STATUS AND PROSPECTS OF ORGANISED AND UNORGANISED POTATO SEED PRODUCERS IN PUNJAB

Thesis

Submitted to the Punjab Agricultural University
in partial fulfilment of the requirements
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MASTER OF SCIENCE
in
EXTENSION EDUCATION
(Minor Subject: Vegetable Science)

By

Lakhwinder Singh
(L-2015-A-38-M)

Department of Extension Education
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LUDHIANA – 141 004

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CERTIFICATE I

This is to certify that the thesis entitled, **"Status and prospects of organised and unorganised potato seed producers in Punjab"** submitted for the degree of **M.Sc.** in the subject of **Extension Education** (Minor subject: **Vegetable Science**) of the Punjab Agricultural University, Ludhiana, is a bonafide research work carried out by **Lakhwinder Singh (L-2015-A-38-M)** under my supervision and that no part of this thesis/dissertation has been submitted for any other degree.

The assistance and help received during the course of investigation have been fully acknowledged.

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CERTIFICATE II

This is to certify that the thesis entitled, **"Status and prospects of organised and unorganised potato seed producers in Punjab"** submitted by **Lakhwinder Singh (L-2015-A-38-M)** to the Punjab Agricultural University, Ludhiana, in partial fulfillment of the requirements for the degree of **M.Sc.** in the subject of **Extension Education** (Minor subject: **Vegetable Science**) has been approved by the Student's Advisory Committee after an oral examination on the same.

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ABSTRACT

The present study entitled "Status and prospects of organised and unorganised potato seed producers in Punjab" was conducted in a cluster of three major potato seed producing districts of Punjab i.e. Jalandhar, Hoshiarpur and Kapurthala. A sample of 180 respondents comprising 90 organised and 90 unorganised potato seed producers were selected. It was found that majority of the organised and unorganised respondents were in the age group of 40-55 years and having joint families with average size 4-6 members and had large operational land holding. Majority of the respondents had medium level of risk bearing capacity, economic motivation and innovativeness. Study revealed that majority of the respondents had adopted recommended potato varieties at their fields. More number of organised farmers obtained seed from govt. sources like CPRI (30.00%) and PAU in comparison to unorganised farmers and used foundation and certified seed for multiplication. Organised respondents planted their crops earlier. Majority (91.11%) of organised respondents performed dehaulming at 60-80 DAS, while majority of unorganised respondents (55.56%) performed dehaulming at 100-120DAS. On an average, organised respondents applied more number of sprays of insecticides (1.82) and fungicides (2.06) to produce quality potato seed as compared to 1.60 and 1.80 in case of unorganised respondents. Organised potato seed producers usually graded their produce for distant markets of other states and were not much dependent on middleman for selling their produce. About 37.77 per cent of unorganised and 13.33 percent of organised expressed their desire to decrease 9.0 and 1.29 per cent area under potato seed production in future, respectively. Non-remunerative prices, lack of regulated markets, non-availability of storage facilities, price fluctuation in the markets, high cost of seed and non-availability of quality seed were major problems faced by the respondents.

Keywords: Status, Prospects, Problems, Potato seed producers

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ਖੋਜ ਦਾ ਸਿਰਲੇਖ	:	ਪੰਜਾਬ ਵਿੱਚ ਸੰਗਠਿਤ ਅਤੇ ਅਸੰਗਠਿਤ ਆਲੂ ਬੀਜਾਂ ਉਤਪਾਦਕਾਂ ਦੀ ਸਥਿਤੀ ਅਤੇ ਭਵਿੱਖਤ ਸੰਭਾਵਨਾਵਾਂ
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ਪੰਜਾਬ ਦੇ ਤਿੰਨ ਪ੍ਰਮੁੱਖ ਆਲੂ ਬੀਜ ਪੈਦਾ ਕਰਨ ਵਾਲੇ ਜ਼ਿਲ੍ਹਿਆਂ ਜਿਵੇਂ ਜਲੰਧਰ, ਹੁਸ਼ਿਆਰਪੁਰ ਅਤੇ ਕਪੂਰਥਲਾ ਵਿੱਚ ''ਪੰਜਾਬ ਵਿੱਚ ਸੰਗਠਿਤ ਅਤੇ ਅਸੰਗਠਿਤ ਆਲੂ ਬੀਜਾਂ ਉਤਪਾਦਕਾਂ ਦੀ ਸਥਿਤੀ ਅਤੇ ਭਵਿੱਖਤ ਸੰਭਾਵਨਾਵਾਂ'' ਦਾ ਅਧਿਐਨ ਕੀਤਾ ਗਿਆ । ਕੁੱਲ 180 ਕਾਸ਼ਤਕਾਰਾਂ, ਜਿਨ੍ਹਾਂ ਵਿੱਚ 90 ਸੰਗਠਿਤ ਅਤੇ 90 ਅਸੰਗਠਿਤ ਬੀਜ ਉਤਪਾਦਕਾਂ ਸ਼ਾਮਲ ਸਨ ਦੀ ਚੋਣ ਕੀਤੀ ਗਈ। ਇਹ ਪਾਇਆ ਗਿਆ ਕਿ ਸੰਗਠਿਤ ਅਤੇ ਗ਼ੈਰਸੰਗਠਿਤ ਬਹੁਬਿਣਤੀ ਦੇ ਬਹੁਤੇ ਲੋਕ 40-55 ਸਾਲਾਂ ਦੇ ਉਮਰ ਵਰਗ ਦੇ ਹਨ ਅਤੇ ਸਾਂਝੇ ਪਰਿਵਾਰਾਂ ਦੇ ਔਸਤਨ ਅਕਾਰ 4-6 ਮੈਂਬਰ ਹਨ ਅਤੇ ਖੇਤੀ ਯੋਗ ਰਕਬੇ ਦੇ ਲਿਹਾਜ ਨਾਲ ਵੱਡੇ ਵਰਗ ਸ਼੍ਰੇਣੀ ਦੇ ਸਨ। ਜ਼ਿਆਦਾਤਰ ਉੱਤਰਦਾਤਾਵਾਂ ਦੀ ਜੋਖਮ ਦੇਣ ਵਾਲੀ ਸਮਰੱਥਾ, ਆਰਥਿਕ ਪ੍ਰੇਰਣਾ ਅਤੇ ਨਵੀਨਤਾਕਾਰੀ ਦਾ ਮੱਧਮ ਪੱਧਰ ਸੀ, ਅਧਿਐਨ ਵਿੱਚ ਇਹ ਸਾਹਮਣੇ ਆਇਆ ਹੈ ਕਿ ਜ਼ਿਆਦਾਤਰ ਉੱਤਰਦਾਤਾਵਾਂ ਨੇ ਆਪਣੇ ਖੇਤਾਂ ਵਿੱਚ ਸਿਫਾਰਸ਼ ਕੀਤੀ ਗਈ ਆਲੂ ਦੀ ਕਿਸਮ ਨੂੰ ਅਪਣਾਇਆ। ਵਧੇਰੇ ਸੰਗਠਿਤ ਕਿਸਾਨਾਂ ਨੇ ਸਰਕਾਰੀ ਤੋਂ ਬੀਜ ਪ੍ਰਪਤ ਕੀਤੇ, ਸਰੋਤ ਜਿਵੇਂ ਕਿ ਸੀ.ਪੀ.ਆਰ.ਆਈ. (30.00%) ਅਤੇ ਪੀ.ਏ.ਯੂ. ਤੋਂ ਬੀਜ ਪ੍ਰਾਪਤ ਕੀਤੇ। ਅਸੰਗਠਿਤ ਕਿਸਾਨਾਂ ਦੀ ਤੁਲਾਨ ਵਿੱਚ ਅਤੇ ਫਾਊਂਡੇਸ਼ਨ ਅਤੇ ਪ੍ਰਮਾਣਿਤ ਬੀਜ ਦਾ ਇਸਤੇਮਾਲ ਕੀਤਾ। ਸੰਗਠਿਤ ਜਵਾਬਦੇਹਾਂ ਨੇ ਪਹਿਲਾਂ ਆਪਣੀ ਫ਼ਸਲ ਦੀ ਜਲਦੀ ਬਿਜਾਈ ਕੀਤੀ ਬਹੁਤੇ ਅਣਗਿਣਤ ਉੱਤਰਦਾਤਾਵਾਂ (55.56%) ਨੇ ਬਿਜਾਈ ਦੇ 100-120 ਦਿਨਾਂ ਵੱਲਾਂ ਦੀ ਕਟਾਈ ਕੀਤੀ। ਔਸਤਨ ਸੰਗਠਿਤ ਉਤਰਦਾਤਾਵਾਂ ਆਲੂ ਬੀਜ ਦੀ ਗੁਣਵੱਤਾ ਸੁਧਾਰਨ ਲਈ ਕੀਟਨਾਸ਼ਕ ਅਤੇ ਉੱਲੀਨਾਸ਼ਕ ਦਵਾਈਆਂ ਦੀ ਉਪਯੋਗ, ਅਸੰਗਠਿਤ ਉਤਪਾਦਕਾਂ ਦੇ ਮੁਕਾਬਲੇ ਜ਼ਿਆਦਾ ਕੀਤਾ। ਸੰਗਠਿਤ ਆਲੂ ਬੀਜ ਉਤਪਾਦਕ ਆਮ ਤੌਰ 'ਤੇ ਆਪਣੇ ਉਤਪਾਦਾਂ ਨੂੰ ਦੂਜੇ ਸੂਬਿਆਂ ਦੇ ਬਜ਼ਾਰਾਂ ਵਿੱਚ ਸ਼੍ਰੇਣੀਬੱਧ ਕਰਦੇ ਹਨ ਅਤੇ ਆਪਣੇ ਉਤਪਾਦ ਵੇਚਣ ਲਈ ਦਲਾਲਾਂ ਤੇ ਜ਼ਿਆਦਾ ਨਿਰਭਰ ਨਹੀਂ ਹੁੰਦੇ। ਲਗਭਗ 37.77 ਫ਼ੀਸਦੀ ਅਸੰਗਠਿਤ ਅਤੇ 13.33 ਫ਼ੀਸਦੀ ਸੰਗਠਿਤ ਉਤਪਾਦਕਾਂ ਨੇ ਭਵਿੱਖ ਵਿੱਚ ਆਲੂ ਬੀਜਾਂ ਦੇ ਉਤਪਾਦਨ ਵਿੱਚ 9.0 ਅਤੇ 1.29 ਫ਼ੀਸਦੀ ਰਕਬਾ ਘਟਾਉਣ ਦੀ ਇੱਛਾ ਜ਼ਾਹਰ ਕੀਤੀ। ਗ਼ੈਰ-ਲਾਹੇਵੰਦ ਭਾਅ, ਨਿਯਮਤ ਬਾਜ਼ਾਰਾਂ ਦੀ ਘਾਟ, ਸਟੋਰੇਜ ਦੀਆਂ ਸੁਵਿਧਾਵਾਂ ਦੀ ਗ਼ੈਰ-ਉਪਲਬਧਤਾ, ਬਾਜ਼ਾਰਾਂ ਵਿੱਚ ਕੀਮਤ ਵਿੱਚ ਉਤਾਰ-ਚੜ੍ਹਾਅ, ਬੀਜਾਂ ਦੀ ਉੱਚ ਕੀਮਤ ਅਤੇ ਗੁਣਵੱਤਾ ਬੀਜ ਦੀ ਗ਼ੈਰ-ਉਪਲੱਬਧਤਾ ਮੁੱਖ ਤੌਰ 'ਤੇ ਉੱਤਰਦਾਤਾਵਾਂ ਵੱਲੋਂ ਪੇਸ਼ ਕੀਤੀਆਂ ਗਈਆਂ ਸਮੱਸਿਆਵਾਂ ਸਨ ।

ਮੁੱਖ ਸ਼ਬਦ: ਸਥਿਤੀ, ਭਵਿੱਖਤ ਸੰਭਾਵਨਾਵਾਂ, ਸਮੱਸਿਆਵਾਂ, ਆਲੂ ਬੀਜ ਉਤਪਾਦਕ

ਮੁੱਖ ਸਲਾਹਕਾਰ ਦੇ ਹਸਤਾਖਰ

ਵਿੱਦਿਆਰਥੀ ਦੇ ਹਸਤਾਖਰ

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CHAPTER-I

INTRODUCTION

In the present era of technological developments and innovative breakthroughs, there is a dire need to help the rural poor, which are mainly landless or own small chunks of farmland. This will be possible only through a change from the existing traditional system of cropping pattern to a more innovative and commercial farm business. Such an approach will not only help in the alleviation of poverty through higher farm incomes but would also generate employment opportunities for the small farm households and the landless. Among the available options for improving the welfare of the rural poor, one must begin with an understanding of the resource base of these households. In this context, majority of farming community owns less than 5 hectares of land, but has surplus labour force. Both these characteristics most appropriately fit into those farm enterprises, which are not only labour intensive but also promise higher productivity and income. It is essential to change the face of our traditional agricultural exports by bringing in new products possessing comparative advantage in the international market. Such potential products in the short run are vegetables. Vegetable cultivation generally requires more labour, thereby creating productive employment opportunities and generating higher incomes (AVRDC 2001; Abedullah *et al* 2002).

Potato (*Solanum tuberosum* L.) is a third most important food crop, grown in more than 150 countries in the world (Anonymous 2015a). It is one of the most productive crop which can play a significant role in ensuring food security, being a versatile food which can be cooked in many ways, processed into number of products and fitted in any meal (Marwaha *et al* 2002). It produces the highest dry matter and proteins per unit area and time among the major food crops (Ram 1997). Due to rice, wheat and maize being staple food of our country, we failed to accept potato as a staple food article. The problem of under and malnutrition can largely be solved if potato is accepted as a major not merely as a vegetable in our country (Rao 1977). In India, about 68 per cent potatoes are utilized for table purpose, 7.5 per cent for processing, 8.5 per cent for seed and remaining 16 per cent produce goes waste due to pre and post-harvest handling. (Gupta *et al* 2014). In case of processed products it is possible to add missing or low ingredients in order to enhance overall nutritional value of the product (Eltawil *et al* 2006). The potato is a crop which has always been the “Poor man’s friend”.

Year 2008 was declared as the *International Year of the Potato* by the United Nations, to raise the profile of potato crop in developing nations, by referring the crop as a ‘hidden treasure’. World acreage of potato is 18.2 million hectares with average productivity of 17.2 tonnes per hectare. At present, India rank 2nd after China with 48 million tonnes of potato production and average yield is 23.6 tonnes per hectare (Anonymous 2014). The

increase over last 60 years in area, production and productivity is 550, 1745 and 178 per cent, respectively. This growth can be attributed to indigenously developed technologies which were used in India for cultivation of potato (Dattatreyulu 1985). Majority 70.5 per cent of potato producing area and 80 per cent of the total production in the country is located in three states namely Bihar, Uttar Pradesh, and West Bengal.

The subsection Potato is distinguished from all other subsections within the genus Solanum by "true potatoes whose tubers are borne on underground stolons, which are true stems, not roots" (Hawkes 1994). In India, nearly 81 per cent of the potato crop grown during winter with short day conditions (10 to 11hrs sunshine), about 13 per cent in the hills during summer under long day condition (more than 12hrs sunshine) and around 6 per cent in the plateau during the rainy season under almost equinox conditions (Basu *et al* 2003, Gupta *et al* 2014). Traditionally, potato are grown vegetative by planting seed tubers because it easy for planting and other cultural operations. But the cost of healthy planting material is high mainly in the eastern part of India. Nearly 20-30 t/ha seed tubers are required for planting in one hectare area and seed alone accounting for 50-60 per cent of the total production cost (Yadav *et al* 2014).

Based on the production process of seeds, seed production can be classified into two broad heads i.e. Formal and Informal seed production system. The formal seed production system uses organised channels under the supervision and quality control system provided by public or private institutions, in accordance with special rules and regulations. This system is able to meet the demands of modern agriculture and complies with the seed industry's requirements. Seeds of most cash and horticultural crops, particularly hybrids, are supplied by the formal seed system. In contrast, the informal, or on-farm seed systems, vary among regions and crops. Farmers keep some part of the harvest for planting in the next season in this system. The system usually plants local varieties of seed kept from the previous year's harvest or obtained from neighbours and/or the local market. This is the predominant system for food crops in subsistence agriculture. While the main goal of the formal seed system is to supply quality seed produced under proper supervision and set standards, the informal seed systems aims at the self-supply of seed with cost advantage, considered an important alternative for improving food security (Anonymous 2003; Bentley *et al* 2011)

Punjab rank 6th in Potato production. Potato was grown on 96.6 thousand hectares during 2016-17 with total production of 2.42 million tones and average productivity around 25 tonnes per hectare (Anonymous 2018). Punjab account for 20.8 per cent of the area under potato cultivation of the country, which results in wide variations in the productivity levels of potato in different states. Therefore, all efforts may be put in developing location-specific technologies to increase the productivity of potato crop. The main potato crop is planted from mid-October to mid-November and harvested from January onwards depending upon

prevailing market prices in Punjab (Luthra *et al* 2009). Thus, for early harvesting the quick bulking varieties are preferred which can produce high yield of acceptable tuber quality. Recently, a large number of companies including multinationals such as Fritolay, ITC, Ace Foods have stepped into the field of potato processing (Marwaha *et al* 2010).

Quality seed is a pre-requisite input for a productive crop. Seed sector played an important role in developing sustainability in agriculture specifically in India. The seed industry flourished along with the growth in agricultural productivity. To cope up with the increasing demand there has to be a sustained growth in agriculture which could be achieved with developing and adopting innovative technologies and seed will play a crucial role in these technologies in the years to come. Even though the organised seed industry of India is four decades old, the growth is phenomenal. Seed sector of our country is reasonably advanced when compared to other countries of the world. The private seed industry is not only engaged in production and marketing of the seed but also investing huge amounts in research and development of new varieties. Thus, there has been substantial growth in size and level of performance of seed industry in India over the last forty years. Seed production activities are carried out by both public and private players. National Seed Corporation (NSC) and State Farm Corporation of India (SFCI) and 13 State Seed Corporations constitute the public sector organizations. The private sector is comprised of approximately 150 seed companies, which are national and multinational in nature and other seed producing/selling companies. (Gadwal 2003)

Shortage of good quality seed has been recognized as the single most important factor limiting potato productivity in the developing countries. The availability of tissue culture technology for rapid multiplication of disease-free planting material has facilitated potato seed production to a great extent (Dodds 1988). At present, 94 per cent of the total quantity of seed is produced in sub-tropical plains and remaining 6 per cent in hilly areas. India is the only leading country in Asia which has developed scientific seed production technology for sub-tropics by taking advantage of low aphid period and absence of soil borne diseases and insect-pest. A technique was developed in 1970s to cultivate disease free seed potato in sub-tropical plains of India during low aphid period which is referred to as Seed Plot Technique (Chakrabarti 2017). This technique along with the application of bio-technological approaches for virus elimination, micro-propagation and effective viral diagnostics has resulted in success of the National Potato Seed Production Programme by producing about 2600 tonnes of breeder seed every year. The State Departments of Agriculture/ Horticulture further multiplies this seed to approximately 4,32,000 tonnes of certified seed. Thus, the country saves a huge amount of foreign exchange (i.e. about 484 million US dollars) as compared to its neighboring countries such as Pakistan, Bangladesh and even China which import seed potatoes from European countries (Anonymous 2012).

Punjab seed potato refers to the potato tubers used as seed. The external characteristics such as skin colour, shape, depth of eyes and sprout colour are variety dependent. Thus the term Punjab potato seed is used for tubers of any potato variety produced for seed purpose in the doaba region of Punjab with its peculiar environmental endowments using the local skill and technological interventions associated with the niche.

Punjab seed potato is produced in a region which is free from soil borne diseases i.e. Brown Rot (*Ralstonia solanacerum*) and Ring Rot (*Clavibactia michiganesis*), potato tuber moth (*Phthorimaea operculella*) and golden cyst nematode (Anonymous 2012). The regional weather combined with a special practice, the Seed Plot Technique is very favorable for production of seed potato with minimum level of viral disease infestation. Punjab Potato Seed is free from viral diseases or have virus infection below the permissible limits of the minimum seed certification standards of India. The progressive farming community is devoting all its attention with skill development, adoption of advanced technology for crop management and disease indexing, application of "Seed Plot Techniques", grower to grower linkage and supply chain network, public sector support.

Punjab seed potato has special quality on account of niche, associated skill and technology accumulation. The doaba region of Punjab has been engaged in the production of seed potato for more than six decades. The regional potato growers have combined their knowledge and skill acquired through experience over generation with technical advancement such as tissue culture, aeroponics, mechanization and cold storage facilities for production of healthy potato seed for growers of the entire country. Punjab seed potato has higher yield potential which motivates the growers of other potato growing states such as West Bengal, Karnataka and Gujarat to buy Punjab seed potato even at prices higher than other available options (Anonymous 2018b).

Doaba region of Punjab is situated between the Sutlej and Beas rivers. It comprises of five districts of Punjab. The region has sandy loam soil having pH 7.5 to 8.0 and good quality of irrigation water. The maximum day temperature should be below 30^{o}C and night temperature should not be more than 20^{o}C for proper crop growth. The better tuberization needs day and night temperature of 20^{o}C and 14^{o}C, respectively. These climatic conditions exist in Punjab from October to January. The occurrence of cold winters keeps the aphid population below the threshold level. Cool climate with sunny days and cool nights is ideal for potato production. These soil and climatic conditions are appropriate for virus free potato seed production (Pronk *et al* 2017).

Punjab potato farmers are the major supplier of quality potato seed. In India, area under potato is 2.0 million hectares, which require 6.0 million tonnes of seed potato @ 3.0 tonnes/hectares seed use. Thus, 60 per cent (1.5 million tonnes) of the current Punjab potato production (2.5 million tonnes) is supplied to potato growing states such as Maharashtra,

Karnataka, West Bengal, Orissa, Gujarat and NEH region. Punjab has established itself as potato seed producing state and supplies about 85 per cent of the total seed potato requirement of the country. Doaba region, where potato seed is grown on approximately 50,000 hectares of area, is the home of potato seed for the entire country (Wustman *et al* 2011). The potato seed produced in this region is healthy, free from several insect-pests and diseases, particularly virus which are known to cause rapid and severe degeneration of potato seed quality (Anonymous 2012).

Quality of seed potato comprises of true to type, disease free and optimum sized tuber. The availability of quality seed tuber of improved potato cultivars in adequate amount must be ensured by agricultural research institutes (Singh 2008). Punjab has established itself as potato seed producing state and supplies about 75 per cent of the total seed potato requirement of the country. However, National seed requirement of potato is around 1.24 million tons considering 25 per cent yearly seed replacement and there is 40 per cent shortage of the certified seed to raise potato crop. It is a challenge to produce quality (virus free) seed to completely meet seed requirement of the country. Thus, the present study was planned to analyzed status and prospects of organised and unorganised potato seed producers in Punjab state.

1.1 Objectives of the study

1. To know the socio-personal characteristics of selected potato seed producers
2. To determine the present status of organised and unorganised potato seed producers
3. To study the prospects of organised and unorganised potato seed producers in Punjab
4. To identify the problems faced by the potato seed producers and suggestions thereof

1.2 Limitations of the study

1. The findings of the study are based on the expressed opinion of the respondents. Although every effort was made to get accurate information from the respondents, the possibility of the respondents giving some biased information cannot be completely ruled out.
2. Being a single student's project, it has all those limitations which are common in such cases i.e. limitation of time and other resources.

CHAPTER-II

REVIEW OF LITERATURE

A comprehensive review of literature is an integral part of any investigation, as it not only gives an idea on the work done in the past and assists in delineation of problem area but also provides basis for interpretation and discussion of findings. It maps out the research gaps and research methodologies followed in the previous research studies. However, an earnest effort has been made by the investigator to review the available literature having direct or indirect bearing on the present study. The review so collected is presented under the following heads:

2.1 Socio-personal characteristics of potato seed producers

2.2 Status of potato seed producers

2.3 Prospects of potato seed producers.

2.4 Problems of potato seed producers.

2.1 Socio-personal characteristics of potato seed producers

Kaur (2002) studied the socio-personal characteristics of vegetable seed production in selected districts of Punjab. Study revealed that majority of the respondents were of middle age and had education level primary to matriculation; 3.50-18.75 acre of operational land holding; 1.0–3.5 acres of operational area under vegetable seed production; income from vegetable seed production to the tune of Rs. 20003-30,006 per acre, having 1-5 years of experience in vegetable seed production and had low mass media exposure

Majority of the pea growers belonged to middle age group (32- 46 years) was found by Josan (2002). Around 33 per cent of the pea growers were matriculate and majority of the respondents (78.95%) had operational land holding 2 to 18 acres.

Kumar (2005) analyzed contract farming in hybrid vegetable seed production in northern Karnataka. The average family size of contract seed growers was around 9 members and all the contract seed growers were educated. Average age of the respondents was 41 years and young age coupled with better education has made the farmers to increase their farm income by adopting hybrid vegetable seed production. The average size of the land holdings of the contract farmer was 9.35 acres. The average area under hybrid vegetable seed production accounted for about 0.50 acres, which worked out to be 5.34 per cent of total land holding. The companies allotted very small sized land to cultivators mainly to maintain the quality of seeds.

Arneja *et al* (2009) studied the socio-personal characteristics of the potato growers in Jalandhar district of Punjab. The study revealed that about half of the respondents were belonged to age group of 40-55 years. As many as 32.66 per cent of them were matriculate and nearly 50 per cent were having 2 to 38 acres operational land holding. Majority of potato

growers (92.00%) followed rice-potato-fallow rotation. It was also found that 68.00 per cent had medium mass media exposure and 58.66 per cent respondents had 1 to 33 acres area under potato cultivation and majority of them had 8-12 years of experience in potato growing.

Kumar (2011) studied contract farming in baby corn and sweet corn in Ludhiana and Jalandhar districts of Punjab. It was revealed 47.50 per cent of the respondents were in age group of 36-45 years, 26.75 per cent of the respondents were educated up to senior secondary, 63.75 per cent of the respondents belonged to nuclear family, 51.25 per cent of them had 3-5 family members, 52.5 per cent of the respondents had medium (10-25 acres) operational land holding, 40 per cent of them had 7-11 lacs annual income, 26.25 per cent and 27.5 per cent of the respondents had one year experience in contract farming of baby corn and sweet corn respectively, 46.55 per cent of the respondents had 2-6 acres area under baby corn and 53.12 per cent of them had 1-5 acres of operational area under sweet corn and more than half of the respondents (51.25%) had high risk bearing capacity.

Singh (2013) analysed the functioning, profile, facilitating factors for development and problems faced by members of Confederation of Potato Seed Farmers in Punjab (POSCON). It was found that most of the respondents were in the age of 38-48 years, educated up to matriculation, lived in joint families, had operational land holding up to 160 acres and low extension contacts. Majority of the respondents belonged to medium risk bearing capacity, economic motivation, managerial ability and innovativeness.

Sharma (2014) studied socio-economic characteristics of the agripreneurs such as land owned, income and entrepreneurial behavior of the agripreneurs were positively and significantly correlated at 1 per cent level of significance with number of machines at agro-processing complexes. It was also found that most of the agripreneurs studied up to matriculate, has nuclear families, possesses medium land holdings, less mass media exposure and less number of female agri-entrepreneurs were found.

Singh (2014) inferred that the socio-personal characteristics of summer mungbean growers in Punjab state. It was revealed that most of the respondents were in the age group of 38-49 years, educated up to graduation and had medium operational land holding (10-25 acres) had 2-3 family members engaged in summer mungbean cultivation and medium mass media exposure. The experience of more than half of the farmers in summer mungbean cultivation was 2-6 years.

Pawar (2016) reported socio-personal attributes of potato growers in Jabalpur. Majority of potato growers (57.50%) had young age group, (35.00%) belonged to middle school, 44.16 per cent were having small size of land holding and half of them (45.83%) had medium area under potato crop. Majority (58.33%) of potato growers had medium social participation, medium annual income, half (53.33%) of them were having medium economic motivation, scientific orientation, information sources utilization and half (60.84%) of potato

growers had medium extension contact.

2.2 Status of potato seed producers

Scott *et al* (2000) reported that developing countries are likely to have higher growth rates in production and productivity of potatoes during 1993-2020 than the world average growth rate. According to these estimates, the developing countries are likely to produce 48 per cent world potatoes by 2020 as against 10.5 per cent in 1961 and 44 per cent during the current years. The increase will be more pronounced in India, Sub-Saharan Africa, China and other Asian countries. Thus, the Asia-Pacific region with two major potato producing countries, viz. China and India is likely to be a focus for potato production.

Kaur (2002) studied the status of vegetable seed production in selected districts of Punjab. Majority of the respondents purchased the seed from reputed private seed agencies, employed 60-88 labour per acre during the season, harvested and extracted the crop manually, stored the seed in gunny bags; sold the seed to reputed private seed agencies and followed the recommended practices. The overall status of vegetable seed production was high. Total area under vegetable seed production was 18.72 per cent of the operational land holding and was likely to increase to 22.12 per cent. The overall scope of vegetable seed production was high.

Singh (2003) analyzed status of mentha cultivation in Ludhiana and Nawanshahr districts of Punjab. Maximum number of farmers followed verbal contract, sowed recommended varieties, planted the crop directly through suckers, sowed at recommended time with recommended spacing, applied adequate irrigation, used recommended insecticides and took only one cutting. Most of the farmers did not follow the recommendation about fertilizer application. Overall status of mentha cultivation, extent of adoption and level of adoption were found to be medium.

Singh (2005) observed that status of turmeric cultivation in Punjab. It was found that the majority of farmers had medium mass media exposure and had high risk orientation. Most of the farmers followed package of practices recommended by PAU for cultivating turmeric. Majority of the farmers stored the produce in home storages and sold it in local market after processing. Most of the farmers employed 94-114 man days per acre for turmeric cultivation which is 2-4 times more than labour involved in rice-wheat cultivation.

Kumar (2005) analyzed contract farming in hybrid vegetable seed production in northern Karnataka. The results revealed that seed production cost estimated to be Rs. 54893, Rs. 36688, Rs. 29288 and Rs. 35868 per acre in tomato, brinjal, okra and ridge gourd, respectively. The acreage yields of seed obtained were 78, 302, 298 and 140 kgs in tomato, brinjal, okra and ridge gourd seed growers group. The marginal productivity analysis indicated that seed, human labour, fertilizer and micronutrients, plant protection chemicals, irrigation, staking sticks and gunny thread in tomato, seeds, human labour, bullock and tractor charges, farm yard manure in brinjal, farm yard manure, bullock and tractor charges, human

labour, fertilizers and micronutrients in okra and FYM, irrigation, fertilizer and micronutrients, seeds, bullock and tractor charges in ridge gourd were under-utilized. The mean technical efficiency index was 79, 76, 72 and 73 for tomato, brinjal, okra and ridge gourd seed growers, respectively. Written agreement was used in contract farming. The technical aspects of agreement were simple terms, drafted in short, clarifying the responsibilities of farmers and firms.

Tripathi (2005) studied that contract farming in potato production in Haryana. The cost of potato cultivation has been found 17 to 24 per cent higher under contract farming over various costs than under non-contract system, mainly due to high investments on seeds, fertilizers and machine power. Yield has been found that 255.78 quintals per ha in the contract farms, which is 8.84 per cent higher over the potato yield obtained from the non-contract farms. Gross income has been Rs 99753 per ha in the contract farms as against Rs 41572 per ha in non-contract system. The sale price of potato has been found much higher (Rs 390/q) for contract than non-contract farms (Rs 177 /q). The net return over operational cost (cost 'A1') has been found as Rs 11882 per ha in non-contract farms, which increased more than five-times under contract farming system, it being Rs 62982 per ha. Similarly, the net return has been found five-and-a-half times more in contract than non-contract system over cost C1 (without rental value of the land). The net return over cost C2 has been observed as Rs 51866 per ha for contract farms and only Rs 800 per ha under non-contract system. Benefit-cost ratio on various costs has been found to vary from 1.40 to 1.02 for without contract and from 2.71 and 2.08 for contract farming. The impact of contract farming has been quite visible and remarkably favourable on yield and profitability of potato production at the existing pattern of resource-use and production technology prevalent in the Haryana farming system. These findings have clearly underlined the superiority of contract farming over non-contract farming system in potato production.

Ojo (2005) investigated the economics of Irish potato production in Plateau State. The results indicated that the potato farmers were predominantly small-scale and fall between the age-group of 40-49 years with average age of forty-one years. However, the active and virile age groups of 20-29 and 30-39 were relatively low. The optimum farm plans of the basic models revealed that higher productivity and more revenue could be achieved over the unplanned farms by reorganizing resources and activities in the potato-maize production system. The resource-use efficiencies showed that land and family labour were not critical factors and that they were in surplus. However, operating capital was a critical factor, implying that farmers lack enough capital to implement an organised farm plan. The sensitivity analysis showed that a 20 per cent increase in the cost of fertilizer reduced farm income by 5 per cent, 9 per cent and 10 per cent in the 3 LGAs while subsequent increases in both input and output prices improved farmers income appreciably. Policy choices should be

geared towards inspiring additional youths into farming by launching programmes like graduate farming pattern. Research and extension intervention is required in the area of training farmers on how to re-organize farming activities and resources like labour and land to increase farmer's income. To capture the problem of great cost of cultivation, government work should focus on ways of financing small scale farming, through cooperative saving schemes and input supply arrangements. Finally National Root Crop Research Institute should collaborate with International Potato Centre in the area of integrated pest and disease management to reduce the high rate potato perishability.

Naik and Karihaloo (2007) studied shortage of good quality seed is recognized as the single most important factor hindering potato production in Asia. Availability of quality planting material of improved potato varieties in adequate quantities, therefore, is the major issue that needs to be attended by respective national agricultural research systems in order to attain the projected production targets. Several FAO reports suggest that about 75 per cent of the global seed requirement is me through informal seed system comprising exchange among neighbors, friends, relatives, tribes and villages, indicating its importance in world agriculture. Further, the formal seed system mainly relies on local extension services for diffusion of quality planting material. Such services are either poor or non-existent in many countries of the Asia-Pacific region. The major task for proving potato productivity and production in this region, therefore, is to strengthen form one seed system, integrate it with socially efficient informal seed system and also to develop public-private partnership in quality seed production.

Sidhu *et al* (2009) studied diversification through vegetable cultivation in Punjab state. Crop diversification has been perceived as the only alternative to end the problems arising due to paddy wheat rotation. The data collected personally on a structured interview schedule from six agro-climatic zones of Punjab reveals that majority of the vegetable growers were growing vegetables in less than 3.5 acres of the land and the share of vegetable crops was maximum in the area under diversification. However, area under vegetable crops increased by 0.08 per cent and 2.66 per cent during and Rabi season respectively. With vegetable cultivation emerging as major alternative preferred by farmers, the extension personnel and the policy makers should address the problem areas in vegetable cultivation and its marketing.

Rana (2011) revealed that the status of Indian potato processing industry. Punjab annually produce 0.11 million tons of processing quality potatoes playing important role to fill the vital gap in raw material availability in this part of nation, Punjab's share in national population, potato area and potato production is 2.33 per cent, 5.19 per cent and 5.43 per cent respectively: while its contribution towards national potato processing capacities is 12.17 per cent, 14.29 per cent and 12.05 per cent in the production of potato chips, French fries and all

potato products respectively. Punjab is supposed to play still more important role in the Indian potato processing industry in future.

Singh (2014) studied that the status of summer mungbean cultivation in Punjab state. Most of the farmers were presently cultivating summer mungbean on an area of 0.5-5.5 acres and following summer mungbean-basmati rice-wheat crop rotation. More than 80 per cent of the farmers cultivated summer mungbean on a commercial scale which earned them an additional income. It was also revealed that 91.42 per cent of the farmers were cleaning the summer mungbean produce so as to add value to it. More than 75 per cent of the farmers were involved in drying of summer mungbean while only 12.58 and 10.00 per cent of them were involved in packaging and sorting, respectively.

Ghebreslassie *et al* (2014) studied potato seed supply, marketing and production constraints in Eritrea. It was revealed that there was no standard seed supply system thus majority (91.3%) of the growers purchase seed from open market with a limited supply from the Ministry of Agriculture. Furthermore, about 63 per cent of the farmers from Zoba Maekel reserve their own seed for the next cycle compared to 53.6 per cent from Zoba Debub. It was noted that the Tsaeda embaba variety grows predominantly in the country owing to its yield and resistance. Majority of the growers relied on tuber colour and shape for variety identification, thus over 76 per cent prefer the round shaped and white coloured variety. The potential marketing outlets include wholesale, retailer and direct to consumers. Majority (78.3%) of the interviewed growers indicated that large portion of their produce is marketed via wholesaler followed by retailers (27.5%).

Sharma (2014) depicted the status of agro-processing complexes established by Punjab agricultural university in Punjab. It was revealed that agro-processing complexes are profitable self-ventures. Majority of the respondents were getting good income from the agro-processing complexes. Most of the agripreneurs involved their family members at their agro-processing complexes along with outside labour. Hence, create employment opportunities for rural people. A high number of agro-processing complexes were established from 2011-2015. Around 25 per cent of the agripreneurs had started their agro-processing complexes from flour mill+ oil expeller. Presently, Around 37.00 per cent of the agripreneurs are having flour mill+ oil expeller+ rice sheller+ grinder+ others (cattle feed mill+ cotton delinter+ maize flour mill). Number of female agripreneurs was very less. Most of the agripreneurs had possessed medium to high level of entrepreneurial behavior. Most of the agripreneurs had taken loan from banks for meeting their credit requirements. Majority of the respondents felt benefits like access to better education for their children and availability of better homely atmosphere due to better financial conditions. Majority of the agripreneurs had got their homes renovated and all agripreneurs had felt improvement in their social status. Majority of the agripreneurs were using direct to consumer marketing channel for marketing of their produce.

Kumar *et al* (2016) assessed the knowledge gap and constraints of potato growers in Tawang district of Arunachal Pradesh. Results revealed that a majority of respondents had good knowledge of land preparation, time of sowing, method of sowing and harvesting, spacing of crop and earthing up operations followed in potato crop. The highest knowledge gap was observed in the field of plant protection (52.50%) followed by recommended doses of fertilizer, dose of chemicals (46.60%), fertilizer application method (42.50%) and water management (40.00%). Radio was found to be the most vital source of agricultural farm information for respondents. This gap should be bridged through organization of trainings, demonstrations, awareness campaigns and mass media programmes on potato cultivation.

Gebru *et al* (2017) assessed of production practices of smallholder potato (*Solanum tuberosum* L.) farmers in Ethiopia. It was revealed that smallholder farmers had very small land (about 0.5 hectare per household). Low access to and High prices of seed tubers of improved potato crop varieties (>0.25 USD kg^{-1} seed tubers) and lack of information on good fertilizer management practices for cultivating the potato crop with only a blanket rate of 147 and 135 kg hectare of urea and diammonium phosphate, respectively, limit potato yield in the area.

2.3 Prospects of potato seed producers

Kaur (1990) found that majority of the respondent's perceived low prospects of diversification in crop alternatives and dairy. From the crop alternatives maximum number of farmers were willing to shift to sugarcane and raya.

Mane (1995) studied prospects of exports and imports in Indian agriculture. The study revealed that the share of agricultural exports of agricultural imports in the corresponding total exports and total imports declined during the period under consideration. The fall in import share was steeper than that in export share.

Sidhu *et al* (1997) revealed that the wheat, paddy and rapeseed–mustard seed raised by the selected contract seed growers were more economical compared to non-seed crops. These crops provided additional net returns to the farmers to the extent of about Rs. 3278, Rs. 2821 and Rs. 3406 per hectare, respectively.

Kumar *et al* (2001) conducted a survey in 100 villages of 7 districts of Uttar Pradesh and found that integration of a variety of short duration medical and aromatic plants between the food grain crops can help in production of high value industrial raw material for agrochemical, food and cosmetic industries, in addition to the production of food grains in desired amounts. This kind of development was expected to sustain adequate food production, large profits to farmers and promote growth of small scale industries in towns and cities creating employment opportunities villagers.

Singh (2003) studied that status and prospects of mentha cultivation in Ludhiana and Nawanshahr districts of Punjab. Mentha crop was found to be profitable over comparable

crops like sunflower, moong and mash. Intercropping of mentha was found to be profitable by majority of farmers.

Singh (2005) observed prospects of turmeric cultivation in Punjab. Majority of the farmers grew turmeric as main crop and were satisfied from turmeric cultivation. Most of the farmers were aware of exporting of turmeric but none of the farmers exports it. Most of the farmers adopted turmeric cultivation for expectation of high income. It was reported that 60 per cent of the respondents exhibited constancy in keeping area under turmeric cultivation whereas 32.50 per cent of the respondents opted to increases their area because respondents obtain more income per acre from the turmeric cultivation and 7.50 per cent of the respondents were willing to decrease their area under turmeric cultivation because it is labor consuming method and there is lack of finance and its marketing problems.

Kumar (2008) studied the status of protected cultivation of vegetables by the farmers of Punjab and reported that majority of the respondents wanted to decrease the area under protected cultivation and a little more than one fourth i.e. 21.33 per cent of the respondents were willing to increase the area under protected cultivation whereas 36.00 per cent of the respondents were interested to keep the area under protected cultivation.

Yasmin (2009) reported that 90 per cent of the farmers opted organic farming to increase their income level. More than 80 per cent had written contract (plain paper) with the contracting agencies. A little more than half of the respondents (53.00%) wanted to keep the area constant under organic farming, 19 per cent of the respondents wanted to increase the area under organic farming and 22 per cent of the respondents wanted to decrease the area under organic farming. Only 6 per cent of the respondents wanted to discontinue organic farming.

Singh (2011) reported that 22.50 per cent of the respondents wanted to increase the area under vegetable hybrid seed production because they felt it a profitable enterprise whereas 20.00 per cent of the vegetable hybrid seed producers were going to decrease the area under vegetable hybrid seed production while 13.75 per cent were going to discontinue it due the various reasons such as lack of trained labour, uncertainty of weather, difficulty in controlling insect pest and diseases, difficulty in maintaining isolation.

Kumar (2011) studied prospects of contract farming in baby corn and sweet corn in Ludhiana and Jalandhar districts of Punjab. Majority i.e. 86.25 per cent of them motivated for this venture due to expectation of more income and 93.75 per cent were not aware about the other companies involved in contract farming of baby corn and sweet corn and retail market of it. Nearly half of the respondents (52.50%) had heard about contract farming from extension workers of contracting agency. Majority of the respondents were satisfied with quality and quantity of seeds, quality and timeliness of advisory services, price and procurement method of the produce. Nearly 30 per cent of the respondents wanted to increase

area under baby corn whereas nearly half of them (46.88%) intended to increase area under sweet corn cultivation.

Singh (2011) analyzed that marketing problems of table potato. Study was undertaken to explore the marketing problems and prospects of table potato in Punjab. Primary data were collected from ten respondents who were top ten potato growers and members of Confederation of Potato Seed Farmers (POSCON), using pre designed, structured and non-disguised questionnaire. The results indicated that quality was an important feature of produce for growers and to maintain the same mechanized grading technique is used. Marketing of potato is done through different intermediaries such as itinerant merchants, wholesaler and retailers. Demand based pricing method is used by potato growers in the absence of price support programmes by Government. Major problems came out were the skilled labour, transportation, poor infrastructure of roads, storage facilities, illiteracy of labor, Non-availability of seed also comes out the major problems. The technology competition and finance are considered as less significant problem.

Singh (2013) studied that about 71 per cent of the respondents had medium level of group cohesiveness, group leadership (52.50%) and co-operation among the group members (41.25%). About 86 per cent were willing to continue with the membership, follow other members (41.25%) and instructions given by the group leader (82.50%).

Kalra *et al* (2013) revealed on potato seed producing group, confederation of Potato Seed Farmers (POSCON) in Jalandhar. It was found that all functioning characteristics to be effective. The overall Functioning Effectiveness Index (FEI) of the group was more than 0.70 indicates that the group functioned effectively in terms of selected group characteristics. The major variables such as group goal achievements, group motivation, group cooperation and participation in group activities had contributed highly effective performance of the group. It was also found that important facilitating factors for effective functioning of the group were increased income, transparency in functioning, knowledge gain in advanced technical information in potato seed production and easily availability of loans. The main hindering factors were inadequate government support for lobbying issues, marketing and policies that favor of farmers.

Singh (2014) studied that the prospects of summer mungbean cultivation in Punjab state. It was concluded that half of the farmer's (48.57%) were willing to keep their area constant under summer mungbean cultivation, one-fourth (25.71%) of them wanted to increase the area under this crop. More than half of the farmers were willing to store their produce after harvesting. However the remaining farmers were unwilling to store their produce because of financial problems and lack of storage facilities. It was also concluded that all of the farmers were willing to go for cleaning of summer mungbean produce as a form of value addition. Nearly 90.00 per cent of the farmers were willing to go for drying, while

34.28 per cent of the farmers were willing to go for sorting and packaging of summer mungbean produce in future. Only 18 farmers were willing to process their summer mungbean produce out of which, 72.22 per cent preferred to process their produce into *dhuli moong*.

Chowdhury (2015) analyzed that in the context of production and export potato has a great prospect in Bangladesh. However, it is a matter of great regret that our farmers fail to get back even their production cost. Cost of productions becomes higher, but the price of potato becomes lower at the time of harvest. Most of the potato farmers have failed to get back even 30 per cent of their investment in the current season, which has created a shocking situation for them. Again cold storage charge is across the country which is a very high rate; on the other hand nearly 420 cold storages across the country can store 3.6 million tons of potato, which is 44 per cent of the total production.

2.4 Problems of potato seed producers

Manrique (1993) revealed constraints for potato production in the tropics. Potato tuber yields in the tropics are extremely low compared to those of temperate zones. The low yields merely reflect the inability of the current technology to overcome soil and environmental constraints. Given the various constraints affecting potato production in the tropics, few viable soil and crop management options remain. It was revealed key constraints for potato production, assesses the impact of indigenous and/or adapted technology in managing them, and examines basic relationships describing productivity changes as management takes place.

Kaur (2002) analyzed the status and scope of vegetable seed production in selected districts of Punjab. Marketing of seed not sure and non-availability of expert labour were the major problems faced by respondents.

Josan (2002) reported that all the respondents (i.e. pea growers) faced the problem of that price of pea was not fixed whereas 75.00 per cent of the respondents observed decrease in yield of pea crop. About 62.00 per cent of the respondents faced the problems of lack of technical knowledge and costly seeds. Non-availability of pure and quality seed i.e. 56.57 per cent faced problem of the pea growers. Almost equal percentage of pea growers i.e. 21.07 per cent and 19.78 per cent had faced the problems regarding length and complex procedure for getting credit and non-availability of recommended insecticies/fungicides/weedicides, respectively.

Singh (2003) conducted that status and prospects of mentha cultivation in Ludhiana and Nawanshahr districts of Punjab. Major problems expressed by the farmers were prevailing less price of mint oil, low price given to them, rains at harvest, lack of electricity and lack of extension work.

Pandit *et al* (2003) studied problems of potato marketing in India suffers from

severe constraints like high marketing cost and margins, wide price fluctuations, existence of large number of middlemen, storage and transportation bottlenecks and lack of other marketing infrastructures. It was also found that markets are imperfect, segmented and inefficiently performing the marketing functions. Producers were deprived of the proper share in consumer's rupee due to existence of large number of middlemen in the marketing channel. Lack of cold chain, awareness of Indian potato varieties in the foreign markets, long-term export strategy, suitable packaging material etc. Expanding the existing cold storage facilities, encouraging diversified use of potato & producers, consumers cooperatives, market regulation, establishing more processing units and processing, seed zones, conducting export oriented market research and formulating well-drawn long term export policy to ensure the efficient potato marketing.

Singh (2005) observed that problems of turmeric cultivation in Punjab. Non-availability of nearby market, lack of processing units, fluctuating market rates and exploitation by middlemen were the main problems perceived by the farmers.

Kumar (2005) analyzed contract farming in hybrid vegetable seed production in northern Karnataka. Availability of skilled labour, adequate and timely capital and non-existence of crop insurance was the problems confronting the seed growers.

Ahmad (2005) studied constraints in potato cultivation. It was observed that availability of funds, access to good quality seed, provision of cold storage and transportation facilities and stable potato price could increase potato production in the province.

Algizouli (2007) analyzed the economics of potatoes production and marketing in Khartoum State. The study focused on production constraints, cost analysis and estimated marketing margins of the products, to determine its financial performance of the potatoes crop in the State. The results indicated lack of improved seeds in sufficient quantities and not available on time for cultivation, seeds were imported and local seeds carry diseases, scarcity of soft loans and the lack of production inputs, particularly fertilizers, were the main reasons for the low productivity of potatoes crop in seasons 2005/2006. The results showed that potatoes crop was highly profitable, and that large share of the marketing margins cost rests upon the fees and storage activity. The study recommended supply of adequate financing of production inputs and markets, benefiting from the central markets experiences in advanced countries, introduction of the private sector in the production of local seeds, using modern techniques for producing seeds free of diseases, and participation of the private sector to manufacture surplus production of potatoes crop.

Kumar and Kumar (2008) studied problems, prospects and its effect on income and employment. The study observed dominance of female labour on both types of farms. Delayed payment for crop produce, lack of credit for crop production, scarcity of water for irrigation, erratic power supply and difficulty in meeting quality requirements were the major

constraints faced by contract farmers. The scarcity of water for irrigation, erratic power supply, lack of credit for crop production, and lower price for crop produce identified as major constraints of non-contract farmers. The major constraints expressed by the contracting agencies in expanding contract farming include violation of terms and conditions by farmers, lack of proper management by the company, frequent price fluctuations in international markets, and scarcity of transport vehicles during peak periods.

Arneja *et al* (2009) reported constraints in potato cultivation faced by the potato growers. Majority of the respondents reported non-availability of disease resistant varieties and 68.00 per cent reported labour as the major problem. Maximum number of respondents reported that there was no support price fixed by the government for potato crop.

Muthoni and Nyamongo (2009) conducted that the constraints of Irish potatoes production in Kenya. It reveals that low soil fertility, lack of quality seeds and attacks by pests and diseases are the main factors that limit Irish potato production in Kenya. The study also reveals that access to certified seed is limited by lack of appropriate supply channels and high per unit cost. This has led to self-supply and neighbor supply being the main sources of potato seed in the country. In addition, high costs of inputs such as fertilizers and fungicides have led to their suboptimal application resulting in low yields. Production of potatoes being largely rain-fed; there are seasonal fluctuations in supply of potatoes. This, coupled with limited on-farm storage facilities, results in low prices during the peak production periods and hence low returns to farmers. Furthermore, marketing channels of the produce are controlled by cartels and brokers leaving farmers with minimal opportunity to negotiate for prices. Poor road infrastructure and disregard to standards such as weight per bag and produce quality tend to worsen the situation. There is urgent need for the government to enforce the existing regulatory measures such as weight standards to save the farmers from exploitation by the market cartels. Improvement of the road network will also assist to cut down the transport costs. In addition, the government should assist farmers to organize themselves into cooperatives that will assist in selling their produce. This too will protect farmers from being exploited by brokers. Lastly, there is need to build the capacity of farmers to produce certified potato seed if potato production is to be improved. Such capacity includes training and financially empowering farmers through credit facilities.

Arora (2011) studied that opinion of the vegetable growers regarding vegetable processing in Ludhiana district of Punjab. Lack of finance was most serious problem perceived by respondents in processing of vegetables.

Dhiman *et al* (2011) reported that problems of small scale agro based industries in Patiala district. It was found that Rice mill industry facing the various problems regarding lack of financial assistance, improper marketing channel, high degree of breakdown of finished products and non-availability of research lab for quality control.

Kumar (2011) analyzed problems of contract farming in baby corn and sweet corn in Ludhiana and Jalandhar districts of Punjab. The main problems faced by the respondents were intensive labour, transportation, lack of skilled labour and maintenance of quality, whereas difficult to motivate farmers to grow baby corn and sweet corn, lack of technical knowledge amongst the farmers and lack of awareness regarding contract farming among farmers were the major problems faced by the contracting agency.

Khan (2013) indicated the problems of oilseeds production in West Bengal. It thus comes out that to further promote growth in the cultivation of oilseeds, such constraints need to be addressed in future intervention schemes, particularly relating to price risks and economic uncertainties. Such efforts are expected to place cultivation of sesame in West Bengal on a self-sustained growth path.

Singh (2013) studied that the major problems faced by the respondents were no support price of potato (88.75%), low price (68.75%) and difficulty to use e-marketing (67.50%).

Karanja *et al* (2014) observed analysis of the key challenges facing potato farmers in Oljoro-Orok division, Kenya rainfall variations, lack of clean seeds and crop diseases have been found to be the major challenges facing potato production in the division. As many as 45 per cent of the respondents see rainfall variation as the main cause of decreased potato yields, 33 per cent lack of clean seeds and 6 per cent crop diseases. It was found that farmers use crop diversification and off season approaches to adapt to rainfall variability. The study recommended adaptation measure to be applied to cope with rainfall variation. Such measures include irrigation using water available in Jacob, Terracin and Kivindo dams during dry spelt. A lot of emphases on the use of certified seeds should be done by the agriculture field officers to caution farmers from planting the same potatoes they harvested in the previous harvest.

Singh (2014) studied that the problems of summer mungbean cultivation in Punjab state. The study pointed out that uncertainty in weather was the major production related problem, difficulty in labour management was the major economic and managerial problem, lack of knowledge about machinery for value addition and packaging was the major problem for capacity building, non-availability of market information was the major problem from marketing, value addition and processing area and lack of advance payment for stored produce was the main storage problem faced by the summer mungbean growers.

Peer *et al* (2014) reported constraints for adoption of recommended crop production technologies faced by the potato growers in the sub-tropical zone of Jammu division. The sample of 225 potato growers was selected through proportionate random sampling method. It was revealed that the major constraints for the adoption of crop production technologies faced by the potato growers were complicated seed treatment technique (100.00%), non-availability of fertilizers at proper time (76%), financial problem (72.89%), non-availability of

insecticides/ pesticides at proper time (64.64%), high cost of fertilizers (61.77%), high cost of seed (60.04%), high cost of fungicides (57.78%) and labour problem (54.66%).

Sharma (2014) conducted problems of agro-processing complexes established by Punjab agricultural university in Punjab. Majority of the agripreneurs faced the problem of erratic power supply, heavy cost of transportation of raw material, high cost of inputs and lack of skilled labour.

Ghebreslassie *et al* (2014) revealed potato seed supply, marketing and production constraints in Eritrea. Main production limiting constraints are identified as low input supplies, availability and cost of clean seeds, pest pressure while huge market demand and access to transportation are considered as potentials encouraging grower. It recommended that an immediate action to establish sustainable seed supply system is taken into consideration in line with a regular extension service to provide technical advice to growers.

Chowdhury (2015) analyzed that dissemination of market information should be increased so that farmers can get the fair price of the potato. Major problems faced by the potato farmers were lower price of potato during harvesting period, shortage of capital, price fluctuation, high charge of cold storage, perishability of potato, lack of good quality seed, poor storage facility, higher price of inputs and lack of marketing facility etc. Proper steps should be postulated by Government to puzzle out this problem.

Uddin *et al* (2015) studied constraints and suggestions for modern variety potato production technology. A study was carried out to determine the production constraints of modern varieties of potatoes and also find out the probable suggestions to overcome the constraints as verified the views between the farmers and extension officials in Bangladesh. The most important constraints reported by the farmers and officials ranked in the high initial investment, lack of Government procurement, storing cost high at cold storage, low market price of potato, lack of timely quality seed supply, lack of cow dung manure and high price of pesticides. Similarly top ranking of suggestions by farmers and officials were initiatives of Govt. procurement, timely input supply, reducing storing cost, price fixation at harvesting level, arrangement of modern method of production training, easy loan support, co-operative marketing and reducing price of pesticides.

Kumar *et al* (2016) assessed the knowledge gap and constraints of potato growers in Tawang district of Arunachal Pradesh. Among production constraints, small size of land holding, unavailability of sufficient labour, unavailability of quality seed of improved variety and lack of technical knowledge was identified as major constraints for farmers. Among marketing constraints, Lack of regulated market and lack of storage facility for potato were major constraints.

Pawar (2016) analyzed problems of potato growers' in block chhindwara. It was reported the constraints in production like severe attack of insects/pests, high cost of labors,

low production due to climate change, non-availability of information regarding technical guidance, lack of training about scientific production technology of potato and non-availability of improved seeds. It was also perceived by potato growers in marketing like high charges of middleman and brokers commission, low market price of produce, lack of mandi facilities, lack of minimum support price, lack of processing facilities and lack of transport facilities

Gebru *et al* (2017) found that potato production is constrained by a number of factors among which diseases, storage problems, low market prices of tubers at harvest, and insufficient quality seed tubers for planting were the four major constraints challenging potato production.

CHAPTER-III

MATERIAL AND METHODS

The material and methods of any research are the procedures used in conducting the research study. The chapter includes the sampling plan, selection of variables and their measurement, construction and standardization of measuring instrument and analysis of data. The methodological framework of the present study has been discussed under the following heads:

3.1 Locale of study

The study was carried out in a cluster of three potato seed producing districts of Punjab i.e. Jalandhar, Hoshiarpur and Kapurthala which were selected purposively because these districts were having their maximum area under potato seed production.

3.2 Selection of respondents

Different seed production associations or organisations operating in these districts were identified. List of potato seed producers working with identified seed producing organizations, such as, Confederation of Potato Seed Farmers (POSCON), Jalandhar Potato Growers Association, Kapurthala Potato Growers Association, Pepsico in selected districts were obtained from these organisations. These farmers were termed as organised potato seed producers. List of individual potato seed producers was also taken from the Department of Horticulture. These farmers were termed as unorganised seed producers for the present study. From each selected district, 30 organised and 30 unorganised farmers were selected, randomly. Thus, a total of 180 respondents comprising of 90 organised and 90 unorganised potato seed producers were selected for the study.

3.3 Selection of the variables

The variables for the present study were selected after reviewing the related research studies and thorough discussion with the members of advisory committee. The variables selected were as following under two main heads:

3.3.1 Independent variables

3.3.1.1 Age

3.3.1.2 Education

3.3.1.3 Family type

3.3.1.4 Family size

3.3.1.5 Gross annual income

3.3.1.6 Operational land holding

3.3.1.7 Extension contacts

3.3.1.8 Mass media Exposure

3.3.1.9 Risk bearing capacity

3.3.1.10 Economic Motivation

3.3.1.11 Innovativeness

3.3.2 Dependent variables

3.3.2.1 Status

3.3.2.2 Prospects

3.3.2.3 Problems

3.4 Operational definitions

3.4.1 Age

It referred to the chronological age of the farmers in terms of completed years of life at the time of data collection. Three categories of respondents were prepared by using range method i.e. 24-39 years, 40-55 years and 56-71 years.

3.4.2 Education

It referred to the level of formal school education of the respondents in terms of number of years completed successfully. The respondents were categorized into six categories i.e. illiterate, primary, middle, matric, senior secondary and graduation.

3.4.3 Family type

It referred to the composition of a family i.e. either nuclear or joint family. A family was considered as nuclear where only husband, wife and their children lived together, whereas joint family consisted of mother, father, brother(s) or any other relatives living with the respondents.

3.4.4 Family size

It referred to the number of members in the family of the respondents. The size of the family was categorized into three categories by using range method, as following:

4 – 6 members

7 – 9 members

10– 12 members

3.4.5 Gross annual income

It referred to the total gross income of the respondent's family including all agricultural and non-agricultural subsidiary enterprises and returns from the total land holding of the respondent. The gross annual incomes of the respondents were categorized into three main categories using cumulative cube root method as following:

< 25 lakhs

25 – 47 lakhs

> 47 lakhs

3.4.6 Operational land holding

It referred to the size of land holding cultivated by an individual respondent. It was calculated as under:

Operational land holding = Land owned + Land leased in – Land leased out.

The respondents were classified into following five categories on the basis of criteria given in statistical abstract of Punjab (2015).

Category	Operational Land Holding
Marginal	< 1 ha
Small	1-2 ha
Semi-medium	2-4 ha
Medium	4-10 ha
Large	> 10 ha

3.4.7 Extension contacts

It referred to the frequency of contacts made by the respondent with different extension agencies for seeking information related to production of potato seeds . It was studied at three point continuum, such as, Always, Sometimes and Never and score of 3, 2 and 1 were assigned respectively.

3.4.8 Mass Media Exposure

It referred to the frequency of using different media viz Radio, Television, Farm Literature and newspaper by the respondent to gain or improve knowledge regarding potato seed production.

- **Information seeking sources**

It referred to the frequency of contacts made by the respondents with different agencies for seeking information related to potato seed production. It was measured on the three point continuum such as Always, Sometimes and Never and score 3, 2 and 1 was assigned respectively and mean score was calculated.

- **Use of literature and ICT tools**

It referred to the frequency of using different sources of literature, newspaper and Information Communication Technology (ICT) tools by the respondent to gain or improve

knowledge regarding agriculture. The respondents were simply distributed under the categories of literature or ICT tools used by them.

- **Use of Farm telecasts/radio broadcasts**

It referred to the frequency of using different media *viz.,* Radio, Television by the respondent to gain or improve knowledge. Media used by the respondents was measured on the three point continuum such as Always, Sometimes and Never and score 3, 2 and 1 was assigned respectively to calculate mean score .

3.4.9 Risk bearing capacity

It referred to the degree to which an individual is oriented towards risk and uncertainty and had courage to face the complications emerging time to time while starting an enterprise. Modified scale of Supe and Singh (1976) on three point continuum such as Agree, Undecided and Disagree was used with score of 3, 2 and 1 respectively. Based on this criterion the respondents were classified as follow:

Risk bearing capacity	**Score**
Low	15-17
Medium	18-20
High	21-23

3.4.10 Economic Motivation

It referred to the degree to which a farmer desires to increase his farm income and maximize his profit. It was measured by using modified scale of Moulik (1972) on a three point continuum i.e. Agree, Undecided and Disagree and scores of 3, 2 and 1 were assigned respectively.

Economic Motivation	**Score**
Low	9-12
Medium	12-15
High	15-18

3.4.11 Innovativeness

It was taken as the degree to which an individual is relatively earlier in adopting the potato seed production than other respondents of the social system. It was measured by using modified scale of Singh (1972) on a three point continuum i.e. Agree, Undecided and Disagree and scores of 3, 2 and 1 were assigned respectively.

Innovativeness	**Score**
Low	14-17
Medium	18-21
High	22-25

3.4.12 Organised seed producers

It refers to those potato seed growers which are associated with seed producer's organisation such as Confederation of Potato Seed Farmers (POSCON), Jalandhar Potato Grower's Association, Kapurthala Potato Grower's Association and Pepsico.

3.4.13 Unorganised seed producers

It refers to those potato seed producers who are individually producing and marketing the seed and not associated with any potato seed producer's organisation.

3.4.14 Status

It referred to the prevailing position of potato seed producers. It was studied with respect to different aspects, such as, area under potato seed production, experience of farmers in potato seed production, varieties sown, yield obtained, sources of parent seed, value addition and marketing of its produce etc. It was measured in frequency and percentage.

3.4.15 Prospects

It referred to the scope of potato seed production among the farmers. It was studied in terms of number of farmers willing to increase/decrease the area under potato seed production in proportion to the total operational land holding. It included their willingness to follow marketing channel and future plan about potato seed production. It was expressed in terms of frequency and percentage.

3.4.16 Problems

These were the difficulties faced by the organised or unorganised farmers in potato seed production. It was measured in yes/no form.

3.5 Construction of research instrument

Data were collected by using personal interview with potato seed producers by constructing an interview schedule. The interview schedule comprised of four parts:

Part I:

This part covered the information regarding the socio-personal characteristics of potato seed producers such as, age, education, operational land holding, family size, extension contacts etc.

Part II:

This part included the statements regarding status of potato seed producers such as, area under potato crop, varieties grown, time of sowing, seed rate, adoption of recommended cultivation practices, yield obtained, sources of parent seed, net profit from potato seed production etc.

Part III:

This part included the statements regarding the prospects of the potato seed producers, such as, plans to change in area under potato crop in future.

Part IV:

This part contained the statements regarding problems or constraints faced by the potato seed producers. It also included the suggestions of the potato seed producers.

3.6 Pre-testing of research instrument

Interview schedule so prepared was pre-tested on twenty respondents from the non-sampled area i.e. ten organised and ten unorganised. On the basis of information obtained through pre-testing, necessary modifications were made in the schedule after thorough discussion with the advisory committee members so as to remove the ambiguities and make it comprehensive and easy for recording the data.

3.7 Collection of Data

After finalizing the research instrument, the data were collected through personal interview method from the respondents. Proper precautions were taken to ensure an unbiased response of the farmers by providing them necessary instructions after explaining the objectives of the study.

3.8 Analysis of the data

The data were transferred on the master-sheets in Microsoft-excel and were tabulated according to the objectives of the study. Appropriate statistical tools such as frequencies, percentage, mean score, range method were used for analysis.

3.8.1 Mean Score

Mean score of sample farmers in various problems under different problem areas was computed with the help of a three point continuum of agree, neutral and disagree with a score of 3, 2 and 1 respectively.

Average mean score of sample farmers for five problem areas was computed by taking an average of mean scores of sample farmers for various problems under different problem areas. It was used to rank the five problem areas.

3.8.2 Z test for single mean

The single sample z test is used to know whether our sample comes from a particular population, i.e. either there is a significant difference between the population and the sample.

$$Z = \frac{\bar{X} - \mu}{\sqrt{\sigma 2/n}}$$

Where,

$\bar{X}$ = Sample mean

μ = Population mean

σ^2 = Estimate of population variance

n = Sample size

3.8.3 Multiple linear regression

Multiple linear regression attempts to model the relationship between two or more explanatory variables and a response variable by fitting a linear equation to observed data. Every value of the independent variable x is associated with a value of the dependent variable y.

The following regression equation was used for the analysis:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 \ldots\ldots\ldots\ldots + \beta_n X_n$$

Where,

Y = Dependent variable

X = Independent variables

β_0 = Regression constant

$\beta_1, \beta_2, \beta_3 \ldots \beta_n$ = Regression coefficients

CHAPTER-IV

RESULTS AND DISCUSSION

This chapter deals with the results of the study which emerged out of analysis and interpretation of data. For better comprehension of the results, these have been presented under different sections. Every section gives a detailed account of the results of the study and presents an analytical view of the results by discussing its various dimensions and giving relevant references at the appropriate places in agreement or disagreement of the results. Keeping in view the objectives of study, results and discussion have been presented under the following order:

4.1 Socio-personal characteristics of potato seed producers

4.2 Status of potato seed production

4.3 Prospects of potato seed production

4.4 Problems faced by potato seed producers and suggestions thereof.

4.1 Socio-personal characteristics potato seed producers

The information regarding socio-personal characteristics of selected farmers which include age, education, family type, family size, operational land holding, extension contacts, risk bearing capacity, economic motivation and innovativeness was analyzed. The information pertaining to the socio personal characteristics of the farmers has been given in Table 4.1. The findings had been discussed as following:

4.1.1 Age

The data in Table 4.1 indicate that the age of the unorganised and organised respondents varied from 24-71 years. One third (33.33%) and around 48.00 per cent of unorganised respondents belonged to the age group of 24-39 years and 40-55 years, respectively while only 18.88 per cent of the unorganised respondents were in the age group

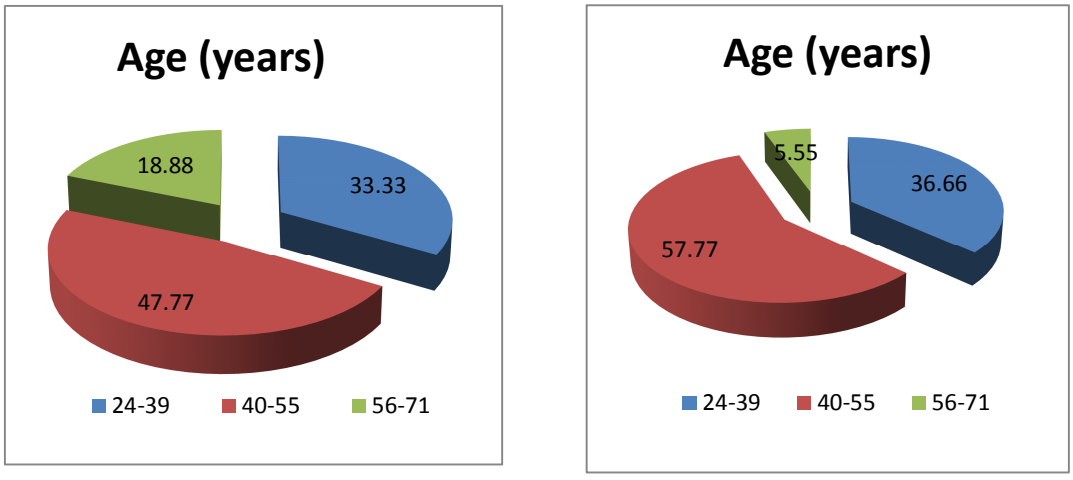

Fig. 1: Distribution of unorganised and organised respondents on the basis of their age

of 56-71 years. On the other hand, 36.66 per cent of the organised respondents belonged to the age group of 24-39 years. Around half of the organised respondents (56.77%) and very less (5.55%) of the respondents were in the age group of 40-55 years and 56-71 years, respectively. These findings are in line with those of Kumar (2010) where it was reported that majority of the family heads belonged to age group of 35 to 55 years.

4.1.2 Education

It can be seem from Table 4.1 that 34.44 per cent of the unorganised respondents were educated up to matric, 26.66 per cent of the unorganised respondents were educated up to senior secondary followed by 13.33 per cent of these respondents were graduated. As many as 16.66 per cent of the unorganised respondents were either illiterate or studied up to primary education. In contrast to this, half of the organised respondents (51.11%) has got senior secondary education. Around 29.00 per cent of the organised respondents were matric and 11.00 per cent of the respondents were graduated. Very less 6.66 per cent and 2.22 per cent of the organised respondents have passed middle and primary level of education, respectively. None of the organised seed producers were illiterate.

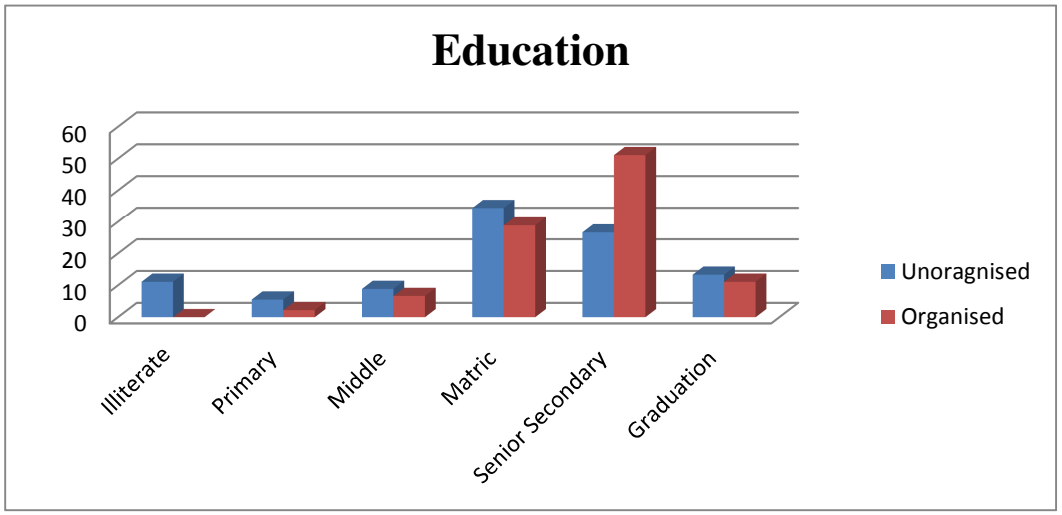

Fig. 2: Distribution of unorganised and organised respondents on the basis of their education

4.1.3 Family type and size

It was found that 58.88 per cent of the unorganised respondents belonged to joint family and 40.11 per cent of the unorganised respondents belonged to nuclear family. Similarly, majority (70.00%) of the organised respondents belonged to joint family and 30.00 per cent of these respondents belonged to nuclear family. The findings are in line with the study conducted by Singh (2013).

It was observed that majority (60.00%) of the unorganised respondents had family size of 4-6 members followed by 30.00 per cent of these respondents had 7-9 members in the

family. Only 10.00 per cent of the unorganised respondents had 10-12 members in the family.

Table 4.1 Distribution of respondents according to their socio-personal characteristics

Sr. No.	Socio-personal characteristics	Category	Unorganised(n_1=90)		Organised(n_2=90)	
			f	%	f	%
1.	Age (years)	24-39	30	33.33	33	36.66
		40-55	43	47.77	52	57.77
		56-71	17	18.88	5	5.55
2.	Education	Illiterate	10	11.11	-	-
		Primary	5	5.55	2	2.22
		Middle	8	8.88	6	6.66
		Matric	31	34.44	26	28.88
		Senior Secondary	24	26.66	46	51.11
		Graduation	12	13.33	10	11.11
3	Family type	Joint	53	58.88	63	70.00
		Nuclear	37	40.11	27	30.00
4	Family size (members)	4-6 members	54	60.00	43	47.77
		7-9 members	27	30.00	31	34.44
		10-12 members	9	10.00	16	17.77
5	Gross annual income (in lakhs)	< 25	62	68.88	26	28.88
		25 – 47	10	11.11	21	23.33
		> 47	18	20.00	43	47.77
6	Land owned	Marginal (< 1 ha)	2	2.22	-	-
		Small (1-2 ha)	5	5.55	-	-
		Semi-medium (2-4 ha)	24	26.66	-	-
		Medium (4-10 ha)	34	37.77	31	34.44
		Large (> 10 ha)	25	27.77	59	65.55
7	Operational land holding	Semi-medium (2-4 ha)	7	7.77	-	-
		Medium (4-10 ha)	24	26.66	10	11.11
		Large (> 10 ha)	59	65.55	80	88.88
8	Source of irrigation*	Electric motor	90	100.00	90	100.00
		Canal	27	30.00	20	22.22
		Diesel pump	35	38.88	42	46.66
9	Cropping rotation followed*	Potato-Maize-Paddy	65	72.22	85	94.44
		Potato-Mentha-Paddy	-	-	6	6.66
		Potato-Muskmelon-	21	23.33	29	32.22

		Paddy				
		Potato-Sunflower-Paddy	-	-	3	3.33
		Potato-Sugarcane	18	20.00	2	2.22
		Potato-Moong-Paddy	-	-	6	6.66
		Potato-Cucumber-Paddy	-	-	2	2.22
		Potato-Wheat-Paddy	5	5.55	-	-
10	Subsidiary enterprises	Dairy	-	-	4	4.44
		Protected cultivation	-	-	6	6.66
11	Experience in potato seed production (in years)	5-21	37	41.11	26	28.88
		22-37	43	47.77	50	55.55
		38-54	10	11.11	14	15.55

***Multiple response**

Similarly, half of the organised respondents (47.77%) had 4-6 members followed by 34.44 per cent of respondents were 7-9 members in the family. Only 17.77 per cent of the organised respondents had 10-12 members in the family.

4.1.4 Gross annual income

The data on gross income from the all the sources of the respondents family was also collected and presented in Table 4.1. It was found that 68.88 per cent of the unorganised respondents had gross annual income less than 25.00 lakhs and 20.00 per cent of respondents were having gross annual income more than 47 lakhs, respectively. About 11.00 per cent of the unorganised respondents were in the range of 25-47 lakhs gross annual income. Half of the organised respondents (47.77%) had gross annual income more than 47 lakhs. Around one-fourth (28.88%) of the organised respondents had gross annual income less than 25 lakhs and 23.33 per cent of these respondents had gross annual income ranging from 25-47 lakhs, respectively.

4.1.5 Land owned

Around 38.00 per cent of the unorganised respondents possessed 4 to 10 hectare of land (Table 4.1). One-fourth (25.55%) of the unorganised respondents had large (>10 ha) land followed by 24.44 per cent owned semi-medium (2-4 ha) land holding. Only 7.77 per cent of the unorganised respondents owned land less than 2 hectare. However majority (65.55%) of the organised respondents owned large (>10 ha) land followed by 34.44 per cent of respondents possessed medium (4-10 ha) landholding. None of the organised respondents owned marginal less than 4 hectare of land.

4.1.6 Operational land holding

Majority (65.55%) of the unorganised respondents had large (>10 ha) operational land holding (Table 4.1). One-fourth (26.66%) of these respondents had medium (4-10 ha) land holding. Only 7.77 per cent of the unorganised respondents had semi-medium (2-4 ha) and none of the unorganised respondents had marginal (<1 ha) and small (1-2 ha) operational land holding. Interestingly, most of i.e. 88.88 per cent of the organised respondents had large (>10 ha) and only 11.11 per cent had medium land holding. None of the organised respondents had marginal (<1 ha), small (1-2 ha) and semi-medium (2-4 ha) operational land holding. The findings are in line with the study conducted by Singh (2013).

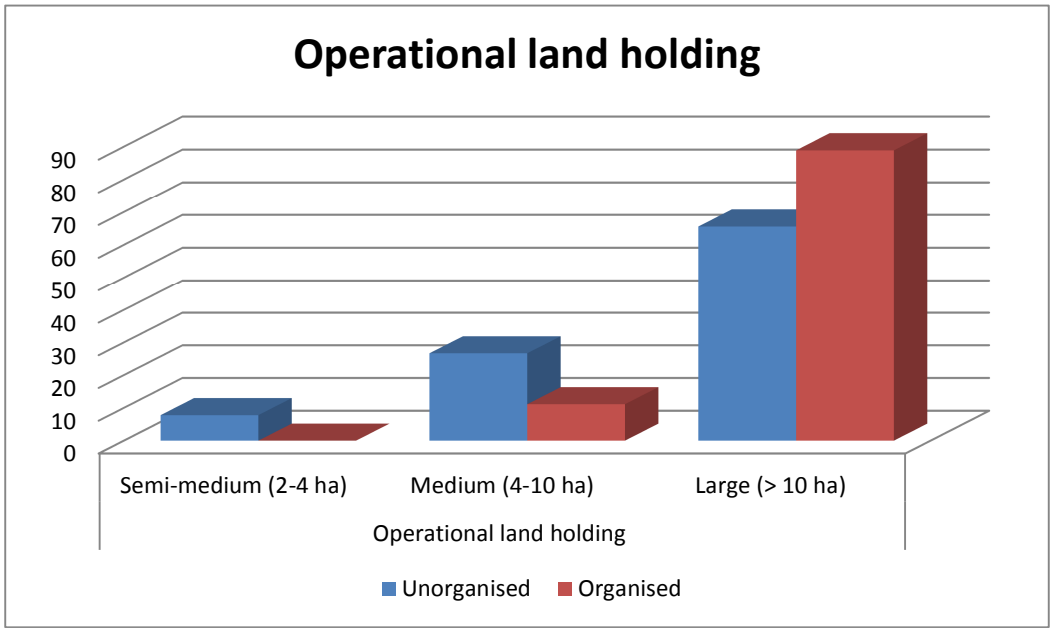

Fig. 3: Distribution of unorganised and organised respondents on the basis of their operational land holding

4.1.7 Source of irrigation

It was found that cent per cent of the unorganised and organised respondents were having electric motor as a main source of irrigation (Table 4.1). About 38.88 per cent of the unorganised respondents also had diesel pump and 30.00 per cent of these respondents had canal water as a source of irrigation. On the other hand, 46.66 per cent of the organised respondents also had diesel pump and 22.22 per cent of these respondents had canal water. Thus it can be seem that most of the respondents were dependent on the installed electric motor for irrigation.

4.1.8 Cropping pattern

The cropping pattern referred to the proportion of area put under various crops by the respondents. Majority (72.22%) of the unorganised respondents followed potato-maize-paddy

cropping pattern, while 23.33 per cent of the respondents were followed potato-muskmelon-paddy cropping pattern (Table 4.1). Only 20.00 per cent of the unorganised respondentss had followed the potato-sugarcane cropping pattern. None of the unorganised respondents followed potato-mentha-paddy, potato-sunflower-paddy, potato-moong-paddy and potato-cucumber-paddy cropping pattern. On the other hand, almost all the organised respondents i.e. 94.44 per cent adopted potato-maize-paddy cropping pattern, 32.22 per cent of the organised respondents were followed potato-muskmelon-paddy cropping pattern. Other cropping pattern followed by the organised respondents were potato-mentha-paddy, potato-sunflower-paddy, potato-sugarcane and potato-cucumber-paddy cropping pattern. None of the organised respondents were followed potato-wheat-paddy cropping pattern. About 20.00 per cent of these organised respondents were followed potato-sugarcane cropping pattern.

4.1.9 Subsidiary enterprises

None of the unorganised respondents had adopted subsidiary enterprises like diary and protected cultivation (Table 4.1). Very few organised respondents had adopted diary and protected cultivation as a subsidiary enterprises.

4.1.10 Experience in potato seed production

It was found that 47.77 per cent of the unorganised respondents highly experienced in potato seed production were in the range of 22-37 years while 41.11 per cent of the unorganised respondents experienced in the potato seed production since 5-27 years (Table 4.1). Only 11.11 per cent of these respondents had experienced in potato seed production for the 38-54 years. Similarly, half of the organised respondents (55.55%) were experienced in potato seed production for the years of 22-37 years. One-fourth (28.88%) of the organised respondents were ranged from 5-21 years and only 15.55 per cent of the organised respondents experienced in potato seed production ranging from 38-54 years, respectively.

4.1.11 Sources of seeking information

The data in the Table 4.2 reveals that 35.55 per cent of the unorganised respondents sought information from pesticide dealers frequently whereas 28.88 per cent of unorganised respondents frequently consulted artias/commission agents. It was found that 17.77 per cent and16.66 per cent of unorganised respondents consulted private company representatives and agricultural development officers (ADO's) or horticultural development officers (HDO's), respectively. Only 12.22 per cent and 8.88 per cent of unorganised respondents frequently took advice from KVK's and PAU scientists for getting farm information, respectively. On the other hand, 43.33 per cent of the organised respondents frequently sought information from pesticide dealers followed by 32.22 per cent of the organised respondents who has consulted private company representatives. About 28.88 per cent organised respondents got information frequently from private company representatives and artias/commission agents.

Table 4.2 Distribution of respondents according to their sources of seeking information regarding potato seed production

Source	Frequently f (%)		Occasionally f (%)		Never f (%)		Mean Score		z-value
	Unorganised (n_1=90)	Organised (n_2=90)	Unorganised (n_1=90)	Organised (n_2=90)	Unorganised (n_1=90)	Organised (n_2=90)	Unorganised (n_1=90)	Organised (n_2=90)	
ADO/HDO	15(16.66)	17(18.88)	23(25.55)	29(32.22)	52(57.77)	44(48.88)	**1.58**	**1.70**	**0.97**
KVK's	11(12.22)	12(13.33)	23(25.55)	34(37.77)	56(62.22)	44(48.88)	**1.50**	**1.64**	**1.36**
PAU scientists	8(8.88)	12(13.33)	21(23.33)	32(35.55)	61(67.77)	46(51.11)	**1.41**	**1.62**	**2.07***
Private company representatives	16(17.77)	29(32.22)	51(56.66)	57(63.33)	23(25.55)	4(4.44)	**1.92**	**2.27**	**3.96***
Arthia's/commission agents	26(28.88)	26(28.88)	43(47.77)	51(56.66)	21(23.33)	13(14.44)	**2.05**	**2.14**	**0.86**
Pesticide dealers	32(35.55)	39(43.33)	51(56.66)	39(43.33)	7(7.77)	12(13.33)	**2.27**	**2.30**	**0.22**

***5% level of significance**

Nearly half (56.66%) of the unorganised respondents sought information from private company representatives and pesticide dealers occasionally. Nearly half of the unorganised respondents (47.77%) got information from artias/ commission agents. Around one-fourth of each the unorganised respondents got advice from PAU scientists, agricultural development officers (ADOs)/horticultural development officers (HDOs) and KVKs occasionally, respectively. Similarly, majority (63.33%) of the organised respondents got information from private representative along with 56.66 per cent, 43.33 per cent, 37.77 per cent and 35.55 per cent of the respondents occasionally got information from artias/commission agents, pesticide dealers, KVKs and PAU scientists occasionally, respectively. One-third i.e. 32.22 per cent of the organised respondents sought information agricultural development officers (ADOs)/horticultural development officers (HDOs). Majority of the unorganised respondents never sought information from PAU scientists and KVKs and agricultural development officers (ADOs)/horticultural development officers (HDOs). Half of the organised respondents i.e. 51.11 per cent and 48.88 per cent each of the organised respondents never got information from PAU scientists, agricultural development officers (ADOs)/horticultural development officers (HDOs), KVKs, respectively.

The mean score was calculated for each source of information by providing the score of 3, 2 and 1 for frequently, occasionally and never, respectively. In unorganised sector, the pesticide dealers, artias /commission agents and private company representatives had got the highest mean score of 2.27 and 2.05 and 1.92, respectively. Similarly, in organised sector, the pesticide dealers, private company representatives and artias/commission agents had got highest score of 2.30, 2.27 and 2.14, respectively. It shows that these were the major sources for seeking information by unorganised respondents because they were most easily approachable sources for the village farmers and were regular in the contact of the respondents. It was found that the difference seeking farm information between unorganised and organised respondents was found to be significant in case of PAU scientists and private company representative (z=3.96, 2.07 at 5% level of significance).

4.1.12 Use of agricultural literature Farm telecasts/ radio broadcasts

The data in Table 4.3 reveals that the distribution of potato growers according to their use of agriculture literature farm telecasts/ radio broadcasts for seeking farm information. Nearly half of the unorganised respondents always read newspapers for getting agricultural information, whereas only 7.77 per cent and 6.66 per cent of the unorganised respondents read magazines and PAU literatures. Similarly, most of the organised respondents (85.55%) always read newspapers for agricultural information followed by 42.22 per cent and 30.00 per cent of the organised respondents read magazines and PAU literatures.

Table 4.3 Distribution of respondents according to use of agricultural literature and Farm telecasts/ radio broadcasts for seeking farm information

Sources	Always (3-5 times/week)		Sometime (1-2 times/week)		Never		Mean Score		z-value
	f (%)		f (%)		f (%)				
	Unorganised (n_1=90)	Organised (n_2=90)	Unorganised (n_1=90)	Organised (n_2=90)	Unorganised (n_1=90)	Organised (n_2=90)	Unorganised (n_1=90)	Organised (n_2=90)	
Newspapers	44(48.88)	77(85.55)	26(28.88)	3(3.33)	20(22.22)	10(11.11)	**2.20**	**2.74**	**4.78***
Magazines	7(7.77)	38(42.22)	18(20.00)	15(16.66)	65(72.22)	37(41.11)	**1.35**	**1.99**	**5.60***
PAU Literatures	6(6.66)	27(30.00)	11(12.22)	20(22.22)	73(81.11)	42(46.66)	**1.25**	**1.81**	**5.28***
Mera Pind Mere Khet	23(25.55)	16(17.77)	49(54.44)	57(63.33)	18(20.00)	17(18.88)	**2.05**	**1.98**	**0.69**
Sohna Punjab	13(14.44)	6(6.66)	28(31.11)	35(38.88)	49(54.44)	49(54.44)	**1.60**	**1.52**	**0.76**
DD Kisan Channel	23(25.55)	15(16.66)	25(27.77)	48(53.33)	42(46.66)	27(30.00)	**1.78**	**1.84**	**0.69**

***5% level of significance**

Most of the unorganised respondents i.e. 81.11 per cent and 72.22 per cent never read PAU literatures and magazines. Also, 22.22 per cent of the unorganised respondents never read newspapers. Similarly, around 47.00 per cent and 41.00 per cent of the organised respondents never read PAU literatures and magazines. Only 11.11 per cent of the organised respondents never read newspapers for agricultural information.

The mean score was calculated for each source by providing the score of 3, 2 and 1 for always, sometimes and never, respectively. In unorganised and organised respondents, getting information from newspapers got the highest mean score of 2.2 and 2.74, respectively. The difference between unorganised and organised sector regarding use of newspapers, magazines and PAU literatures was found to be significant (z= 4.78, 5.60 and 5.28 respectively) at 5% level.

One-fourth of the unorganised respondents always viewed *Mera Pind Mere Khet* and *DD kisan channel*. About 14.44 per cent of the unorganised respondents always viewed *Sohna Punjab* on farm telecast. Only 17.77 per cent, 16.66 per cent and 6.66 per cent of the organised respondents viewed *Mera Pind Mere Khet, DD kisan channel* and *Sohna Punjab*, respectively. Nearly half (54.44%) of the unorganised respondents sometimes viewed *Mera Pind Mere Khet*, whereas 31.11 per cent and 27.77 per cent of these respondents viewed sometimes *Sohna Punjab* and *DD kisan* channel. Majority of the organised respondents (63.33%) sometimes viewed *Mera Pind Mere Khet.* Half of the organised respondents i.e. 53.33 per cent and 38.88 per cent of these respondents viewed *DD kisan channel*, *Sohna Punjab,* respectively.

The mean score for unorganised respondents was highest for *Mera Pind Mere Khet*, and *DD kisan* channel i.e. 2.05 and 1.78, respectively. For organised sector, highest mean score was 1.98 and 1.84 for *Mera Pind Mere Khet* and *DD kisan* channel. It was found that there is non-significant difference regarding use of farm telecasts in unorganised and organised respondents (z= 0.69, 1.33, 0.76&0.69 at 5% level of significant)

4.1.13 Usage of ICT tools

The data in Table 4.4 reveals that, half of the unorganised respondents used Whatsapp application followed by 48.88 per cent and 42.22 per cent used weather app and subscribed SMSs. It was also found that 33.33 per cent and 32.22 per cent of unorganised respondents used internet and facebook for getting agricultural information. Majority of the organised respondents i.e. 64.44 per cent and 60.00 per cent used whatsapp and weather apps, respectively. About 57.77 per cent of the respondents used search engines like Google, Yahoo for searching information as followed by 54.44 per cent 36.66 per cent for SMS subscriber and Facebook related to agriculture. Usage of ICT tools by higher number of the respondents indicates that more number of farmers because familiar with these tools and using them.

Table 4.4 Distribution of respondents according to usage of ICT tools for seeking agriculture information

Source*	Unorganised (n_1=90)		Organised (n_2=90)	
	f	(%)	f	(%)
Whatsapp	45	50.00	58	64.44
Facebook	29	32.22	33	36.66
Weather apps	38	42.22	54	60.00
SMS subscriber	44	48.88	49	54.44
Internet (Google search)	30	33.33	52	57.77

***Multiple response**

4.1.14 Farm machinery

The data in Table 4.5 shows that, all of the unorganised respondents have tractor, trolley, cultivator, disc harrow and electric pump. Most of the respondents i.e. 90.00 per cent and 82.22 per cent have power sprayer and potato digger. Also 54.44 per cent of them have potato planter. All of the organised respondents have tractor, trolley, cultivator, disc harrows, potato digger, electric pump and power sprayer.

Table 4.5 Distribution of respondents according to farm machinery owned by them

Sr. No.	Farm Machinery*	Unorganised(n_1=90)		Organised (n_2=90)	
		f	(%)	f	(%)
1.	Tractors owned	90	100.00	90	100.00
2.	Trolley	90	100.00	90	100.00
3.	Cultivator	90	100.00	90	100.00
4.	Disc harrows	90	100.00	90	100.00
5.	Potato planter	49	54.44	73	81.11
6.	Potato digger	74	82.22	90	100.00
7.	Electric pump	90	100.00	90	100.00
8.	Power sprayer	81	90.00	90	100.00

***Multiple response**

4.1.15 Risk bearing capacity

The data in Table 4.6 represents that majority of the unorganised respondents i.e. 56.66 per cent had medium (18-20) level of risk bearing capacity. One-fourth (23.33%) of unorganised respondents, one-fifth (20.00%) of these respondents had low (15-17) and high (21-23) level of risk bearing capacity. Majority of the organised respondents (58.88%) had medium (18-20) level of risk bearing capacity. About i.e. 31.11 per cent and only 10.00 per cent of the organised respondents had high (21-23) and low (15-17) level of risk bearing capacity. The findings of study are in line with Singh (2013).

Table 4.6 Distribution of respondents according to their risk bearing capacity

Sr. No.	Risk bearing capacity (Scores)	Unorganised(n_1=90)	Organised (n_2=90)
		f (%)	f (%)
1	Low (15–17)	21(23.33)	9(10.00)
2	Medium (18–20)	51(56.66)	53(58.88)
3	High (21–23)	18(20.00)	28(31.11)

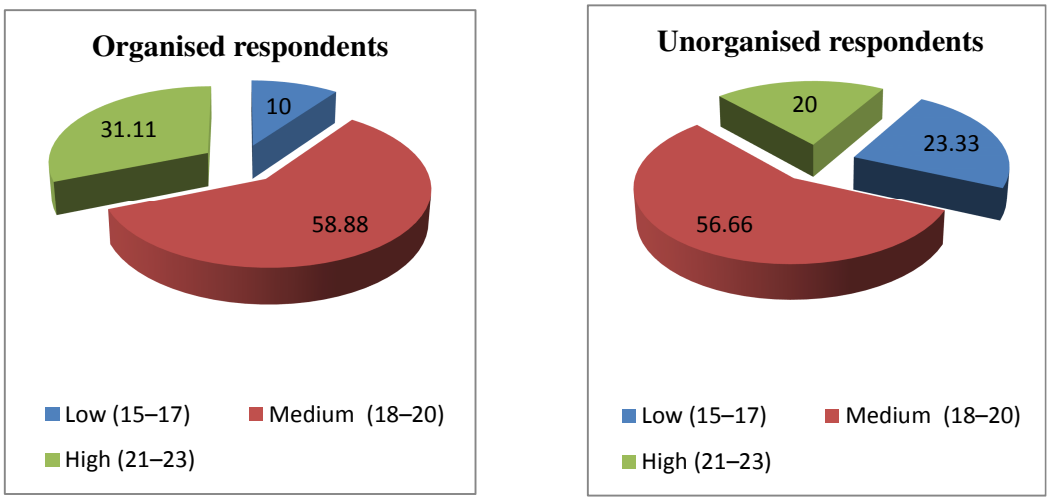

Fig. 4: Distribution of unorganised and organised respondents on the basis of their risk bearing capacity

4.1.16 Economic motivation

The data in Table 4.7 indicate that majority (66.66%) of the unorganised respondents had medium (12-15) level of economic motivation. Only 18.88 per cent and 14.44 per cent of these respondents had high (15-18) and low (9-12) level of economic motivation. Half of the organised respondents (50.00%) and 37.77 per cent of these respondents had medium (12-15) and high (15-18) level of economic motivation. Only 12.22 per cent of the organised respondents had low level of economic motivation. The findings of study are in line with the study conducted by Singh (2013).

Table 4.7 Distribution of respondents according to their economic motivation

Sr. No.	Economic Motivation (Scores)	Unorganised (n_1=90)	Organised (n_2=90)
		f (%)	f (%)
1	Low (9–12)	13(14.44)	11(12.22)
2	Medium (12–15)	60(66.66)	45(50.00)
3	High (15–18)	17(18.88)	34(37.77)

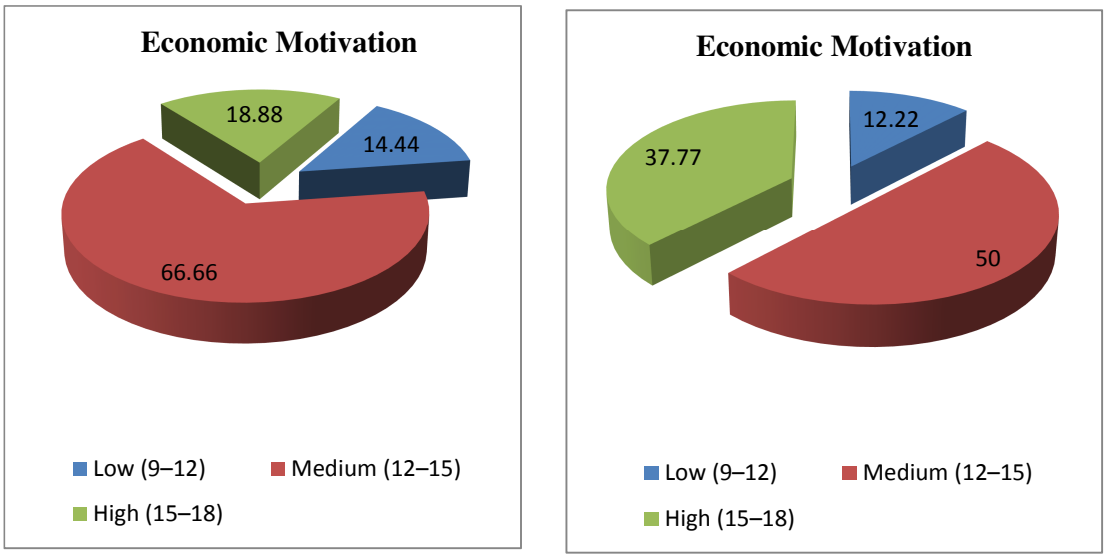

Fig. 5: Distribution of unorganised and organised respondents on the basis of their economic motivation

4.1.17 Innovativeness

The data in Table 4.8 reveals that majority of the unorganised respondents (61.11%) were having medium (18-21) level of innovativeness. Around (31.11%) of the unorganised respondents were having low (14-17) level of innovativeness. Only 7.77 per cent of the unorganised respondents were highly innovativeness. About 57.77 per cent of the organised respondents were having medium level of innovativeness and 23.33 per cent of these respondents were highly innovative. Only 18.88 per cent of the organised respondents had low level of innovativeness regarding operations or techniques involved in potato seed production. The findings of study are in line with the study conducted by Singh (2013).

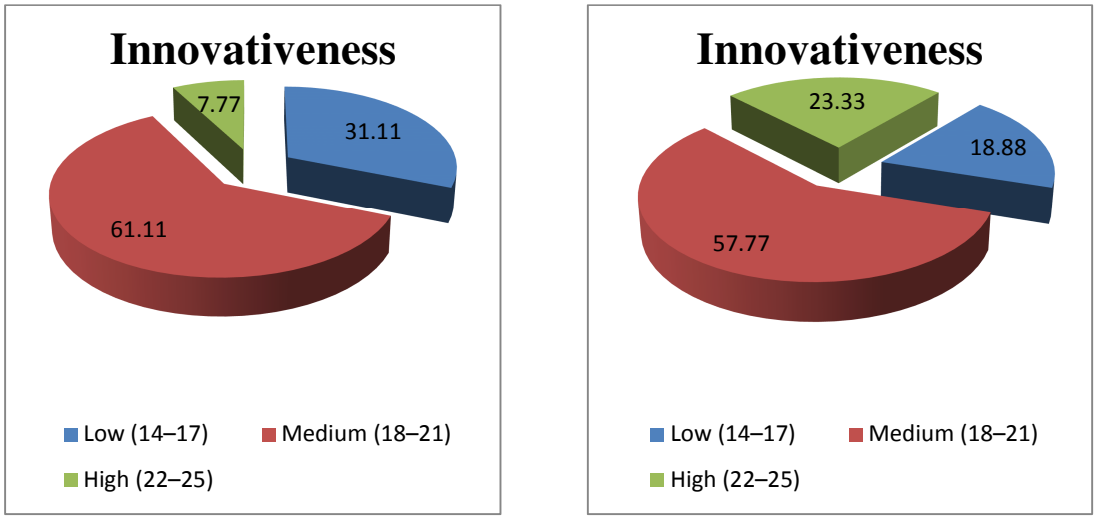

Fig. 6: Distribution of unorganised and organised respondents on the basis of their innovativeness

Table 4.8 Distribution of respondents according to their innovativeness

Sr. No.	Innovativeness (Scores)	Unorganised (n_1=90)	Organised (n_2=90)
		f (%)	f (%)
1	Low (14–17)	28(31.11)	17(18.88)
2	Medium (18–21)	55(61.11)	52(57.77)
3	High (22–25)	7(7.77)	21(23.33)

4.2 Status of potato seed production

The present position of potato seed producers by the respondents was analyzed and tabulated under various categories such as area under potato crop, varieties grown, time of sowing, seed rate, adoption of recommended cultivation practices, yield obtained, sources of parent seed, net profit from potato seed production etc. These are listed and further explained as following:

4.2.1 Area under potato cultivation and average yield

The data in Table 4.9 depicts the distribution of respondents according to area under potato cultivation and average yield during last five years. The area of organised respondents under potato seed production has been increased from 14564 acres to 14974 acres during the years 2013 to 2017 except in the year of 2016, in which there was decrease in area due to price fluctuation while area under organised respondents under potato cultivation has been increased in the year 2013 and 2014 but there was decreased in area of potato cultivation in next two years i.e. 2015-2016. It was observed that average yield of organised respondents was lower than the yield of unorganised respondents as they focus more on quality aspect of potato seed which is sold at relatively higher price than the seed produced by the unorganised respondents.

Table 4.9 Distribution of respondents according to area under potato cultivation and average yield during last five years

Year	Unorganised seed producers			Organised seed producers		
	Area (acres)	*Percentage of total area	Average yield (q/acre)	Area (acres)	**Percentage of total area	Average yield (q/acre)
2013	5537	78.52	125.5	14564	89.35	91.89
2014	5788	82.08	124.4	15105	92.67	91.44
2015	5980	84.81	125.4	15679	96.19	92
2016	5965	84.59	128.7	14861	91.17	94.11
2017	5694	80.75	126	14974	91.87	92.78

* Total area of unorganised seed producers =7051acres
**Total area of organised seed producers =16299acres

Regarding yield of potato crop, both unorganised and organised sectors have a trend of increasing yield in first four years while in year of 2016. Scott *et al (2000)* reported the similar trend related to production of potato crop in India. Overall, there is stagnant in production and yield of potato throughout the years.

4.2.2 Varieties grown and area under different potato varieties

There are number of varieties released by Central Potato Research Institute and recommended by the Punjab Agricultural University in Punjab state. It is evident from Table 4.10 that almost all the unorganised respondents i.e. 95.55 per cent has grown recommended Kufri Pukhraj variety which covered 3869 acres of area under potato crop. Around 40.00 per cent of unorganised respondents had grown Kufri Jyoti variety on 1678 acres of potato crop. Other varieties of potato crop adopted by the unorganised respondents were Kufri Chipsona-1 (10.00%), Kufri Chandramukhi (8.88%), Kufri Sindhuri (2.22%) and Kufri Bahar (2.22%), respectively. None of the unorganised respondents had grown Kufri Badshah of potato crop. On the other hand, majority (76.66%) of the organised respondents has grown Kufri Phukhraj variety on 12528 acres of land and 60.00 per cent of the organised respondents had adopted Kufri Jyoti variety which covered 6128 acres of the potato seed production. Also 12.22 per cent of the organised respondents had grown recommended variety of Kufri Badashah variety for potato seed production. None of the organised respondents adopted varieties like Kufri Sindhri, Kufri Chipsona-1, Kufri Bahar and Kufri Chandramukhi.

Only 7.77 per cent and 4.44 per cent of the unorganised respondents had grown non-recommended varieties like Lady Rossetta and Super-6 of potato crop. Around 37.00 per cent, 11.11 per cent of the organised respondents had grown non-recommended varieties like Lady Rossetta and FC-3, respectively. This was due to reason that the farmers were associated with Pepsico which provided seed for cultivation of these two varieties. Only 6.66 per cent of organised respondents had grown Super-6 variety of potato crop.

It is evident from the Table 4.10 that majority of unorganised and organised respondents had adopted recommended varieties of potato seed production and put an area of 98.40 per cent and 90.58 per cent under recommended varieties, respectively. Non-recommended varieties were grown on an area of 1427 acres account for 6.9 per cent of the total area.

4.2.3 Cultivation practices

4.2.3.1 Source of seed

It can be seen from Table 4.11 that more number of organised farmers obtained seed from govt. sources like CPRI and PAU in comparison to unorganised farmers. Nearly 6.66 per cent and 4.44 per cent unorganised respondents procured seeds from CPRI and PAU. Around 30.00 per cent of organised respondents procure seed from CPRI and nearly 7.77 per cent of the organised respondents procured seed from PAU for their potato production.

Table 4.10 Distribution of respondents according to varieties grown and area under different potato varieties during the year 2017

(area in acres)

Varieties	Unorganised		Organised		Total	
	f* (%)	(area= 5694)	f* (%)	(area= 14974)	f* (%)	(area= 20668)
Recommended varieties						
Kufri Pukhraj	86 (95.55)	3869 (67.94)	69 (76.66)	8659 (57.82)	155 (86.11)	12528 (60.61)
Kufri Jyoti	36 (40.00)	1678 (29.46)	54 (60.00)	4450 (29.71)	90 (50.00)	6128 (29.64)
Kufri Sindhuri	2 (2.22)	14 (0.24)	-	-	2 (1.11)	14 (0.06)
Kufri Badshah	-	-	11 (12.22)	455 (3.03)	11 (6.11)	455 (2.20)
Kufri Chipsona-1	9 (10.00)	18 (0.31)	-	-	9 (5.00)	18 (0.08)
Kufri Bahar	2 (2.22)	16 (0.28)	-	-	2 (1.11)	16 (0.07)
Kufri Chandramukhi	8 (8.88)	8 (0.14)	-	-	8 (4.44)	8 (0.03)
Total	-	5603 (98.40)	-	13564 (90.58)	-	19167 (92.73)
Non-Recommended varieties						
Lady Rossetta	7 (7.77)	17 (0.29)	33 (36.66)	1124 (7.50)	40 (44.44)	1141 (5.52)
FC-3	-	-	10 (11.11)	126 (0.84)	10 (5.55)	126 (0.60)
Super-6	4 (4.44)	74 (1.29)	6 (6.66)	160 (1.06)	10 (5.55)	160 (0.77)
Total	-	91 (1.59)	-	1410 (9.41)	-	1427 (6.90)

***Multiple Response**

The data in Table 4.11 shows that unorganised respondents i.e. 36.66 per cent bought seed from fellow farmers while 26.66 per cent of them purchased seed from POSCON members. On contrary, organised farmers preferred the agencies like JPGA members and Pepsico for getting seed of potato seed production. About 23 per cent organised respondents procured seed from their Pepsico and one-fifth of them prepared seed on their own farm followed by 15.55 per cent from POSCON members. Less number of organised respondents i.e. 7.77 per cent, 6.66 per cent and 5.55 per cent procured seed from JPGA members, NSC and fellow farmers, respectively.

4.2.3.2 Type of seed used

As shown in Table 4.11, majority (60.00%) of the unorganised respondents used unlabeled seed followed by i.e. 26.66 per cent used truthfully labeled seed. Less than ten per cent of the unorganised respondents used certified and foundation seed of potato seed production. Around 42.00 and 33.00 per cent of the organised respondents used certified seed

Table 4.11 Distribution of respondents according to various cultivation practices followed by them

Sr. No.	Cultivation practices		Unorganised (n_1=90)		Organised (n_2=90)	
			f	(%)	f	(%)
1	**Source of seed***					
	Govt. sources	CPRI	6	6.66	27	30.00
		PAU	4	4.44	7	7.77
	Private sources	JPGA members	4	4.44	7	7.77
		POSCON members	24	26.66	14	15.55
		Pepsico	-	-	21	23.33
		Fellow Farmers	33	36.66	5	5.55
		NSC	-	-	6	6.66
		Own	23	25.55	18	20.00
2	**Type of seed used***					
	Foundation seed		7	7.77	30	33.33
	Certified seed		9	9.99	38	42.22
	Truthfully labeled seed		24	26.66	14	15.55
	Unlabeled		54	60.00	23	25.55
3	**Seed replacement**					
	0-3 years		46	51.11	76	84.44
	>3 years		44	48.88	14	15.55
4	**Time of sowing**					
	Earlier than recommended (before Oct.)		82	91.11	31	34.44
	Recommended (5^{th} Oct. – 15^{th} Oct.)		8	8.88	59	65.55
5	**Seed rate**					
	Less than recommended (< 12q/acre)		4	4.44	0	0
	Recommended (12-18q/acre)		86	95.55	90	100.00
6	**Number of Irrigations**					
	Less than recommended (< 7)		59	65.55	43	47.77
	Recommended (7 to 8)		31	34.44	47	52.22
7	**Seed treatment**		73	81.11	90	100.00
	Chemical used*	Monceren	44	48.88	76	84.44
		Emisan	23	25.55	11	12.22
		Boric acid	0	0.00	3	3.33
		Gaucho	3	3.33	13	14.44
		Vitavax	4	4.44	0	0.00
8	**Planting method**					
	Ridge		90	100.00	90	100.00
9	**Spacing**					
	Recommended (55x15cm)		4	4.44	6	6.66
	More than recommended		86	95.55	84	93.33
10	**Soil testing**		28	31.11	53	58.88

***Multiple response**

NSC- National seeds Corporation Limited
JPGA- Jalandhar Potato Grower's Association
CPRI- Central Potato Research Institute

and foundation seed followed by 25.55 per cent of these respondents used unlabeled seed (i.e. the seed which is procured from fellow farmers or other sources which are neither certified at any end nor follow any legal procedure for seed marketing). Only 15.55 per cent of the organised respondents used truthfully labeled seed for cultivation.

4.2.3.3 Seed replacement

As per recommendation of Punjab Agricultural University, Ludhiana farmer should replace the seed every 3 years. This is due to the reason that yield is reduced progressively if the same seed is used year after year. The data in Table 4.11 shows that half of the unorganised respondents (51.11%) replaced the seed within three years, while others replaced the seed after more than 3 years. Most of the organised respondents i.e. 84.44 per cent replaced the seed within the 0-3 years followed by only 15.55 per cent of organised respondents replaced the seed after more than 3 years. Then it can be inferred that organised farmers replaced seed more frequently as compared to unorganised respondents.

4.2.3.4 Time of sowing

The sowing of potato seed crop in time is important for harnessing its higher quality and good production. Almost all the unorganised respondents (91.11%) has sown the potato before October. Nearly 9.00 per cent of the unorganised respondents has sown between 5^{th}-15^{th} October. Majority of the organised respondents (65.55%) has sown between the period 5^{th}October -15^{th} October which is recommended time of sowing for potato seed production. Around (34.44%) of the organised respondents had sown before October.

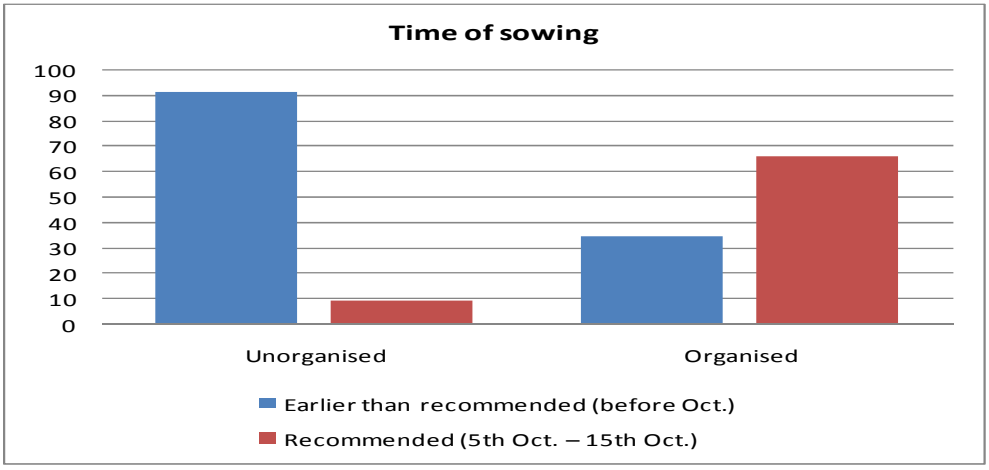

Fig. 7: Distribution of unorganised and organised respondents on the basis of their sowing time

4.2.3.5 Seed rate

The data in Table 4.11 reveals that almost all the unorganised respondents (95.55%) used recommended seed rate (12-18 q/acre) of potato seed production. Nearly four per cent of the unorganised respondents has used less than recommended seed rate. All the organised respondents has used recommended seed rate (12-18 q/acre). None of the organised

respondents deviated from recommended seed rate.

4.2.3.6 Number of Irrigation

Irrigation is an important aspect required for proper growth and good yield of potato seed crop. Stolon formation, tuber initiation and tuber development stages are the critical stages of irrigation. It was observed that majority of the unorganised respondents (65.55%) has applied less than recommended irrigations. Around 34.00 per cent of the unorganised respondents had applied recommended number of irrigations i.e. 7-8. None of the unorganised respondents applied more than recommended irrigation. Half of the organised respondents i.e. 52.22 per cent applied 7 to 8 recommended number of irrigations followed by 47.77 per cent of the respondents who has applied less than recommended irrigations.

4.2.3.7 Seed treatment

Seed treatment helps to control seed borne diseases such as Black scruf (*Rhizoctonia solani*) and Common scruf (*Streptomyces scabies*). The data in Table 4.11 shows that majority of the unorganised respondents (81.11%) and all the organised respondents has adopted practice of seed treatment. Around 49.00 per cent of the unorganised respondents used Monceren (Pencycuron 250 SC) chemical for the potato seed treatment. One-fourth of these respondents (25.55%) used emisan chemical. Nearly four per cent and three per cent of the unorganised respondents used Vitavax (Carboxion 75 WP) and Gaucho (Imidacloprid 70WG) chemicals, respectively.

Most of (84.44%) the organised respondents used Monceren (Pencycuron 250 SC) chemical. Nearly ten per cent of the organised respondents used Gaucho (Imidacloprid 70WG) and emisan chemicals. Very few of the organised respondents (3.33%) used boric acid. None of the organised respondents treated the seed with Vitavax (Carboxion 75 WP) chemical.

4.2.3.8 Planting method

The data in Table 4.11 depict that, all of the unorganised and organised respondents used ridges as a planting method. None of the unorganised or organised respondents used bed method of planting.

4.2.3.9 Spacing

The data in Table 4.11 shows that, majority of the unorganised respondents (95.55%) and organised respondents (93.33%) planted their crop at more than recommended spacing as farmers hold a view that the crop planted with a wider spacing ensures better germination and early emergence.

4.2.3.10 Soil testing

The data in Table 4.11 indicate that more number of organised (58.88%) as compared to the unorganised respondents (31.11%) had got their soil tested.

4.2.4 Fertilizer application

The data in Table 4.12 shows that none of the unorganised and organised respondents applied recommended urea fertilizer (165kg). Regarding DAP, more than 50kg of fertilizer applied by all the unorganised and organised respondents. It was found that farmers used to apply DAP as a preferred source of phosphorous, instead of SSP (Single Superphosphate) which has been recommended by PAU, Ludhiana for this crop. Non-availability and high cost of SSP were mail reasons cited by the respondents for not using SSP (Single Superphosphate). Most of the respondents i.e. 82.22 per cent of the unorganised respondents and 84.44 per cent of organised respondents applied recommended (40kg) Muriate of Potash (MOP) fertilizer application. Only 17.77 per cent of the unorganised respondents applied less than recommended MOP fertilizer.

Table 4.12 Distribution of respondents according to fertilizer application in potato crop

Sr. No.	Fertilizer	Categories	Unorganised (n_1=90)		Organised (n_2=90)	
			f	(%)	f	(%)
1	Urea	51-100 kg	44	48.88	79	71.11
		101-150 kg	46	51.11	11	12.22
		Recommended (165 kg)	0	0.00	0	0.00
2	DAP*	50-100 kg	69	76.66	40	44.44
		100-150 kg	21	23.33	50	55.55
3	Muriate of Potash (MOP)	Less than recommended	16	17.77	7	7.77
		Recommended (40 kg)	74	82.22	76	84.44
		More than recommended	0	0.00	7	7.77
4	Ammonium sulphate	0-50 kg	4	4.44	29	32.22
		51-100 kg	1	1.11	19	21.11
5	Sulphur	5-10 kg	7	7.77	0	0.00
		10-15 kg	5	5.55	4	4.44
6	Manures	Green manure	2	2.22	12	13.33
		FYM	0	0.00	3	3.33
		Compost	0	0.00	3	3.33

* NOTE: PAU recommended SSP (Single Superphosphate) for potato, DAP is not recommended but still farmers preferred DAP

PAU Ludhiana recommended no specific sulphur containing fertilizer application whereas recommended SSP (Single Superphosphate) which can fulfill the sulphur requirements along with Phosphorus but farmers were not using SSP so they applied sulphur containing fertilizers such as Ammonium sulphate and Sulphur to the crop. It can also be seen from Table 4.12 that more number of organised respondents (53.33%) has applied ammonium sulphate fertilizer in their fields. Very few of the respondents had applied sulphur fertilizer application in their potato seed production. Very few of the respondents had used green manure, FYM and compost at their fields.

4.2.5 Cultural practices

4.2.5.1Earthing up

Earthing up helps in controlling weeds, provides better aeration in the root zone and prevents tuber forming stolons from turning into shoots due to their exposure to sun light. The data in Table 4.13 depicts that majority (67.77%) of the unorganised respondents performed earthing up operation in the range between 25-30 days after sowing (DAS) followed by i.e. 32.22 per cent of these respondents who has performed earthing up operation in range between 30-35 days after sowing (DAS) in potato seed production. In contrast to most of the organised respondents (85.55%) has performed earthing up operation in the range of 25-30 days after sowing (DAS).

Table 4.13 Distribution of respondents according to cultural practices followed by them

Sr. No.	Cultural practices	Unorganised (n_1=90)		Organised (n_2=90)	
		f	(%)	f	(%)
1.	**Time of Earthing-up operation**				
	25-30 DAS	61	67.77	77	85.55
	30-35 DAS	29	32.22	13	14.44
2.	**Time of Dehaulming**				
	60-80 DAS	-	-	82	91.11
	80-100 DAS	40	44.44	8	8.88
	100-120 DAS	50	55.56	-	-
	Method of dehaulming				
	Manually	70	77.77	88	97.77
	Chemical	20	22.22	2	2.22
3.	**Roughing operation**				
	30 DAS	10	11.11	7	7.77
	35 DAS	27	30.00	46	51.11
	40 DAS	35	38.88	37	41.11
	50 DAS	-	-	22	24.44
	No	18	20.00	0	0.00
	Times				
	One	72	80.00	62	68.88
	Two	0	0.00	28	31.11
4.	**Symptoms of virus**				
	Identified	54	60.00	57	63.33
	Not identified	36	40.00	33	36.66

4.2.5.2 Dehaulming operation

The data in Table 4.13 depicts that most of the unorganised respondents (77.77%) practiced dehaulming operation manually. About 22.22 per cent of the unorganised respondents followed dehaulming operation with chemicals. Almost all (97.77%) the organised respondents followed manual method of dehaulming. Majority i.e. 55.56 per cent of the unorganised respondents practiced dehaulming operation in the range 100-120 days after sowing (DAS). Almost all (91.11%) of the organised respondents had dehaulming operation in the range of 60-80 days after sowing (DAS). Nearly eight per cent of the respondents

practiced dehaulming operation in range between 80-100 days after sowing (DAS). It is recommended to cut the haulms 10-15 days before harvesting when irrigation has been stopped.

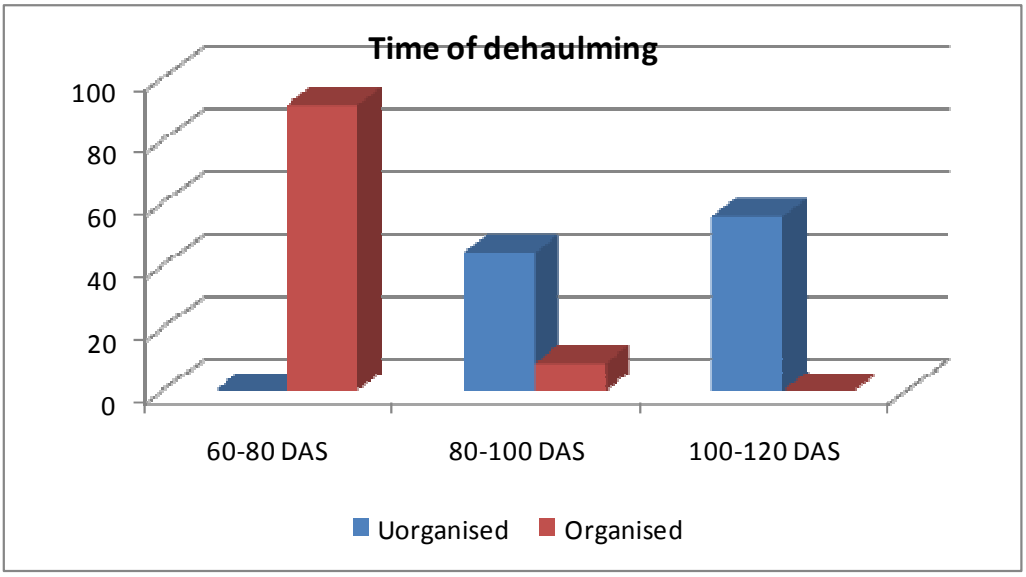

Fig. 8: Distribution of unorganised and organised respondents on the basis of their dehaulming operation

4.2.5.3 Rouging operation

Rouging of unhealthy plants noticed during the growing season is recommended to ensure the production of virus free better quality seed. Quality seed is free from viral diseases or have virus infection below the permissible limits of the minimum seed certification standards of India. The data in Table 4.13 depicts that around 39.00 per cent of the unorganised respondents performed rouging operation at 40 days after sowing (DAS). Around 20.00 per cent of unorganised respondents has not adopted the practice of the roughing operation. Half of the organised respondents (51.11%) performed rouging operation at 35 days after sowing (DAS). All the unorganised respondents practiced rouging operation in one time. Majority (68.88%) of the organised respondents followed rouging operation in one time. One-third (31.11%) of these respondents followed rouging operation in two times.

4.2.5.4 Symptoms of virus

The data in Table 4.13 depicts that majority of the unorganised respondents (60%) and organised respondents (63.33%) could identify the symptoms of virus.

4.2.6 Control measures

The data in Table 4.14 represents the distribution of respondents according to adoption of different chemicals i.e. weedicides, insecticides and fungicides in potato seed production. It was found that three-fourth (75.55%) of unorganised respondents followed by 31.11 per cent of these respondents used chemicals like Gramaxone (Paraquat 24WSC) and

Sencor (Metribuzin 70WP) for management weeds in potato seed crop, respectively. Around 52.00 per cent of the organised respondents followed by 46.66 per cent of them had used Sencor (Metribuzin 70WP) and Gramaxone (Paraquat 24WSC) for management of weeds in potato seed production, respectively. Only 3.33 per cent of the organised respondents used Matrix (Rimsulfuron 25WG) to manage weeds in potato seed production.

Table 4.14 Distribution of respondents according to chemical control measures followed by them to manage weeds, insect-pests and diseases in potato seed production

Sr. No.	Control measures	Unorganised (n_1=90)		Organised (n_2=90)	
		f	(%)	f	(%)
1.	**Weeds***				
	Gramaxone 24 WSC (paraquat)**	68	75.55	42	46.66
	Sencor 70WP (Metribuzin)**	28	31.11	47	52.22
	Matrix 25WG (Rimsulfuron)	0	0.00	3	3.33
2.	**Aphid and Jassid***				
	Confidor 17.8SL (Imidacloprid)	52	57.77	64	71.11
	Actara 25WG (Thiamethoxam)	4	4.44	0	0.00
	Rogor 30EC (Dimethoate)**	47	52.22	59	65.55
3.	**Cutworm**				
	Lorsban 20EC (Chlorpyriphos)**	15	16.66	0	0.00
	Altacor 35WG (Rynaxypyr)	4	4.44	15	16.66
	Expert 20SG (Flubendiamide+Thiacloprid)	0	0.00	3	3.33
	Thimet 10G (phorate)**	0	0.00	2	2.22
4.	**Late Blight***				
	Indofil M-45**	90	100.00	90	100.00
	Ridomil Gold 60WG**	14	15.55	36	40.00
	Acrobat 69WG (Dimethomorph)	0	0.00	12	13.33

***Multiple response**
****** **PAU recommended**

It was also found that 57.77 per cent of the unorganised respondents had used Confidor (Imidacloprid 17.8SL) which is not recommended for potato crop. Reason of using confidor (Imidacloprid 17.8SL) might be due to the fact that it has been commonly used in most of the field crops and thus readily available to farmers. Nearly half of (52.22%) these respondents had used Rogor (Dimethoate 30EC) for management of aphid-jassid in potato seed production. Nearly four per cent of the unorganised respondents used Actara (Thiamethoxam 25WG). Similarly, majority (71.11%) and 65.55 per cent of the organised respondents used Confidor (Imidacloprid 17.8SL) and Rogor (Dimethoate 30EC), respectively, for management of sucking pests in potato seed production. It is recommended to adopt plant protection measures when twenty or more aphids are observed on 100

compound leaves. It was also revealed that few of the respondents had used chemical

control measure to manage cutworm in their field. The important chemicals used by them were found to be Lorsban (Chlorpyriphos 20EC), Altacor (Rynaxypyr 35WG) and Expert 20SG (Flubendiamide+Thiacloprid).

Late blight is a serious disease of potato and drastically affects tuber yields. Effective management of late blight is realized through application of fungicides. The data in Table 4.14 depicts that all the unorganised and organised respondents used Indofil M-45 fungicide to manage of diseases in potato seed production. Nearly 15.00 per cent of unorganised respondents and 40.00 per cent of organised respondents used Ridomil Gold 60WG fungicide at their fields. About 13.33 per cent of the organised respondents used Acrobat 69WG (Dimethomorph) for the management of diseases in potato seed production.

4.2.7 Number of sprays

The data in Table 4.15 represents that three-fourth (73.33%) of the unorganised respondents sprayed one times and about 14.44 per cent of these respondents sprayed two times with herbicides in potato seed production. Similarly, 65.55 per cent of the organised respondents sprayed two times and about 28.00 per cent of these respondents sprayed one times and very few (5.55%) of the respondents sprayed three times for control of weeds in potato seed production.

Table 4.15 Distribution of respondents based upon the number of weedicides/pesticides applied in potato seed production

Sr. No.	Control measures	Unorganised (n_1=90)		Organised (n_2=90)	
		f	(%)	f	(%)
1	**Weeds** (Herbicide application)				
	One	66	73.33	26	28.88
	Two	13	14.44	59	65.55
	Three	-	-	5	5.55
2	**Aphid and Jassid**				
	One	38	42.22	-	-
	Two	50	55.55	70	77.77
	Three	2	2.22	8	8.88
3	**Cutworm**				
	One	6	6.66	6	6.66
	Two	13	14.44	12	13.33
4	**Late Blight**				
	One	18	20.00	11	12.22
	Two	72	80.00	62	68.88
	Three	-	-	17	18.88

Regarding control of aphid and jassid, half of the unorganised respondents (55.55%) sprayed two times followed by 42.22 per cent of these respondents who has sprayed their crop only once. Very few (2.22%) of the unorganised respondents sprayed three times their potato seed production. On contrary, majority (77.77%) of the organised respondents sprayed their crop two times to manage sucking pests and only 8.88 per cent of the respondents sprayed

three times in potato seed production.

Regarding management of cutworm their crop 14.44 and 6.66 per cent of the unorganised respondents had sprayed two times and one times, respectively. Similarly, 13.33 per cent of the organised respondents sprayed their crop two times and less than ten per cent of them had sprayed one times to manage cutworm in potato seed production.

Late blight is an important disease of potato seed production. It was found that organised farmers sprayed their crop more number of times than unorganised farmers. Majority of unorganised (80%) and organised farmers (68.88%) sprayed their crop two times to manage late blight However 18.88 per cent of organised farmers sprayed three times to manage late blight in potato seed production.

4.2.8 Average number of sprays

The average number of times potato crop was sprayed to manage weeds and insects-pests were presented in Table 4.16. It can be seen that the average number of sprays used by unorganised respondents were 1.02, 1.60, 0.35 and 1.80 for management of weeds, aphids-jassids, cutworm and whitefly, respectively in their field. However the average numbers of sprays used by organised farmers were 1.76, 1.82, 0.37 and 2.06, respectively. Thus it can be inferred for the Table 4.15 that organised farmers had adopted chemical measures more effectively to manage weeds and insects-pests at their fields.

Table 4.16 The average number of weedicides/pesticides applied in potato seed production

Sr. No.	Control measures	Unorganised (n_1=90)	Organised (n_2=90)
1	Herbicides*	1.02 (0-2)*	1.76 (0-3)*
2	Aphid and Jassid	1.60 (1-3)*	1.82 (1-3)*
3	Cutworm	0.35 (0-2)*	0.37 (0-2)*
4	Late Blight	1.80 (1-2)*	2.06 (1-3)*

***Range of number of sprays**

4.2.9 Labor employed in different farm operation

The data in Table 4.17 reveals that in case of unorganised respondents, the highest average man days per acreage (13.50) were utilized in harvesting/digging operation followed by 13.43 man days per acreage in grading operation whereas, storage, land preparation, sowing and irrigation used low number of man-days per acreage i.e. 3.45, 2.97, 2.87, 1.86, respectively. In case of organised respondents, similar results were obtained. Highest man-days per acreage were consumed in grading (13.73) followed by harvesting (13.00) of the potato crop. Storage consumed 4.61 man-days per acreage, which is more than unorganised respondents. Other operation land preparation, sowing and irrigation used comparatively less number of man-days per acreage i.e. 3.84, 4.07, 2.00 respectively.

Table 4.17 Labor employed in various farm operation during potato seed production

Sr. No.	Aspects	Unorganised (n_1=90)		Organised (n_2=90)	
		Total man-days	Mean	Total man-days	Mean
1	Land preparation	268	2.97	346	3.84
2	Sowing	259	2.87	367	4.07
3	Irrigation	168	1.86	180	2.00
4	Fertilization/pesticides sprays	321	3.56	411	4.56
5	Harvesting/Digging	1215	13.50	1170	13.00
6	Grading	1182	13.43	1236	13.73
7	Storage	311	3.45	415	4.61

***5% level of significance**

The data in Table 4.18 represents that around 49.00 per cent and 30.00 per cent of the unorganised respondents has employed 25-39 man days per acre and 39-53 man days per acre, respectively. Whereas, 53-67 man days per acre were deputed by 21.11 per cent of the unorganised respondents. Around 40.00 per cent of the organised respondents employed labor within the range of 39-53 man days followed by 35.55 per cent and 24.44 per cent of these respondents employed labor during potato seed production within the range of 25-39 and 53-67 man days per acre, respectively.

Table 4.18 Distribution of respondents according to the average number of man-days employed during potato seed production

Sr. No.	Labor (man days / acre)	Unorganised (n_1=90)		Organised (n_2=90)	
		f	(%)	f	(%)
1	25-39	44	48.88	32	35.55
2	39-53	27	30.00	36	40.00
3	53-67	19	21.11	22	24.44

4.2.10 Hired labor rate

The data in Table 4.19 reveal that 74.44 per cent of the unorganised respondents hired labor rate in the range of Rs 250-300. Nearly 13.00 per cent and 12.00 per cent of unorganised respondents hired labor rate ranged between of Rs 300-350 and Rs 200-250, respectively. Most of the organised respondents i.e. 88.88 per cent hired labor in the ranged of Rs 250-300. Only 11.11 per cent of organised respondents hired labour in range of Rs 300-350.

Table 4.19 Distribution of respondents according to rate of hired labour at their farms

Sr. No.	Labor rate (Rs.)	Unorganised (n_1=90)		Organised (n_2=90)	
		f	(%)	f	(%)
1	200-250	11	12.22	0	0.00
2	250-300	67	74.44	80	88.88
3	300-350	12	13.33	10	11.11

4.2.11 Process followed after harvesting

4.2.11.1 Grading

The data in Table 4.20 represents that 74.44 per cent of the unorganised respondents performed grading before selling their produce. All the organised respondents graded the produce before selling. As per recommendation of PAU, Ludhiana, grading of the tubers should be carried out in following categories: small (<25g), medium (25-50g), large (50-75g) and extra-large (>75g) on the basis of their sizes.

Table 4.20 Distribution of respondents according to various marketing operations followed by them

Sr. No.	Aspects	Unorganised (n_1=90)		Organised (n_2=90)	
		f	(%)	f	(%)
1	**Grading**				
	Graded	67	74.44	90	100.00
	Not graded	23	25.55	0	0.00
2	**Place of Marketing***				
	Local market	67	74.44	62	68.88
	Distant market	23	25.55	52	57.77
3	**Middle man involvement**				
	Merchants	39	43.33	17	18.88
	Commission agent	29	32.22	16	17.77
	No involvement	22	24.44	39	43.33
4	**Cold storage**	76	84.44	86	95.55
5	**Information source regarding current market price**				
	Merchants	15	16.66	17	18.88
	Commission agent	29	32.22	0	0.00
	Seed producing Association	0	0.00	8	8.88
	Local Market	26	28.88	20	22.22
	Distant farmers	20	22.22	45	50.00

***Multiple response**

4.2.11.2 Place of Marketing

The data in Table 4.20 indicate that 74.44 per cent of the unorganised respondents sold their produce in local market. One-fourth of (25.55%) the unorganised respondents sold the produce in the distant. Contrarily, 57.77 per cent of the organised respondents sold the produce in the market which is distant from their fields to fetch higher return.

4.2.11.3 Middle man involvement

The data in Table 4.20 show that 43.33 per cent of the unorganised respondents were dependent on merchants for marketing of potato seed production and 24.44 per cent of unorganised respondents does not involved any middle man and sold their produce directly. More number of the organised respondents (43.33%) had not involved any middle man. Nearly 19.00 per cent and 17.77 per cent of organised respondents involved merchants and commission agent as middle man for selling their produce, respectively. Merchants are referred to those persons who just work on commission basis to bring farmer and buying firm together whereas commission agent are referred to those persons to whom farmers sell their produce and in addition to this also borrow money from them.

4.2.11.4 Storage

The data in Table 4.20 represents that most of unorganised respondents (84.44%) and almost all the organised respondents (95.55%) stored the produce in cold stores. None of the unorganised and organised respondents stored the produce at home.

4.2.11.5 Information source regarding current market price

The data in Table 4.20 depict that 32.22 per cent of the unorganised respondents got information source regarding current market price from commission agent followed by 28.88 per cent and 22.22 per cent of the unorganised respondents sought information from local market and distant market, respectively. Half of the organised respondents (50.00%) sought information regarding current market price from the distant farmers which is away from the local market. Around one-fifth (22.22%) and 18.88 per cent of these respondents got information from local market and merchants, respectively. Only 8.88 per cent of the organised respondents get information from seed producing association.

4.2.12 Storage of produce in cold stores

4.2.12.1 Quantity

The data in Table 4.21 represents that majority of the unorganised respondents (60.52%) stored 10-50 per cent of their produce quantity in cold stores. None of unorganised respondents stored more than 75 per cent quantity in cold storage. More than half (51.16%) organised respondents had stored 10-50 per cent produce quantity in cold stores. As many as 31.39 per cent of the organised respondents stored more than 75 per cent of produce the quantity in the cold stores to sell later on.

4.2.12.2 Duration

The data in Table 4.21 reveal that one-third of the unorganised respondents (39.89%) stored produce in cold storage up to 4 months. Majority of (60.52%) these respondents stored 4 to 6 months duration in cold storage. Majority of (61.11%) organised respondent stored produce in cold storage above 6 months.

4.2.12.3 Distance

The data in Table 4.21 represents that 56.57 per cent of the unorganised respondents stored their produce in cold stores located at a distance up to 5km. Most of the organised respondents i.e. 88.37 per cent stored them produce at a distance up to 5km from field.

Table 4.21 Distribution of respondents according to storage of produce in cold stores

Sr. No.	Aspects of cold storage	Unorganised (n_1=76)		Organised (n_2=86)	
		f	(%)	f	(%)
1	**Quantity**				
	10-50%	46	60.52	44	51.16
	50-75%	30	39.47	15	17.44
	75-100%	0	0.00	27	31.39
2	**Duration**				
	Up to 6 month	25	32.89	6	6.97
	4-6 month	46	60.52	25	29.06
	Above 6 month	5	6.57	55	63.95
3	**Distance**				
	Up to 5 km	43	56.57	76	88.37
	> 5 km	33	43.42	10	11.62

4.3 Prospects of potato seed production

4.3.1 Prospects

The data in Table 4.22a shows that almost all the unorganised respondents (97.77%) would continue the potato seed production and only a meager percentage (2.22%) would discontinue the potato seed production in the subsequent year. On the other hand, all the organised respondents would continue the potato seed production in the future. None of the organised respondents expressed their wish to discontinue the potato seed production.

Majority of the unorganised respondents (60.00%) wished to keep area constant under potato seed production and around 38.00 per cent of the unorganised respondents would likely to decrease the area under potato seed production in the next year. None of the unorganised respondents would likely to increase area under potato seed production. Three-fourth of the organised respondents wished to produce potato seed on the same area. About 13 per cent of the organised respondents would likely to decrease area under potato seed production, whereas only 11.11 per cent of them would likely to increase the area under potato seed production in the future. This decrease is attributed to price fluctuation in the

market and increase is due to surplus seed left with the farmers.

Table 4.22a Distribution of respondents according to prospects of potato seed production

Sr. No.	Aspects	Unorganised (n_1=90)		Organised (n_2=90)	
		f	(%)	f	(%)
1	Continue	88	97.77	90	100.00
	Discontinue	2	2.22	0	0.00
2	Increase	0	0.00	10	11.11
	Decrease	34	37.77	12	13.33
	Constant	54	60.00	68	75.55

4.3.2 Acreage dynamics and acreage shift

It can also be seen from Table 4.22b that 37.77 per cent of unorganised respondents would like to decrease area under potato seed production from 1477 acres to 981 acres in the subsequent year, whereas majority of them would keep the area constant at 4201 acres. However 2.22 per cent of them would likely to discontinue the potato seed production but in case of organised respondents, 11.11 per cent would likely to increase area under potato seed production from 380 acres to 486 acres in the subsequent year, whereas 13.33 of them wished to decrease area from 1390 acres to 1090 acres in the next year. However majority of the organised respondents consequent to keep the area constant i.e. 13204 acres. On the whole, it was calculated that there would be decrease in area under potato seed production in the subsequent area. The decrease would likely to be 9 per cent in case of unorganised respondents and 1.29 per cent for organised respondents. The decrease in area might be attributed to many factors like non-remunerative prices, fluctuation in sale prices etc.

Respondents who wished to discontinue or decrease area under potato seed production were asked to name the substitute crop in place of potato crop for the next year. The data in Table 4.23 shows that majority of them would likely to grow sugarcane and wheat crops by replacing potato crop in the next year. However, few of them also wished to opt for beet root or maize crop in place of potato crop in the next year.

Table 4.22b Distribution of the respondents according to the acreage dynamics and acreage shift in potato seed production

Acreage shift	Unorganised				Organised			
	Respondents (%)	Operational land holding	Present acreage	Future acreage	Respondents (%)	Operational land holding	Present acreage	Future acreage
Discontinue	2 (2.22)	64	16	0	-	-	-	-
Increase	-	-	-	-	10 (11.11)	431	380	486
Decrease	34 (37.77)	2146	1477	981	12 (13.33)	1584	1390	1090
Constant	54 (60.00)	4841	4201	4201	68 (75.55)	14524	13204	13204
Total	90	7051	5694	5182 (-9.0%)	90	16539	14974	14780 (-1.29%)

Table 4.23 Distribution of respondents according to their wish to grow substitute crop in place of potato seed production

Sr. No.	Crop	Unorganised (n_1=36)		Organised (n_2=12)	
		f	(%)	f	(%)
1	Wheat	12	33.33	5	41.66
2	Sugarcane	18	50.00	3	25.00
3	Beet root	5	13.88	4	33.33
4	Maize	1	2.77	0	0.00

4.3.3 Reasons for adopting potato seed production

The data in Table 4.24 depict that all the unorganised respondents adopted potato seed production due to their interest. Almost all the unorganised respondents (97.77%) cultivated the potato with expectation of getting high income. Around 45 per cent and 35 per cent of the unorganised potato seed producers adopted with a desire to become businessman and diversifying existing farming, respectively. Less than one-fifth of the unorganised respondents (18.88%) adopted potato seed production as advised/suggested by other farmer/person. Almost all of the organised respondents had adopted potato seed production because of interest and expectation of high income. Almost all the organised respondents (92.22%) were adopting potato with a desire to become businessman. Around 47 per cent of the organised respondents adopted seed production to diversify existing farming. Very less 4.44 per cent of the organised respondents were advised/suggested by other farmer/person. The findings of the study are in line with Kaur (1999) in which it was reported that the main reasons for adoption of flower seed production was expectation of high income followed by increase in status. Singh (2005) also found similar results.

Table 4.24 Distribution of respondents according to reasons for adopting potato seed production

Sr. No.	Aspects	Unorganised(n_1=90)		Organised (n_2=90)	
		f	(%)	f	(%)
1	Due to own interest	90	100.00	90	100.00
2	Expectation of high income	88	97.77	90	100.00
3	Desire to become businessman	41	45.55	83	92.22
4	Diversification in existing farming	32	35.55	42	46.66
5	Advised/suggested by other farmers/person	17	18.88	4	4.44

***Multiple response**

4.3.4 Marketing of potato seed in other states

Marketing of potato seed in other states of country require many formalities and government permissions. It was found from the data in Table 4.26 shows that unorganised respondents (77.77%) had no knowledge regarding the procedure of marketing in other states. Less than one-fourth of the respondents (22.22%) had knowledge about the procedure of marketing. A slightly greater than half of the respondents knew the marketing procedures

prevailing in the other state like West Bengal, UP, Assam and Gujarat etc.

4.3.5 Profitability

The data in Table 4.25 shows that 77.77 per cent of the unorganised respondents has not perceived potato seed production as a profitable venture. Also 22.22 per cent of unorganised respondents perceived profitability in potato seed production. On contrary, majority of the organised respondents perceived potato seed production as profitable. Only 11.11 per cent of these respondents did perceive potato seed production as profitable.

Table 4.25 Distribution of respondents with regard to various aspects of marketing

Sr. No.	Aspects	Unorganised (n_1=90)		Organised (n_2=90)	
		f	(%)	f	(%)
1	Marketing procedures in other states	20	22.22	46	51.11
2	Perceived profitability of potato seed production	20	22.22	80	88.88
4	Willing to get associated with any organization	21	23.33	-	-

4.3.6 Willingness association with any organisation

The data in Table 4.25 shows that 76.66 per cent of the unorganised respondents had not expressed their willingness to get associated with any organization. Less than one-fourth of these respondents i.e. 23.33 per cent want to get associate with any organisation.

4.3.7 Satisfaction regarding potato seed production

The data in Table 4.26 represent that almost all the unorganised and organised respondents were satisfied with the production and finance aspect of potato seed production. Most of unorganised respondents i.e. 85.55 per cent were also found to be satisfied with management at their potato farms. Almost all i.e. 100.00 per cent, 97.77 per cent and 95.55 per cent of the organised respondents were found to be satisfied with the aspects of production, finance, management, respectively. It is surprising to note that only 11.11 per cent of organised and none of unorganised respondents were satisfied with marketing of seed potato.

Table 4.26 Distribution of respondents according to their satisfaction regarding different aspects of potato seed production

Sr. No.	Aspects	Unorganised (n_1=90)		Organised (n_2=90)	
		f	(%)	f	(%)
1	Production	90	100.00	90	100.00
2	Finance	84	93.33	88	97.77
3	Management	77	85.55	86	95.55
4	Marketing	0	0.00	10	11.11

***Multiple response**

4.3.8 Potato seed production under organised sector

The data in Table 4.27 depict that majority (64.44%) of the organised respondents had verbal kind of contract followed by 35.55 per cent of respondents who had written kind of contract for potato seed production at their farms. Out of the respondent who has opted for written contract, majority of them had legal stamp paper agreement followed by a meager number of respondents who had plain paper agreement.

Three-fourth (72.22%) of organised respondents supplied the potato seed at contract place. Around 28.00 per cent of the organised respondents supplied the produce directly from their farm.

Table 4.27 Distribution of potato seed producers regarding various aspects of Association services

Sr. No.	Aspects		Organised(n_2=90)	
			f	(%)
1	Kind of contract	Verbal	58	64.44
		Written	32	35.55
2	Legal status	Plain paper agreement	3	3.33
		Stamp paper	29	32.22
3	Supply of produce	Directly from farm	25	27.77
		Supplied at contract place	65	72.22
4	Services offered by agency*	Technical services	35	38.88
		Credit	14	15.55
		Marketing	90	100.00
		Transportation	8	8.88
5	Satisfied with the facilities provided by Association	Yes	84	93.33

***Multiple response**

All the organised respondents used marketing services facilitated by their organisiation followed 38.88 per cent of them who has used technical services. Only i.e. 15.55 per cent, 8.88 per cent of organised respondents used credit and transportation services offered by the organization, respectively. The findings are in line with the study conducted by Kalra *et al* (2013).

Vast percentages i.e. 93.33 of the organised respondents were satisfied with the facilities provided by the association.

4.3.9 Multiple linear regression for organised seed producers

Multiple linear regression has been applied to find the determinants of yield for organised seed producers (Table 4.28). It was found that seed replacement, time of sowing, DAP application, sulphur application, time of dehaulming and man days for fertilization/pesticides sprays were significantly affecting the yield of potato seed in case of organised seed producers.

Over all linear regression model was significant as F value is 3.148 at one per cent level of significance. Value of R^2 for organised respondents is 0.684, which means that 68.4

per cent variation in the data is explained by the given independent variables.

Table 4.28 Multiple linear regression Analysis for yield of potato seed production for organised seed producers

Independent variable	Organised			
	β	Std. Error	t	Sig.
Seed replacement	6.703	1.888	3.550***	.001
Time of sowing	-8.005	4.391	1.823*	.078
Seed rate	-.191	1.609	.119	.906
Irrigation	5.963	3.868	1.542	.133
Spacing (Row x Row)	.170	.612	.278	.783
Spacing (Plant x Plant)	-.376	1.129	.333	.741
Urea dose	-.140	.133	1.047	.303
DAP dose	-.264	.118	2.234**	.033
MOP dose	.104	.450	.230	.819
Sulphur dose	.665	.337	1.974*	.057
Time of earthing operation	-.154	.993	.155	.878
Time of dehaulming operation	-1.204	.551	2.184**	.036
Number of herbicide sprays	-1.127	4.015	.281	.781
Number of insecticide sprays (Aphid and jassid)	-6.378	4.794	1.330	.193
Number of insecticide sprays (Cutworm)	3.026	7.872	.384	.703
Number of fungicide sprays	11.744	7.728	1.520	.138
Rouging operation (days after sowing)	-.459	1.184	.388	.701
Number of Rouging operations	-.474	6.989	.068	.946
Man days for land preparation	-2.230	2.237	.997	.326
Man days for sowing	2.775	2.027	1.369	.181
Man days for fertilization/pesticides sprays	-4.713	1.713	2.751***	.010
Man days for harvesting/digging	-.418	.472	.886	.382

F= 3.148***
R^2= 0.684
*** 1% level of significance
**5% level of significance
*10% level of significance

It can further be inferred that seed replacement and sulphur was positively affecting the yield of seed potato with regression coefficient of 6.703 and 0.665 whereas time of sowing, DAP application, time of dehaulming and man days for fertilization/pesticides sprays were found to adversely affecting the yield of seed potato with regression coefficient of 8.005, 0.264, 1.204 and 4.713, respectively,

4.3.10 Multiple linear regression for unorganised seed producers

Multiple linear regression has been applied to find the determinants of yield for unorganised respondents (Table 4.29). It was found that seed replacement and man days for fertilization/pesticides sprays were significantly affecting the yield of potato seed in case of organised seed producers.

Over all linear regression model is significant as F value is 3.148 at one per cent level

of significance. Value of R^2 for unorganised respondents is 0.484 which means that 48.4 per cent variation in the data is explained by the given independent variables.

Table 4.29 Multiple linear regression Analysis for yield of potato seed production for unorganised respondents.

Independent variable	Unorganised			
	β	Std. Error	t	Sig.
Seed replacement	3.774	1.804	2.092**	.040
Time of sowing	-1.639	1.670	.981	.330
Seed rate	-.351	1.276	.275	.784
Irrigation	-1.541	1.942	.793	.431
Spacing (Row x Row)	.739	.602	1.228	.224
Spacing (Plant x Plant)	1.054	1.162	.907	.368
Urea dose	.056	.076	.740	.462
DAP dose	-.003	.052	.055	.956
MOP dose	-.391	.253	1.545	.127
Sulphur dose	-.180	.341	.527	.600
Time of earthing operation	-.386	.371	1.041	.302
Time of dehaulming operation	.302	.225	1.339	.185
Number of herbicide sprays	1.219	3.197	.381	.704
Number of insecticide sprays (Aphid and jassid)	4.532	3.837	1.181	.242
Number of insecticide sprays (Cutworm)	-.055	2.664	.021	.984
Number of fungicide sprays	-6.825	4.821	1.416	.162
Rouging operation (days after sowing)	.817	.515	1.585	.118
Number of Rouging operations	-32.542	19.934	1.632	.107
Man days for land preparation	1.308	1.604	.815	.418
Man days for sowing	-.239	1.254	.191	.849
Man days for fertilization/pesticides sprays	-2.093	.777	2.692***	.009
Man days for harvesting/digging	.187	.344	.543	.589

F= 2.605***
R^2= 0.484
*** 1% level of significance
**5% level of significance
*10% level of significance

It can further be inferred that seed replacement was positively affecting the yield of seed potato with regression coefficient of 3.774 whereas man days for fertilization/pesticides sprays were found to adversely affecting the yield of seed potato with regression coefficient of 2.093.

4.4 Problems of potato seed production

The data in Table 4.30 showed that respondents faced many problems related to potato production and problems were categorized into sowing, seed, irrigation, fertilizer, manuring, earthing-up, weed control, insert pest & disease management, harvesting, contract farming, storage, marketing, institutional, packaging categories etc. In case of sowing, around

20 per cent of the unorganised respondents faced the problems related to high cost of planting machine. Only 17.77 per cent and 11.11 percent of the unorganised respondents faced the problems of non- availability of planting machine and uncertainty of water, respectively. Very less 5.55 per cent of the organised respondents faced the problem of uncertainty of weather.

In case of seed, around 40.00 per cent of the unorganised respondents faced the problems of high cost of seed. Also, 21.11 per cent of the respondents faced the problem of non-availability of quality of seed. It was also reported that 18.88 per cent of respondents perceived that treatment of seed is a complicated technique during potato seed production. Very less i.e. 8.88 per cent and 4.44 per cent of the unorganised respondents faced the problems of difficulty in getting the seed of required variety and lack of improved seed variety, respectively. One-fourth of organised respondents (24.44%) faced the problems of non-availability of quality seed. About one-fifth of the organised respondents faced the problems of high cost of seed. Very few of organised respondents faced the problems of difficulty in getting the seed of required variety and lack of improved seed variety, respectively.

In case of irrigation related problems, around 30.00 per cent of the unorganised respondents faced the problem of non-availability of canal water followed by 27.77 per cent had the problems of short supply of electricity. About 48.88 per cent and 46.66 per cent of organised respondents faced the problems of non-availability of canal water and short electricity of water, respectively.

In case of fertilizer application, non-availability of SSP fertilizer at proper stage was also faced by the organised and unorganised respondents. One-fourth (28.88%) of the unorganised respondents and 21.11 per cent of these respondents faced the problem of high cost of fertilizer and lack of labor, respectively. Similarly, 28.88 per cent of the organised respondents faced the constraints of lack of labor.

In case of manuring, 28.88 per cent of the unorganised respondents perceived manuring takes more time for decomposition followed by 14.44 per cent of the respondents faced problem of lack of time for manuring during potato seed production. Nearly five per cent of the unorganised respondents faced the problems like difficulty in cultural practices and to shortage of labor. Around 24.00 per cent and 20.00 per cent of the organised respondents faced the problems related to shortage of time and labor. Very less i.e. 5.55 per cent and 4.44 per cent of the organised respondents faced the constraints of more time to decomposition and difficulty in cultural practices.

Regarding earthing-up of unorganised respondents 13.33 per cent, 6.66 per cent, 4.44 per cent and 4.44 per cent faced the problems of overlapping operations, uncertainty of weather, non-availability of implements and shortage of labor, respectively. Also very less i.e. 8.88 per cent and 5.55 per cent of the organised respondents faced the constraints of shortage

Table 4.30 Distribution of respondents according to problems faced by potato seed producers

Sr. No.	Problem	Unorganised (n_1=90)		Organised (n_2=90)	
		f	(%)	f	(%)
I	**Sowing**				
1	Non-availability of planting machine	16	17.77	0	0.00
2	High cost of planting machine	18	20.00	0	0.00
3	Uncertainty of weather	10	11.11	5	5.55
II	**Seed**				
1	Non availability of quality seed	19	21.11	22	24.44
2	High cost of seed	35	38.88	16	17.77
3	Difficulty in getting the seed of required variety	8	8.88	5	5.55
4	Lack of improved seed variety	4	4.44	1	1.11
5	Seed treatment is a complicated technique	17	18.88	0	0.00
III	**Irrigation**				
1	Short supply of electricity	25	27.77	44	48.88
2	Non availability of canal water	28	31.11	42	46.66
IV	**Fertilizer application**				
1	Non availability of SSP fertilizer at proper stage	45	50.00	50	55.55
2	High cost of fertilizers	26	28.88	0	0.00
3	Lack of labour	19	21.11	26	28.88
V	**Manuring**				
1	Lack of time	13	14.44	18	20.00
2	More time for decomposition	26	28.88	5	5.55
3	Difficulty in cultural practices	8	4.44	4	4.44
4	Lack of Labour	4	4.44	22	24.44
VI	**Earthing-up**				
1	Uncertainty of weather	6	6.66	0	0.00
2	Overlapping of operation	12	13.33	5	5.55
3	Non availability of implements	4	4.44	0	0.00
4	Lack of Labour	4	4.44	8	8.88
VII	**Weed control**				
1	High cost of weedicides	15	16.66	2	2.22
VIII	**Insert-pest & disease management**				
1	Non-availability of insecticide at proper time	2	2.22	0	0.00
2	Problems in identifying of insect-pest	15	16.66	0	0.00

3	Financial problems	6	6.66	0	0.00
4	Lack of knowledge about correct method of pesticides application	3	3.33	0	0.00
5	High cost of pesticides	20	22.22	3	3.33
IX	**Harvesting**				
1	Labour during dahaulming	33	36.66	42	46.66
X	**Contract farming**				
1	Dishonoring of contract agreement	-	-	5	5.55
2	Prices fluctuations in markets	-	-	36	40.00
3	Difficulty in meeting quality requirement	-	-	10	11.11
4	Risk	-	-	25	27.77
XI	**Storage**				
1	Non-availability of storage facilities	51	56.66	8	8.88
2	Difficulty in transportation	11	12.22	2	2.22
3	High rent of cold storage	58	64.44	11	12.22
XII	**Marketing**				
1	Lack of Regulated markets	81	90.00	55	61.11
2	Price fluctuation	82	91.11	62	68.88
3	Non availability of marketing information	42	46.66	28	31.11
4	Lack of demand	79	87.77	47	52.22
5	Non remunerative price	51	56.66	31	34.44
6	Inadequate transport facilities	13	14.44	7	7.77
7	Middle man involved	57	63.33	36	40.00
XIII	**Institutional**				
1	Lack of credit facility	10	11.11	7	7.77
2	Lack of extension services	4	4.44	3	3.33
3	Non-availability of subsidies on machine	60	66.66	48	53.33
4	Difficulty in getting loan	9	10.00	0	0.00
XIV	**Packaging**				
1	Non availability of skilled labour	19	21.11	19	21.11
2	Difficulty in cleaning, grading and packaging	34	37.77	25	27.77
3	Difficulty in getting the seed certification	7	7.77	0	0.00
4	Packaging material	45	50.00	28	31.11

of labor and overlapping of operation. As far as weed control related problems, about 16.66 per cent of the unorganised respondents and very few of the organised respondents faced the problem of high cost of weedicides.

In case of insect-pest & disease management related problems, 22.22 per cent of the unorganised respondents faced problems of high cost of pesticides followed by 16.66 per cent of these respondents faced the problem of identifying of insect-pest. Very few of the unorganised respondents i.e. 6.66 per cent, 3.33 per cent and 2.22 per cent faced financial problems, lack of knowledge about correct method of pesticide application and non-availability of insecticide at proper time in potato seed production, respectively. Very few of the organised respondents i.e. 3.33 per cent faced the problem of high cost of pesticides. Regarding harvesting 36.66 per cent of unorganised respondents and 46.66 per cent of the organised respondents faced the problems of shortage of labor during dehaluming in potato seed production.

In case of contract farming, 40.00 per cent of the organised respondents faced the problems of price fluctuation in market followed by 27.77 per cent of these respondents perceived risk related problems. It was observed during interaction with farmers that the contractors sometimes make faulty evaluation of the quality of crop and deny purchasing at predefined price. This is mostly in case when market price of the crop is lower than the contract price. Very less i.e. 11.11 per cent and 5.55 per cent of the organised respondents faced the problems like difficulty in meeting quality requirement and dishonoring of contract agreement, respectively during potato seed production.

In case of storage related problems, majority of the unorganised respondents (64.44%) faced the problems of high rent of cold storage followed by 56.66 per cent of these respondents faced the problem of non-availability of storage facilities. About 12.22 per cent of the unorganised respondents faced the problem of difficulty in transportation of potato seed. Interestingly, very less number of the organised respondents faced the problems related to storage of potato seed. It might be attributed to the fact that majority of organised respondents owned their cold stores and might extend help to one-another being belonging to common organisation.

Regarding marketing problems, almost all the unorganised respondents i.e. 91.11 per cent, 90.00 per cent and 87.77 per cent perceived problems of price fluctuation, lack of regulated markets and lack of demand, respectively. Majority (63.33%) of the unorganised respondents faced the problem of involvement of middle man followed by 56.66 per cent of these respondents faced the problems of non-remunerative prices. Around 47.00 per cent of the unorganised respondents faced the problem of non-availability of market information during potato seed production. On the other hand, majority of the organised respondents i.e. 68.88 per cent and 61.11 per cent faced the problems related to price fluctuation and lack of regulated market, respectively. Around 40.00 per cent of the organised respondents faced the problems of involvement of middleman followed by 34.44 per cent, 31.11 per cent of these respondents faced the problems in non-remunerative price and non-availability of market

information, respectively. Only eight per cent of the organised respondents had problem of adequate transport facilities during potato seed production.

In case of institutional problems, majority (66.66%) of the unorganised respondents faced problems of non-availability of subsidies on machine like potato planter, potato digger, potato grader etc. Also, 11.11 per cent, 10.00 per cent and 4.44 per cent of these respondents faced the problems i.e. lack of credit facility, difficulty in getting clean and lack of extension services, respectively. In the same pattern, half of the organised respondents (53.33%) faced the problems of non-availability of subsidies on machine like potato planter, potato digger, potato grader etc. Very less number of the organised respondents had perceived problems like lack of credit facility and lack of extension services. None of the organised respondents faced the problem of difficulty on getting loan during potato seed production.

In case of packaging, half of the unorganised respondents (50.00%) had problems in packaging material followed by 37.77 per cent of these respondents faced difficulty in cleaning, grading and packaging respectively. As many as 21.11 per cent of the unorganised respondents faced problem of non-availability of skilled labor and only 7.77 per cent had faced difficulty in getting the seed certification. One-third (31.11%) of the organised respondents had problems on packaging material followed by 27.77 per cent of the organised respondents faced problems in non-availability of skilled labor and none of the organised respondents had difficulty in getting the seed certification.

4.4 Suggestions

The data pertaining to Table 4.31 depict the various suggestions given by the respondents regarding potato seed production. All the unorganised and organised respondents suggested that govt. should implement MSP of potato to control price fluctuation in potato seed production. As many as 30.00 per cent of the unorganised respondents and 70.00 per cent of the organised respondents suggested that guidelines should be issued by the government agencies regarding the prospective area under potato cultivation so that to avoid glut in the market. About half (48.88%) of unorganised respondents and 53.33 per cent of the organised respondents also suggested that concept of e-NAM should be encouraged and properly implemented to eliminate the middle man. Most of the unorganised respondents (81.11%), majority (60%) of the organised respondents suggested that government should provide subsidies for purchase of machinery and to enhance storage facilities of potato seed. About 38.88 per cent of the unorganised respondents and 42.22 per cent of organised respondents suggested that government institutes should provide good quality seeds at district level. Both unorganised (7.77%) and organised (27.77%) of the respondents felt that contract farming should be supported and regulated by government agencies.

Table 4.31 Distribution of respondents according to their suggestions regarding improvement in potato seed production

Sr. No.	Suggestions	Unorganised (n_1=90)	Organised (n_2=90)
		f (%)	f (%)
1	Government should implement MSP of potato to control high fluctuation in potato price.	90(100.00)	90(100.00)
2	Guidelines should be issued by the government agencies regarding the prospective area under potato cultivation so that there is no glut in the market.	27(30.00)	63(70.00)
3	Concept of e-NAM should be encouraged and properly implemented to eliminate the middle man.	44(48.88)	48(53.33)
4	Government should provide subsidies for purchase of machinery and storage of potato seed.	73(81.11)	54(60.00)
5	Government institutes should provide good quality seeds at district level.	35(38.88)	38(42.22)
6	Contract farming should be supported and regulated by government agencies.	7(7.77)	25(27.77)
7	Government agencies should make channels for export of potato seed.	35(38.88)	45(50.00)
8	Good quality breeder seed should be made available in high quantity.	5(5.55)	33(36.66)
9	Small cold storage structures should be increased to avoid post-harvest losses.	47(52.22)	22(24.44)
10	Co-operative societies should purchase various land preparation machinery required for cultivation of potato crop in potato growing areas.	23(25.55)	12(13.33)

***Multiple response**

Around 38.88 per cent of the unorganised respondents, 50 per cent of organised respondents suggested that government agencies should make channels for export of potato seed. About 36.66 per cent of the organised respondents and only 5.55 per cent of the unorganised respondents suggested that good quality breeder seed should be made available in high quantity. About half of the unorganised respondents (52.22%) and 24.47 per cent of organised respondents suggested that small cold storage structures should be promoted to avoid post-harvest losses in potato seed production. One-fourth (25.55%) of the unorganised respondents and 13.33 per cent of organised respondents suggested that co-operative societies should purchase various land preparation machinery required for potato seed production in potato growing areas to minimize farmers investment on high cost machinery.

CHAPTER-V

SUMMARY

Potato (*Solanum tuberosum* L.) is a third most important food crop, grown in more than 150 countries in the world. In India, about 68 per cent of the potato produce is utilized for table purpose, 7.5 per cent for processing, 8.5 per cent for seed and remaining 16 per cent produce goes waste due to pre and post-harvest handling. At present, India rank 2nd after China with 48 million tonnes of potato production and average yield 23.6 tonnes per hectare. Shortage of good quality seed has been recognized as the single most important factor limiting potato productivity in the developing countries. India is the only leading country in Asia which has developed scientific seed production technology for sub-tropics by taking advantage of low aphid period and absence of soil borne diseases and insect-pest. Punjab has established itself as potato seed producing state and supplies about 75 per cent of the total seed potato requirement of the country. However, National seed requirement of potato is around 1.24 million tons considering 25 per cent yearly seed replacement and there is 40 per cent shortage of the certified seed to raise potato crop. It is a challenge to produce quality (virus free) seed to completely meet seed requirement of the country.

Punjab rank 6th in Potato production. Potato was grown on 96.6 thousand hectares during 2016-17 with total production of 2.42 million tones and average productivity around 25 tonnes per hectare. Punjab seed potato is produced in a region which is free from soil borne diseases i.e. Brown Rot (*Ralstonia solanacerum*) and Ring Rot (*Clavibactia michiganesis*), potato tuber moth (*Phthorimaea operculella*) and golden cyst nematode. The regional weather combined with a special practice, the Seed Plot Technique has been recommended for production of seed potato with minimum level of viral disease infestation. Punjab potato seed is free from viral diseases or have virus infection below the permissible limits of the minimum seed certification standards of India. Punjab potato farmers are the major supplier of quality potato seed. In India, there is requirement of 6.0 million tonnes of seed potato when used at rate of 3.0 tonnes/hectares for sowing. Punjab potato is supplied to potato growing states such as Maharashtra, Karnataka, West Bengal, Orissa, Gujarat and NEH region. Punjab has established itself as potato seed producing state and supplies about 85 per cent of the total seed potato requirement of the country. Doaba region, where potato seed production is being carried on approximately 50,000 hectares of area, is the home of potato seed for the entire country. The potato seed produced in this region is healthy, free from several insect-pests and diseases, particularly virus which are known to cause rapid and severe degeneration of potato seed quality. Thus, the present study was planned to analyzed “Status and prospects of organised and unorganised potato seed producers in Punjab state” with the following objectives:

1. To know the socio-personal characteristics of selected potato seed producers
2. To determine the present status of organised and unorganised potato seed producers
3. To study the prospects of organised and unorganised potato seed producers in Punjab
4. To identify the problems faced by the potato seed producers and suggestions thereof

The study was conducted in a cluster of three potato seed producing districts of Punjab i.e. Jalandhar, Hoshiarpur and Kapurthala which were selected purposively because these were having their maximum area under potato seed production. List of potato seed producers working with identified seed producing organizations, such as, Confederation of Potato Seed Farmers (POSCON), Jalandhar Potato Growers Association, Kapurthala Potato growers Association, Pepsico in selected districts were obtained from these organisations. These farmers were termed as organised potato seed producers. List of individual potato seed producers was also taken from the Department of Horticulture. These farmers were termed as unorganised seed producers. From each selected district, 30 organised and 30 unorganised farmers were selected randomly. Thus, a total of 180 respondents comprising 90 organised and 90 unorganised potato seed producers were selected for the study.

Data were collected by using personal interview with potato seed producers by constructing an interview schedule. The interview schedule was consisting of four parts. The first part covered the information regarding the socio-personal characteristics of potato seed producers such as age, education, operational land holding, family size, extension contacts etc. The second part included the statements regarding status of potato seed producers such as area under potato crop, varieties grown, time of sowing, seed rate, adoption of recommended cultivation practices, yield obtained, sources of parent seed, net profit from potato seed production etc. The third part included the statements regarding the prospects of the potato seed producers such plans to change in area under potato crop in future. The fourth part contained the statements regarding problems or constraints faced by the potato seed producers. It also included the suggestions of the potato seed producers.

Interview schedule so prepared was pre-tested on twenty respondents from the non-sampled area i.e. ten organised and ten unorganised. On the basis of information obtained through pre-testing, necessary modifications were made in the schedule after thorough discussion with the advisory committee members so as to remove the ambiguities and make it comprehensive and easy for recording the data. The responses of the respondents were transferred on the master-sheets in Microsoft-excel and were tabulated according to the objectives of the study. The data were analyzed with the help of appropriate statistical tools such as frequencies, percentage, mean score, range method and single mean Z-test.

It was found that most of the respondents belonged to the age group of 40-55 years and having joint families with average size 4-6 members. Most of the unorganised respondents (34.44%) were matriculates and about half of the organised respondents were

educated up to senior secondary level. Majority of the respondents possessed large size of operational land holding. All the respondents had electric motor pump as their main source of irrigation. Majority of the respondents followed Potato-Maize-Paddy cropping rotation. About half of the respondents engaged in potato seed production were in the range of 22-37 years. Pesticide dealers were most frequently accessed source for seeking information regarding potato seed production whereas, scientists of PAU and KVKs were least preferred. Newspapers and T.V. programme*'Mere Pind Mere Khet'* were most commonly used for seeking farm information among the agriculture literature and farm telecasts. Whatsapp and internet (Google search engine) were the most popular ICT tools among the unorganised and organised respondents. All the respondents owned tractor, trolley, cultivator, disk harrow and electric pump, in addition to this majority of the respondents owned potato planter, potato digger and power sprayer. Most of the farmers had medium risk bearing capacity, economic motivation and innovativeness regarding potato seed production.

On an average, unorganised potato seed producers had 80 per cent of their operational land holding under potato seed production with an average yield of 126q/acre whereas in case of organised respondents 90 per cent of the operational land holding was under potato seed production with an average yield of 92q/acre. Majority of potato seed producers cultivated recommended varieties on an area of 90 to 98 per cent. Regarding yield of potato seed, both unorganised and organised sectors had a trend of increasing yield in first four years with an exception in the year 2016. Kufri Pukhraj was most popular variety among the unorganised and organised respondents. Majority of the unorganised farmers procured potato seed from fellow farmers whereas organised farmers had dependence upon govt. agencies like CPRI. More than half of the unorganised respondents used unlabelled seed whereas most of the respondents of organised sector used certified seed. Majority of the unorganised seed producers has sown their crop earlier than the recommended time but in contrast, two-third of the organised respondents has sown the potato crop on recommended dates. Almost all the respondents sow the crop with recommended seed rate. All the organised farmers and majority of the unorganised farmers treated the seed before sowing monceren was most preferred chemical for seed treatment. Most of the respondents applied lesser dose of urea fertilizer than the recommended, in contrast they applied more than recommended doses of DAP fertilizer. Earthing-up operations were carried 25-30 days after sowing (DAS) by majority of the respondents. Organised potato seed producers dehaulmed their crop at 60-80 days after sowing (DAS) which is the recommended time. It is pertinent to note that all the organised farmers practiced the rouging operation whereas 20 per cent of unorganised farmers did not go for it. Majority of the unorganised respondents used chemicals like Gramaxone and Sencor sprayed one times for management of weeds in potato crop. About 50 per cent of organised respondents used chemicals like Gramaxone and Sencor sprayed two times for

management of weeds in potato seed production. Majority of organised respondents used Confidor and Rogor sprayed three times their crop for management of sucking pests in potato seed production. All the respondents used Indofil M-45 fungicides to manage of diseases in potato seed production. Nearly 15.55 per cent of unorganised and 40.00 per cent of organised respondents used Ridomil Gold fungiicide at their fields. Thus it can inferred that organised farmers had adopted chemical measures more effectively to manage weeds, insects-pests and diseases in their fields. Organised potato seed producers usually graded their produce and were not much dependent on middleman for selling their produce. Organised farmer kept more quantity of seed in cold stores for a longer duration.

Forty per cent of unorganised farmers expressed their desire to decrease the area under potato seed production whereas only 13.33 per cent of organised farmers would likely to decrease the area under potato seed production in the coming year which is reflected in acreage as -9.0 per cent of the unorganised and -1.29 per cent of the organised respondents, respectively. Wheat and sugarcane will be the preferred crops to replace the potato. All the unorganised and organised respondents adopted potato seed production due to their interest and expectation of high income. Nearly half of the organised respondents had knowledge about the prevailing procedure in the other states (such as West Bengal, UP, Assam and Gujarat) for their produce. Majority of the organised respondents perceived in potato seed production as profitable venture. Very few respondents were willing to process their produce before marketing. Almost all the respondents were satisfied with the production, finance and management whereas only 11.11 per cent of the organised respondents satisfied with the marketing prices.

Non- remunerative prices, lack of regulated markets, non-availability of subsides on machinery, price fluctuation in the markets were the major problems faced by the respondents. Also some farmers were suffering from high cost of seed and non-availability of quality seed. Lower availability of labor during dehaulming and time of fertilizer application was again a major problem faced by the respondents. Non-availability of storage facilities and high rent of cold storage was found to be major constraint faced by the unorganised respondents.

Suggestions based on findings

1. Guidelines should be issued by the government agencies regarding the prospective area of cultivation so that there is no glut in the market.
2. Government institutes should provide good quality seeds at district level.
3. Concept of e-NAM should be encouraged and properly implemented to eliminate the middle man.
4. Government agencies should make channels for export of potato seed.
5. Good quality breeder seed should be made available in high quantity.

6. Small cold storage structures should be increased to avoid post-harvest losses..
7. Certification is not practiced by the farmers for the seed production.
8. Government should implement MSP of potato to control high fluctuation in potato price.

Suggestions for future research

1. A study on training needs of potato seed producers can be undertaken.
2. Similar study can be conducted in other districts of Punjab state.
3. Comparative study of other states with Punjab can also be conducted.

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APPENDIX

PUNJAB AGRICUTURAL UNIVERSITY, LUDHIANA

STATUS AND PROSPECTS OF ORGANISED AND UNORGANISED POTATO SEED PRODUCERS IN PUNJAB

PART I: Socio- personal characteristics of respondent

1. Name : _____ Father Name: _____
Village: _____ Block: _____
District: _____ Contact No. _____

2. Age (Yrs): _____ Education status: _____

3. Type of family Joint/Nuclear Family Size_____

4. Total annual income of the family (from all sources) _____

5. Operational Land holding Area(in acres) Source of Irrigation

a) Owned: _____ _____
b) Leased in: _____ _____
c) Leased out: _____ _____
Total [(a+b)-c] _____ _____

*(Source of Irrigation: Canal = 1, Electric motor/pump =2, Diesel Pump =3, Any other = 4)

6. A. Crop Rotation followed: _____

B. Do you practice any subsidiary occupation? Yes / no

if yes, specify_____

7. How frequently do you contact following sources for seeking information regarding potato seed production?

	Sources	**Frequently**	**Occasionally**	**Never**
i)	ADO/HDO	_____	_____	_____
ii)	Scientists of KVK's	_____	_____	_____
iii)	PAU scientists	_____	_____	_____
iv)	Private company representative	_____	_____	_____
v)	Arthia's (Commission agents)	_____	_____	_____
vi)	Pesticide dealers	_____	_____	_____
vii)	Any Other (Specify_____)	_____	_____	_____

8. Mass Media Exposure

i) Do you read agricultural literature? Yes /No

If yes give details

Sources	**Always** (3-5 times/week)	**Sometime** (1-2 times/week)	**Never**
Newspaper	_____	_____	_____
Magazine	_____	_____	_____
PAU Literature	_____	_____	_____
Any other (Specify_____)	_____	_____	_____

ii) How often do you view the following Farm telecasts / radio broadcast?

Sources	**Always** (3-5 times/week)	**Sometime** (1-2 times/week)	**Never**
MeraPind Mere Khet	_____	_____	_____
Sohna Punjab	_____	_____	_____
DD Kisan Channel	_____	_____	_____
Any Other (Specify_____)	_____	_____	_____

iii) Are you getting agricultural information from thefollowing ICT tools such as:

What'sAppgroups _____ Facebook _____
Weather related apps _____ Mobile SMS Service _____
Internet (Google Search) _____ Any other, Specify _____

9. Have you acquired any training in potato seed production? Yes / No
if yes, give details

Name	Organizing agency	Venue	Year	Duration
1.				
2.				

10. Give the details of farm machinery owned by you? Yes/no

i) Tractor _____
ii) Trolley (Hydraulic / simple) _____
iii) Cultivator _____
iv) Disc Harrows _____
v) Potato planter _____
vi) Potato digger _____
vii) Electric pump/motor _____
viii) Power Sprayer _____
ix) Any Other, Specify _____ _____

11. Risk bearing capacity (scale developed by Supe and Singh, 1976)
Please give your response to each of the following statements in terms of Agree (A), Undecided (UD) or Disagree (DA).

Sr. No.	Statements	Agree	Undecided	Disagree
1	Knowing that the chances of success are high, one should take risk			
2	I will continue production of potato even if it is risky			
3	One should take decision of starting new venture by keeping in view the past experience			
4	In order to excel, it is necessary to take risk			
5	A farmer who is willing to take greater risk than the average usually does better financially			
6	When it comes to chance, I would go safe than feel sorry			
7	In risky situation, one learns a great about the new practice			
8	Financially sound farmers can go for potato seed production			

12. Economic Motivation (Modified Scale of Moulik, 1972)

These point scale is given below to measure the economic motivation. You are requested to place in the appropriate columns.

Sr. No.	Statements	Disagree	Neutral	Agree
1.	A farmer should work for economic profits			
2.	A most successful farmer is one who makes the most profit			
3.	A farmer should try any new idea which may earn more money			
4.	A farmer should sell value added products to increase monetary profits in comparison to sell the product as such			
5.	It is difficult for the farmer's children to make good start unless he provides them with economic assistance			
6.	A farmer must learn his living but most important thing in life cannot be defined in economic terms			

13. Innovativeness: (modified scale of Singh, 1972)

Please indicate your response to the following statements in terms of Agree (A), Undecided (UD) or Disagree (DA).

S. No.	**Statements**	**Agree**	**Undecided**	**Disagree**
1.	I am among the first in my circle of friends to start potato seed production of vegetables			
2.	I take advantages of the first available opportunity to find out the new and different results			
3.	Prior to adopting new idea like potato seed production, I prefer to consult relative/friend that has experience with it			
4.	I would like a job that does require me to keep learning new tasks in potato seed production			
5.	I am the kind of the person who always looks for an exciting, stimulating and active life			
6.	I decided to try potato seed production without relying on the opinion of the friends who have already tried it			
7.	Whenever any new things like potato seed production of vegetables come, I try it in the farm			
8.	The innovative people are those who start new venture after seeing its benefits			
9.	I try new venture without consulting the sources that introduce it			

PART II: Status of potato seed producers

14. Area under potato seed production_____

II (a) Status of organized potato seed producers

15. What kind of contract had you made with the contracting agency?

- Oral Written

16. If written contract is there what is the legal status?

- Plain paper agreement
- Stamp paper- Witness/Legal registers

17. Give the terms and conditions of the agreement

a. i. What type of inputs do you get under the contract _____

b. i. Mode of payment Cash/Kind

ii. Mode of delivery of produce

Directly from the farm_____

Supplied at contract agency place _____

c. Services offered by the agency

i. Technical services _____

ii. Credit _____

iii. Marketing _____

iv. Transportation _____

v. Machinery _____

vi. Labour _____

vii. Any other (specify) _____

18. Whether you are satisfied with the advices? Yes/No

II (b) Status of organised and unorganised potato seed producers

19. How long you are engaged in potato seed production? ……..yrs.

20. Give the details of potato crop for last five years?

		Area	Production/acre
(i)	2013	_____	_____
(ii)	2014	_____	_____
(iii)	2015	_____	_____
(iv)	2016	_____	_____
(v)	2017	_____	_____

21. How often do you replace the seed? _____ yrs

22. Give the details offollowing cultivation practices of potato seed production followed by you?

Varieties	Source of seed	CS/FS	Area	Time of sowing	Seed rate
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____

23. How many irrigations do you apply to the crop?

_____

24. Whether the seed was treated or not? Yes/no

If yes, specify the chemical method used? _____

25. What type of planting method do you use? Bed/Ridge

26. At what spacing, do you plant the potato seed?
Row × Row_____ Plant × Plant_____

27. a. Whether you get you soil tested? Yes/No

If No, give reason_____
If yes, give reasons_____

b. When did you get your soil tested? _____yrs ago
c. Do you apply fertilizers according to the soil test? Yes/No
If No, give reason_____

28. Give the details of fertilizers you are applying for potato crop

Nutrient	**Name of fertilizer applied**	**Dose**	**Time**	**Method**
Nitrogen				
Phosphorous				
Potassium				
Other (specify)				

29. Do you apply following manures in potato crop?

	Y/N	Acre
Green manure	_____	_____
FYM	_____	_____
Compost	_____	_____
Poultry manure	_____	_____
Other (specify)	_____	_____

30. Do you perform Earthing-up operations in the field? Yes/No

If yes, then time of earthing-up_____

31. After how many days do you perform dehaulming operation in the potato seed crop?
If yes, then how and when

a. _____Days after sowing
b. Method of dehaulming manually/Chemical
(specify)_____

32. What methods do you follow for management of weeds in potato seed production?

Chemical (specify)	**Manual**(specify)	**Mechanical**(specify)
_____	_____	_____
_____	_____	_____
_____	_____	_____

33. Which of the following insect-pest attack the potato crop and how do you manage it?

Insect-pest	**Chemical used**	**Dose**	**Time**	**Non-chemical method (if any)**
Aphid and jassid				
Cutworm				
Whitefly				

34. Give the details of control measures for management of various diseases of potato crop?

Disease	**Chemical used**	**Dose**	**Time**	**Non-chemical method (if any)**
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

35. Do you practise roughing operation in potato seed production? Yes/no
If yes, then after what period and how many times_____

36. Can you identify the symptoms of virus on potato crop? Yes/No
If No, then whom do you consult for identification_____

37. (a) Do you grade the produce before selling in the market Yes/no
(b) What is the average percentage of seed grade tubers you get? _____
(c) Where do you sell the produce?

	Name/Agent	(Raw)	(Graded)
a. Local market	……..	…….	…….
b. Distant market	……..	…….	…….
c. On farm			
Commission-agent	……..	…….	…….
To fellow farmers	……..	…….	…….
Any other	…….	…….	…….
d. Other (specify)	…….	…….	…….

(d) Is there any involvement of middle man? Yes/no
If yes, then who is the middle man?_____

(d) What do you do with the culled produce_____?

38. Did you store the produce? Yes/No

If yes please mention the place and duration of storage.

	Quantity (% of total produce)	Duration	Expenditure	Distance
Home	( )	……	……	……
Cold store	( )	…….	……	……

39. Farm labor involved in potato seed production/acre?

Type of labor		Man day's	Hired/Family labor
I.	Permanent	( )	( )
II.	Temporary (According to farm operation)		
	a. Land preparation	( )	( )
	b. Sowing	( )	( )
	c. Irrigation	( )	( )
	d. Fertilization/pesticides sprays	( )	( )
	e. Harvesting/Digging	( )	( )
	f. Grading	( )	( )
	g. Storage	( )	( )
	h. Any other	( )	( )
III.	Hired labor rate_____		

40. From where do you get information regarding current market price?

…….

41. Have you got any subsidy provided by government for potato seed production? Yes/No

How much subsidy per acre……..
For what purposes……

PART 111: Prospects of potato seed production

42. Year of starting potato seed production……

43. Do you want to continue the potato seed production? Yes/No
Give reasons for your response…….

44. What are your plans to increase/decrease/discontinue the potato seed production in future?

	Area	Reason
a) Increase	_____	_____
b) Decrease	_____	_____
c) Constant	_____	_____

45. Which crops you use to growbefore adoptingpotato seed production?

…….

46. If you want to substitute potato cultivation, which crop will you prefer over it?

……..

47. What are the reasons for adopting potato cultivation?

	Yes	No
a. Because of your interest	( )	( )
b. Expectation of high income	( )	( )
c. Desire to become businessman	( )	( )
d. Diversification in existing farming	( )	( )
e. Advised/suggested by other farmers/person	( )	( )
f. Any others ……		

48. Do you want to have contract with any agency? Yes/No

49. Do you know the procedure of export of potato seed? Yes/No

50. Have you ever exported the potato seed? Yes/No

51. Is potatoseed production is profitable for you? Yes/No

52. Are you satisfied with the present potato seed production systems?

	Yes/No	Give reasons (for your response)
a. Production	----------	----------
b. Finance	----------	----------
c. Management	----------	----------
d. Marketing	----------	----------

53. If you want to adopt processing before marketing? Please give details_____

PART 1V: Problems of potato seed production

Give you response from the following:

	Yes/No
54. Sowing	
a) Non-availability of planting machine	_____
b) High cost of planting machine	_____
c) Uncertainty of weather	_____
55. Seed	
a) Non availability of quality seed	_____
b) High cost of seed	_____
c) Difficulty in getting the seed of required variety	_____
d) Lack of improved seed variety	_____
e) Seed Treatment is a complicated technique	_____
56. Irrigation	
a) Short supply of electricity	_____
b) Non availability of canal water	_____
57. Fertilizer	
a) Non availability of SSP fertilizer at proper stage	_____
b) High cost of fertilizers	_____
c) Lack of labor	_____
58. Manuring	
a) Overlapping of operation	_____
b) More time for decomposition	_____
c) Difficulty in cultural practices	_____
d) Lack of Labor	_____
59. Earthing-up	
a) Uncertainty of weather	_____

b) Overlapping of operation _____
c) Non availability of implements _____
d) Lack of Labor _____

60. Weed control

a) Not proper timely application _____
b) Lack of technical guidance _____
c) Non availability of weedicides _____
d) High cost of weedicides _____

61. Insect-pest & disease management

a) Non-availability of insecticide at proper time _____
b) Problems in identifying of insect-pest _____
c) Financial problems _____
d) Lack of appropriate spraying equipment's _____
e) Lack of knowledge about correct method of pesticides application _____
f) High cost of pesticides _____

62. Contract farming

a) Dishonoring of contract agreement _____
b) Prices fluctuations in markets _____
c) Delayed payment for crop produce _____
d) Difficulty in meeting quality requirement _____
e) Lack of credits _____
f) Risk _____

63. Storage

a) Non-availability of storage facilities _____
b) Lack of knowledge about storage _____
c) Cold storage are available at distant place _____
d) Difficulty in transportation _____
e) High rent of cold storage _____

64. Marketing

a) Lack of Regulated markets _____
b) Price fluctuation _____
c) Non availability of marketing information _____
d) Lack of demand _____
e) Delayed payment _____
f) Non remunerative price _____
g) Inadequate transport facilities _____
h) Middle man involved _____

65. Institutional

a) Lack of credit facility _____
b) Lack of extension services _____
c) Non-availability of subsidies _____
d) Difficulty in getting loan _____

66. Packaging

a) Non availability of skilled labor _____
b) Difficulty in cleaning, grading and packaging _____
c) Difficulty in getting the seed certification _____
d) Packaging material

67. Please, give your suggestions about potato seed production for improvement to:

……

……

…….

VITA

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