**Assessment of apple grower’s knowledge on cultivation practices in Mandi district of Himachal Pradesh, India**

**ABSTRACT**

Apple (*Malus domestica* Borkh.) is native to Southwestern Asia and is an extensively cultivated fruit crop in temperate regions around the world. Apple holds immense economic importance as a fruit crop globally. The study was undertaken with the objective of studying the knowledge level of apple growers about apple cultivation practices. This study is important because improving the knowledge of apple growers can lead to better farming practices, higher production and ultimately better income and livelihood for the farmers of Mandi district. The study was conducted in the Seraj valley of Mandi district of Himachal Pradesh, which has the highest area under apple cultivation. The total sample size for the present study comprises 120 apple growers. Percentage analysis was used in descriptive analysis for making single comparisons. It was observed that most respondents exhibited strong practical knowledge in apple cultivation practices such as grafting technique, pruning methods and pit spacing. However, significant gaps were observed in technical areas, particularly the names of the weedicides, insecticides and fungicides used. Despite this, nearly half of the respondents had medium knowledge, and only a small fraction had high knowledge. Correlation analysis revealed education (r= 0.757), age (r=0.69) and land holding were (0.256). The majority of the apple growers (50.83%) were middle-aged (38–49 years), while 33.33% were older and 15.83 per cent were younger. Regarding the income, most respondents (69.17%) earned between ₹1–3 lakhs annually, while 20 per cent earned less than ₹1 lakh and only 10.83% earned more than ₹3 lakhs. It was concluded that most of the apple growers were middle-aged with a moderate level of education. They mainly lived in a nuclear family and had medium-sized landholdings. The study also found that factors like age, education, landholding size, use of information sources, extension contact and economic motivation had a positive and significant correlation with farmers' knowledge about apple cultivation.

*Keywords:* Apple, correlation, farming community, knowledge, respondents

**1. INTRODUCTION**

“Apple (*Malus domestica*) is one of the most popular fruits in the world. It represents one of the most produced fruits worldwide, along with citrus and bananas. It is an important temperate fruit, grown in both developed as well as developing countries, including India. Apple is widely popular with both growers as well as consumers for its strong adaptability (ecological) and high nutritional value. Globally, it has an important economic impact, and it has been estimated that almost 5 million hectares of apples are harvested worldwide” (Shah et al., 2022; Wani et al., 2021). It is native to Southwestern Asia and is an extensively cultivated fruit crop in temperate regions around the world. Apple holds immense economic importance as a fruit crop globally (Bramel and Volk 2019). “Apple is considered one of the most important and widely grown fruits in temperate zones of the world with regard to its acreage, production, economic returns, high nutritive value and popularity. The apple tree is small and deciduous, reaching 3 to 12 meters (9.0 to 39 feet) tall with a broad, often densely twiggy crown. Blossoms are produced in spring, simultaneously with the budding of leaves. The fruit matures in autumn and is typically 5 to 9 cm (2 to 3.5 inches) in diameter, enriched with nutrients”. (Malik, 2013).

The global apple production achieved a remarkable figure of 93,144,358.17 MT from an area worth 48,22,226 ha (FAOSTAT, 2023). In India, it has emerged as a major commercial fruit crop in J&K, Himachal Pradesh (H.P.), and Uttarakhand. Its cultivation has also extended to states such as Arunachal Pradesh, Sikkim, Nagaland, and Meghalaya in the North-Eastern region and the Nilgiri hills in Tamil Nadu. In the country, it is cultivated across an area of 3,13,000 ha, producing 22,76,000 MT of fruits annually with a productivity of 7.3 MT/ha (FAOSTAT, 2023)

“A significant pattern of Himachal Pradesh’s economy is derived from horticulture. The state’s temperate horticulture is rapidly growing due to favourable agro-climate conditions, which are typified by the growing dominance of apple farming” (Jangta & Attri, 2025). Horticulture is the main source of economic growth in Himachal Pradesh. The state is known for its horticultural development and is also known as ‘Fruit Bowl of the Nation’ (Wani and Songara, 2018). H.P. has emerged as India’s horticulture state, and it has been designated as the apple state of India for producing the finest quality apples. “Apple is the most important fruit crop of Himachal Pradesh, which constitutes about 49 per cent of the total area under fruit crops and about 85 per cent of the total fruit production. Area under apple has increased from 400 hectares in 1950-51 to 3,025 hectares in 1960-61 and 1,14,646 hectares in 2020-21” (Hartta, 2023). Shimla, Kullu, Chamba, Sirmaur, Lahaul & Spiti and Kinnaur are the primary apple-producing districts in Himachal Pradesh. Farmers in H.P. are urged to develop the world’s finest and most desirable apple varieties. The state department of horticulture assists them in the upliftment of the rural population and has also generated employment. Apple farming dominates the hilly regions of Himachal Pradesh, where it is cultivated across an area of 1,15,680 ha, resulting in an annual production of 4,84,000 MT and a productivity of 4.18 MT/ha (FAOSTAT, 2023). Mandi district possessed an area of 17,352 ha with production of 58,734 metric tonnes and productivity of 3.34 mt/ha (FAOSTAT, 2023).

Apple farming is one of the main sources of income for farmers in the Mandi district of Himachal Pradesh. The region has a suitable climate and land for apple cultivation. However, many apple growers are not fully aware of modern farming techniques, which affect~~s~~ their productivity and profits. Lack of knowledge about proper planting methods, pest and disease control, pruning, irrigation and post-harvest handling leads to low yields and poor-quality fruit. To improve apple production, it is important to first understand what farmers already know and where they lack information. By studying their level of knowledge, we can identify the specific areas where training and support are needed. This will help horticultural departments and extension workers to design better awareness programmes and provide the right guidance to the farmers. This study is important because improving the knowledge of apple growers can lead to better farming practices, higher production and ultimately better income and livelihood for the farmers of Mandi district.

**2. MATERIALS AND METHODS**

The present study was conducted in the Mandi district of Himachal Pradesh. Mandi district is located in central H.P. and is characterised by its mountainous terrain and river systems. It's situated between 31° 13' 50" and 32° 04' 30" North latitude and 76° 37' 20" and 77° 23' 15" East longitude. The district is bordered by several other districts: Kangra to the northwest, Hamirpur and Bilaspur to the west, Solan and Shimla to the south and Kullu to the east.

**2.1 Knowledge Level**

Knowledge level was measured w.r.t correct responses given by the apple growers by way of recall or recognition, or identification on a standardised knowledge test used for the study.

**2.2 Selection of blocks**

There are 11 blocks in the Mandi district of Himachal Pradesh, out of which the Seraj block has been selected purposively because of the maximum number of apple growers.

**2.3 Selection of villages**

Out of 296 villages in the Seraj block, five villages, namely **Dhawas, Cheuni, Lamba Thaach, Chhatri and Tung,** having the maximum number of apple growers were selected.

**2.4 Selection of respondents**:

From each village, 24 respondents were selected through a random sampling method. The total sample size comprises 120 farmers.

TABLE 1. Selection of respondents

|  |  |  |  |
| --- | --- | --- | --- |
| **District** | **Block** | **Village** | **No. of respondents** |
| **Mandi** | **Seraj** | Dhawas | 24 |
| Cheuni | 24 |
| Lamba Thaach | 24 |
| Chhatri | 24 |
| Tung | 24 |
| **Total**  | **01** | **05** | **120** |

**2.5. Statistical analysis**

**2.5.1 Arithmetic Mean (**$\overbar{x}$**)**

The arithmetic mean is the quotient that results when the sum of all items in the series is divided by the number of items (N).

$$\overbar{x}= \frac{\sum\_{}^{}x}{N}$$

Where,

 $\overbar{x}$ = mean

 $\sum\_{}^{}x$ = Sum of each individual score

 N = Total number of items

**2.5.2 Percentage analysis**

Percentage analysis was used in descriptive analysis for making single comparisons. The frequency of the particular cell was multiplied by 100 and divided by the total number of respondents pertaining to the particular cell. Percentages were corrected up to two decimal places.

**2.5.3 Pearson’s product-moment correlation co-efficient**

It was used to find out the relationship between two knowledge levels and socio-personal characteristics of apple growers. Pearson’s product-moment correlation coefficient was calculated using the formula,

$$r= \sum\_{}^{}xy-\frac{\frac{\left(\sum\_{}^{}x\right)(\sum\_{}^{}y)}{n}}{\sqrt{(\frac{\sum\_{}^{}x^{2}-(\sum\_{}^{}x)^{2}}{n}})×\frac{\sum\_{}^{}y^{2}-(\sum\_{}^{}y)^{2}}{n}}$$

Where,

n = Sample size

$\sum\_{}^{}xy-\frac{(\sum\_{}^{}x)(\sum\_{}^{}y)}{n}$ = Sum of product of x and y

$\frac{\sum\_{}^{}x^{2}-\sum\_{}^{}(x)^{2}}{n}$ = Sum of square of x

$\frac{\sum\_{}^{}y^{2}-\sum\_{}^{}(y)^{2}}{n}$ = Sum of square of y

**3. RESULTS AND DISCUSSION**

**Table 2. Distribution of the respondents according to socio-personal characteristics**

**(n=120)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S No.** | **Socio-personal characteristics** | **Category** | **Frequency** | **Percentage** |
| **1** | **Age (years)** | Young (24-38) | 19 | 15.83 |
|  |  | Middle (38-49) | 61 | 50.83 |
|  |  | Old (49-73) | 40 | 33.33 |
| **2** | **Education** | Illiterate | 11 | 9.17 |
|  |  | Primary School | 11 | 9.17 |
|  |  | Middle School | 22 | 18.33 |
|  |  | High school | 27 | 22.5 |
|  |  | Intermediate | 34 | 28.33 |
|  |  | Graduate and above | 15 | 12.5 |
| **3** | **Family Size** | Small (up to 6 members) | 76 | 63.33 |
|  |  | Medium (7-14 members) | 29 | 24.17 |
|  |  | Large (15 and above) | 15 | 12.5 |
| **4** | **Family type** | Nuclear/Single family | 89 | 74.17 |
|  |  | Joint family | 31 | 25.83 |
| **5** | **Housing Pattern** | Kaccha | 20 | 16.67 |
|  |  | Semi-cemented | 38 | 31.67 |
|  |  | Cemented | 62 | 51.67 |
| **6** | **Land Holding** | Marginal (Below 1 ha.) | 34 | 28.33 |
|  |  | Small (1 to 2 ha.) | 30 | 25 |
|  |  | Medium (2 to 4 ha.) | 41 | 34.17 |
|  |  | Large (4 ha. and above) | 15 | 12.5 |
| **7** | **Annual income** | Up to 1.0 lakh | 24 | 20 |
|  |  | 1 lakh to 2 lakh | 42 | 35 |
|  |  | 2-3 lakh | 41 | 34.17 |
|  |  | Above 3 lakh | 13 | 10.83 |
| **8** | **Farm Power** | Tractor | 27 | 22.5 |
|  |  | Diesel Engine/Pumping set | 68 | 56.67 |
|  |  | Electric Motor | 37 | 30.83 |
|  |  | Power tiller | 2 | 1.67 |
|  |  | Bullock | 5 | 4.16 |
| **9** | **Source of Information** | Low (16-19) | 34 | 28.34 |
|  |  | Medium (20-21) | 68 | 56.66 |
|  |  | High (22-24) | 31 | 15 |
| **10** | **Economic Motivation** | Low (6-18) | 37 | 30.83 |
|  |  | Medium (19-30) | 52 | 43.33 |
|  |  | High (31-42) | 31 | 25.83 |
| **11** | **Risk Orientation** | Low (10-13) | 41 | 34.16 |
|  |  | Medium (14-32) | 46 | 38.33 |
|  |  | High (33-41) | 33 | 27.5 |

The majority of the apple growers (50.83%) were middle-aged (38–49 years), while 33.33% were older and 15.83 per cent were younger. In terms of education, 28.33 %had studied up to intermediate, followed by 22.5 per cent up to high school and 18.33 per cent up to middle school. Only 12.5 per cent were graduates or above, and 18.34% were either illiterate or had only primary education, indicating a moderate educational level. The majority of the families (74.17%) were nuclear, and more than half (51.67%) lived in cemented houses, while others had semi-cemented or kaccha houses. The majority of the farmers (34.17%) had medium-sized landholdings, while 28.33% were marginal farmers and 25 per cent were small farmers. Regarding the income, most respondents (69.17%) earned between ₹1–3 lakhs annually, while 20 per cent earned less than ₹1 lakh and only 10.83% earned more than ₹3 lakhs. For farm power, 56.67 per cent used diesel engines or pumps, 30.83 per cent used electric motors, and 22.5 per cent had tractors. A few still used bullocks or power tillers, showing partial mechanisation. Most of the respondents (56.66%) had a medium level of access to information, while 28.34% had low and 15 per cent had high access. Economic motivation was also mostly medium (43.33%), while 25.83 per cent were highly motivated. In terms of risk-taking, 38.33 per cent showed medium, 34.16 per cent low, and 27.5 per cent high risk orientation.

**Table 3: Distribution of the respondents on the basis of Knowledge on various aspects of apple cultivation (n=120)**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **S No.** | **Statements** | **Correct Knowledge** | **%** | **Incorrect Knowledge** | **%** |
| **A. Knowledge about varieties, grafting, pruning and planting** |
| **1** | Mention the names of any two varieties of apples  | 103 | 85.83 | 17 | 14.17 |
| **2** | Mention any one type of grafting  | 99 | 82.5 | 21 | 17.5 |
| **3** | What should be the appropriate size of a pit for planting an apple | 85 | 70.83 | 35 | 29.17 |
| **4** | For how many days should the pit be left open before planting | 95 | 79.17 | 25 | 20.83 |
| **5** | How much cow dung should be added to the pit | 83 | 69.17 | 37 | 30.83 |
| **6** | When should the plants of apple should be planted in the field | 87 | 72.5 | 33 | 27.5 |
| **7** | What should be the optimum time for pruning  | 101 | 84.17 | 19 | 15.83 |
| **8** | At the time of planting, what should be the height of the bud joint above the surface of soil?  | 92 | 76.67 | 28 | 23.33 |
| **B. Knowledge about weedicides, insecticides and disease grafting, pruning and planting** |
| **9** | Name any weedicide for the control of weeds in orchards | 92 | 76.67 | 28 | 23.33 |
| **10** | Name any insect pest of apple  | 87 | 72.5 | 33 | 27.5 |
| **11** | Name any disease of the apple  | 83 | 69.17 | 37 | 30.83 |
| **12** | Tell the name of any insecticide for the control of root borer in apple | 68 | 56.67 | 52 | 43.33 |
| **C. Knowledge about fruit thinning and plant growth regulators** |
| **13** | Name any growth regulator for the control of fruit dropping in apple. | 89 | 74.17 | 31 | 25.83 |
| **14** | Name any growth regulator for the control of fruit setting in apple. | 79 | 65.83 | 41 | 34.17 |
| **15** | Which growth regulator should be applied for the early ripening of apple | 80 | 66.67 | 40 | 33.33 |
| **16** | What is the appropriate time for fruit thinning in apple  | 85 | 70.83 | 35 | 29.17 |

**Knowledge about varieties, grafting, pruning and planting**

The majority (85.83%) of the respondents have knowledge about varieties, and 82.5 per cent of the apple growers had knowledge about the type of grafting. Similarly, 84.17 per cent of the apple growers knew the optimum time for pruning. The knowledge related to technical operations like the duration for leaving pits open, the amount of cow dung required and the height of the bud joint for planting from the surface of the soil was possessed by 79, 69 and 92 per cent of the farmers, respectively.

**Knowledge about weedicides, insecticides and disease**

Table 3 revealed knowledge of the apple growers about weedicides, insecticides and diseases. More than 3/4th of the apple growers were able to name a weedicide commonly used for controlling weeds in apple orchards. Furthermore, 72.5 per cent hadknowledge about insect pests, while 69.17 per cent had knowledge of common diseases affecting the apple crop. However, only 56.67 per cent of respondents could correctly name an insecticide for controlling root borers.

**Knowledge about fruit thinning and plant growth regulators**

The knowledge of the apple growers about fruit thinning, plant growth regulators, weedicides, insecticides and diseases is given in Table 3. About 74.17 per cent of the apple growers were aware of growth regulators used for controlling fruit drop, and 70.83 per cent knew the appropriate time for fruit thinning. However, 65.83 per cent of the apple growers had knowledge about growth regulators used for fruit setting in apples. The 66.67 per cent knew which growth regulator should be applied for early ripening of apple, and 70.83 per cent of the apple growers knew about the appropriate time for fruit thinning in the apple crop.

**Table 4. Level of knowledge of the respondents towards apple cultivation (n=120)**

|  |  |  |
| --- | --- | --- |
| **Knowledge level**  | **Number of apple growers** | **Frequency (%)** |
| Low (11-19) | 12 | 10 |
| Medium (19-22) | 66 | 55 |
| High (22-32) | 42 | 35 |
| Total | 120 | 100 |

Table 4 showed that 55 per cent of the apple growers had medium knowledge, whereas high knowledge about scientific practices was possessed by 35 per cent, and only 10 per cent of the apple growers fell under the low category knowledge level. These findings are in agreement with the findings of *Shah et al.* (2017), which indicated that a larger number of apple growers belonged to the medium knowledge category.

**Fig 1. Knowledge level of apple growers towards apple cultivation**

**Table 5. Association between selected independent variables with knowledge of apple growers about apple cultivation**

|  |  |  |
| --- | --- | --- |
| **S. No.** | **Variables** | **Correlation coefficient(r)** |
| **1** | Age | 0.997\* |
| **2** | Education | 0.970\* |
| **3** | Land holding | 0.577\*\* |
| **4** | Annual income | 0.443\*\* |
| **5** | Source of information | 0.577\*\* |
| **6** | Extension contacts | 0.443\*\* |
| **7** | Economic motivation | 0.645\*\* |

**\***=Correlation is significant at the 0.01 level of probability

**\*\***= Correlation is significant at the 0.05 level of probability

The Table 5 concluded that the independent variables i.e. land holding, source of information utilized, annual income, extension contacts and economic motivation were positively and significantly correlated with the knowledge of apple growers towards apple cultivation at 0.05% %level of probability, whereas the variables like age and education were significantly correlated at 0.01% %level of probability with the knowledge of apple growers towards apple cultivation. These findings are in agreement with the findings of Shah *et.al.* (2022) and Yousuf *et.al.* (2023).

**4. CONCLUSION**

It was concluded that most of the apple growers were middle-aged with a moderate level of education. They mainly lived in a nuclear family and had medium-sized landholdings. The majority of the apple growers earned between ₹1–3 lakhs annually and used diesel or electric-powered farm equipment. Tractors were possessed by a few of the respondents, and the majority used traditional tools. Most of the apple growers had medium access to information, a medium level of economic motivation and a moderate level of risk-taking ability. It was found that the apple growers have good knowledge about apple varieties, method of grafting and pruning practices, but have fair knowledge about technical aspects, viz., pit size, cow dung quantity and planting techniques. The knowledge about weedicides, insect pests and diseases was satisfactory, but fewer farmers knew about specific insecticides to be applied to manage root borers. Awareness of fruit thinning and plant growth regulators was moderate, with some gaps in knowledge about growth regulators used for fruit setting and early ripening. The study also found that factors like age, education, landholding size, use of information sources, extension contact and economic motivation had a positive and significant correlation with farmers' knowledge about apple cultivation.

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