. Treatment T9 (Weedy check) recorded the lowest pod yield of 79.00 q/ha, resulting in a net profit of ₹71,922 and a B: C ratio of 1.83 during 2022-23.

**Table-5** depicted that treatment T3 again led to the highest pod yield of 162.67 q/ha, with a gross income of ₹325,340, net profit of ₹228,576, and a B:C ratio of 3.36 during the 2023-24 during2023-24. Table also depicted that treatment T4 yielded 143.44 q/ha, gross income of ₹286,880, net profit of ₹197,042, and a B:C ratio of 3.19 during 2023-24. Treatment T9 had the lowest performance, with a pod yield of 77.00 q/ha, net profit of ₹67,921, and a B:C ratio of 1.79 during 2023-24.

The results indicated that integrated weed management practices significantly influence the economic outcomes of vegetable pea cultivation. Treatments combining pre-emergence herbicides with hand weeding, particularly Treatment T3, consistently resulted in higher yields, net profits, and B:C ratios across both years. This suggests that such integrated approaches effectively suppress weed competition, leading to enhanced crop performance and profitability. In contrast, the weedy check (Treatment T9) consistently showed the lowest yields and economic returns, highlighting the detrimental impact of uncontrolled weed growth on pea production. These results underscore the importance of implementing effective weed management strategies to optimize yield and economic returns in vegetable pea cultivation. The study aligns with existing literature emphasizing the benefits of integrated weed management. For instance, research has shown that combining herbicides with cultural practices like hand weeding can effectively reduce weed pressure and improve crop yields.

**Table-4: Effect of integrated weed management practices on economics of various treatments in vegetable pea (2022-23)**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Treatment** | **Fixed cost of cultivation (Rs)** | **Additional cost (Rs)** | **Total Expenditure****(Rs)** | **Pod yield (q/ha)** | **Gross income (Rs)** | **Net profit/ha (Rs)** | **B:C ratio** |
| **T1** | 86079.00 | 4884.00 | 90963.00 | 116.22 | 232440.00 | 141477.00 | 2.56 |
| **T2** | 86079.00 | 7256.00 | 93335.00 | 124.22 | 248440.00 | 155105.00 | 2.66 |
| **T3** | 86079.00 | 10685.00 | 96764.00 | 168.89 | 337780.00 | 241016.00 | 3.49 |
| **T4** | 86079.00 | 3759.00 | 89838.00 | 146.67 | 293340.00 | 203502.00 | 3.27 |
| **T5** | 86079.00 | 5514.00 | 91593.00 | 128.67 | 257340.00 | 165747.00 | 2.81 |
| **T6** | 86079.00 | 6915.00 | 92994.00 | 126.67 | 253340.00 | 160346.00 | 2.72 |
| **T7** | 86079.00 | 58400.00 | 144479.00 | 176.89 | 353780.00 | 209301.00 | 2.45 |
| **T8** | 86079.00 | 14600.00 | 100679.00 | 163.22 | 326440.00 | 225761.00 | 3.24 |
| **T9** | 86079.00 | 0.00 | 86079.00 | 79.00 | 158000.00 | 71922.00 | 1.83 |

**Selling price: 2000/q**

**Table-5: Effect of integrated weed management practices on economics of various treatments in vegetable pea (2023-24)**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Treatment** | **Fixed cost of cultivation (Rs)** | **Additional cost (Rs)** | **Total Expenditure****(Rs)** | **Pod yield (q/ha)** | **Gross income (Rs)** | **Net profit/ha (Rs)** | **B:C ratio** |
| **T1** | 86079.00 | 4884.00 | 90963.00 | 112.44  | 224880.00 | 133917.00 | 2.47 |
| **T2** | 86079.00 | 7256.00 | 93335.00 | 122.44  | 244880.00 | 151545.00 | 2.62 |
| **T3** | 86079.00 | 10685.00 | 96764.00 | 162.67  | 325340.00 | 228576.00 | 3.36 |
| **T4** | 86079.00 | 3759.00 | 89838.00 | 143.44  | 286880.00 | 197042.00 | 3.19 |
| **T5** | 86079.00 | 5514.00 | 91593.00 | 122.89  | 245780.00 | 154187.00 | 2.68 |
| **T6** | 86079.00 | 6915.00 | 92994.00 | 123.89  | 247780.00 | 154786.00 | 2.66 |
| **T7** | 86079.00 | 58400.00 | 144479.00 | 174.67  | 349340.00 | 204861.00 | 2.42 |
| **T8** | 86079.00 | 14600.00 | 100679.00 | 156.78  | 313560.00 | 212881.00 | 3.11 |
| **T9** | 86079.00 | 0.00 | 86079.00 | 77.00  | 154000.00 | 67921.00 | 1.79 |

**Selling price: 2000/q**

**Summary and Conclusion:** ~~Present~~ study examined the economic effect of various integrated weed management (IWM) strategies on vegetable pea cultivation over two consecutive years (2022-23 and 2023-24). The treatments combined pre-emergence herbicides, hand weeding, and a weed-free control. The baseline cultivation cost without additional weed management interventions was ₹86,079 per hectare. Major expenses included fertilizers and manures (₹34,925), harvesting labor (₹20,440), and seed procurement (₹12,000).

Result depicted thatTreatment T3 (pre-emergence application of pendimethalin 30 EC @ 0.75 kg a.i./ha + one hand weeding at 40 DAS) achieved the highest pod yield of 168.89 q/ha, resulting in a gross income of ₹337,780 and a net profit of ₹241,016, with a benefit-cost (B:C) ratio of 3.49 during 2022-2023. In contrast, the weedy check (T9) recorded the lowest yield of 79.00 q/ha, net profit of ₹71,922, and a B:C ratio of 1.83 during 2022-23.

Result depicted that treatment T3 maintained superior performance with a pod yield of 162.67 q/ha, gross income of ₹325,340, net profit of ₹228,576, and a B:C ratio of 3.36 during 2023-24. The weedy check (T9) remained the lowest performer with a yield of 77.00 q/ha, net profit of ₹67,921, and a B:C ratio of 1.79 during 2023-24.

Results clearly depicted that integrated weed management practices, particularly combining pre-emergence herbicides with hand weeding (as in Treatment T3), significantly enhances the economic returns of vegetable pea cultivation. Integrated weed management approach effectively suppresses weed competition, leading to higher yields and profitability. Conversely, neglecting weed management (as in the weedy check, T9) results in substantial yield losses and reduced economic benefits. Therefore, adopting such integrated strategies is crucial for optimizing productivity and profitability in vegetable pea farming.

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