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# SEED SUPPLY AND SEED PREFERENCES OF POTATO FARMERS: NIGDE CENTRAL AND IZMIR ODEMİS PROVINCES

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***Abstract***

*Potato is one of the most important staple food crops with a significant role for food security and a potential commercial crop in Turkey. As of 2015, Turkey's potato production amounted to 4.76 million tonnes, and approximately 14.18% of the production occurred in Nigde and 8.57% in Izmir provinces. High-quality seed is the main input for potato production. Import of seed potatoes (rootstock) has increased by 145% and certified seed potato production has increased by 156% in the last 10 years in Turkey. The aim of this study is to determining seed preferences for potato producers in major potato production area, Niğde and İzmir, in Turkey. The study is based on the sample of 141 farmers (69 from the Central district in Nigde and 72 from Odemis district in Izmir) calculated according to the proportional sample size method for 10% error margin and 90% confidential intervals. Conjoint analysis was employed to examine farmers` seed preferences, using seed price, yield, resistance to diseases, production type, maturation time and storage time as the seed attributes. According to the conjoint analysis results, production type has found the first important factor in both research regions such as the cooking type in Nigde, industrial type in Odemis are preferred by farmers. This shows that marketing options affect farmers' potato seed choices. Disease resistance has found the second important factor in Nigde and third in Odemis after the yield performance when buying seeds.*

***Key words*****:** *conjoint analysis, farmers' preferences, potato seed, Turkey*

## INTRODUCTION

Potatoes are consumed as human food and animal feed, processed (chips, finger potatoes, etc.) in various forms. It is known that potato is a valuable nutritional source, especially for underdeveloped and malnourished countries. The United Nations Food and Agriculture Organization (FAO), who believes that potatoes are at the top of the list of products that are currently making a contribution to the resolution of these problems, faces the inauguration and malnutrition of millions of people and has announced 2008 as "World Potato Year" to raise awareness. It is known that potato is one of the most important agricultural product for our country; primary income source for tens of thousands producers' families and the most important food item for many families. It has been determined that about 56% of the potatoes produced in Turkey consume freshly and the fresh potato consumption is around 36 kg per person (Çalışkan, 2014) [5].

Seed is an important input in potato growing as in all crop production. Seed is the main input for plant production and high-quality seed is the first condition of yield productivity. During the production process, a seed problem can be negatively affected not only producers and consumers and many sectors (transport, storage, agricultural employment, industry etc.) between of them. Vegetative propagation of the potato with the lump can cause disease and pests to transport easily by the seed, deterioration of the seed quality more rapidly. Because of this feature of the potato seeds, the use of high-quality seeds is more effective on yield than on other field crops (İşler, 2012) [12].

It has known that potatoes with a history of about 150 years in Turkey; are becoming a sector in itself by the production, marketing and consumption phases. Thanks to the agro-ecological resources that Turkey has, it has proved to be a very privileged position in terms of potato production (İşler, 2012) [12].

The potato is grown in more than 70 provinces of Turkey. As of 2015, Turkey's potato production amounted to 4.76 million tonnes, and approximately 14.18% of the production were occurred in Nigde, 10.37% in Konya and 8.57% in İzmir provinces (TÜİK, 2016) [24]. In order to ensure sustainable production of such an important agricultural product, it is necessary to supply quality seeds at the quality and quality desired by the potato producers. Soil structure, choosing the right potato variety, healthy potato seeds and cultural precautions are the main factors affecting production yield in potato farming.

It has been determined that potato seed is an optimum ambience for many diseases because of 80 per cent water contains. Vegetative propagation with seed made potato seed more sensitive to other plant pathogens that other cultural crop (Taşkın and Erkan, 2013) [22]. Experts forecast that 12% of the potato varieties become extinct in the forthcoming 50 years. For this reason, desired potato seed features and seed supplying places have to be chosen very carefully by potato producers according to the production purposes with the sufficient knowledge consciously. If the chosen seed variety regardless of how high yield potential, does not have the characteristics desired by the producer, it will not be possible to reach the targeted yield. For this reason, potato seed needs to be produce in desired features by potato producers to obtain high quality and sufficient quantity. It is important to determining potato producers' seed usage and seed preferences and seed purchasing behaviour because of that reason. It is important that to know seed supply sources and seed preferences to generate a good supply chain compatible with the farmers' preferences. This is the main point of this research. It has been determined that various studies have been done in several countries related to potato seed usage and farmers preferences (Batt, 2001; Fuglie et al., 2005; Fuglie et al., 2006; Kivuva et al., 2014) [4, 7, 8, 14].

It has not found any research in Turkey related to potato seed supply preferences and affecting factors.

This research is also important at that point. The main aim of this study is to determining seed supply sources of potato producers in Nigde which are the ranked the first in terms of potato production and İzmir provinces; also put forth which factors are considered for seed choices. Auxiliary aims of the study are listed below depending on study main aim.

-Determining usage rate of certificied potato seed and reason of nonusage of certificied seed,

-Determining seed supply places and the reasons of chosen this places

-Determining importance level of seed variety features and which are considered by potato producers comparing features by two important (Nigde and İzmir) production regions,

-Determining problems arise from seed and comparison problem by two important production regions

-Determining problems which producers encounters during the supplying process

-To give suggestions on seed production and supply by considering effective factors on farmers' preferences.

## MATERIALS AND METHODS

It is known that potato produce in every region of Turkey with the planting area of 17966 hectares in 2014 Nigde is the biggest (14 per cent) producer city in Turkey.

It has been determined that İzmir city is ranked the third (8 per cent) in Turkey with the 10590-hectare potato production area (TÜİK, 2015) [23].

Main data are obtained in the face-to-face survey, which was carried out with the potato producers in Nigde (Central) and İzmir (Odemis) in December 2015.The sample size is calculated according to the proportional sample size method which formula is given below (Newbold, 1995) [18].

This sample size method is most applicable for the initial survey in an investigation and for studies, which involve sampling from a small area where the sample size is relatively small (Jayaraman, 1999) [13].

As determining sample volume, calculations were made by including the values for 10% error margin and 90% confidential intervals

into the formula given below.

$$n = \frac{Np(1-p)}{(N-1)\sigma^2_{\hat{p}_x} + p(1-p)}$$

n=sample volume
N= number of potato farmers (Nigde Central: 2455; İzmir Odemis: 5818)
p= rate of potato producers (p is taken 0.5 to reaching maximum sample size)
= population variance (%90 confidential intervals and %10 error margin).
According to these calculations, the sample size was totally found 66 farmers in Nigde Central and 67 farmers in Odemis, which should be interviewed. Survey forms were arranged for required information and filled in by face-to-face interviewing. It was determined that 133 potato producers would be sufficient to negotiate. However, 69 surveys were conducted in Nigde and 72 surveys were conducted in Odemis. Besides the survey, relevant literature such as statistical bulletins, research reports, thesis, articles, and public records has been used for dissection. Villages have been chosen according to the records and Food, Agriculture and Animal Husbandry Ministry experts' opinions. Finally, Konaklı, Alay and Kiledere villages in Nigde Central; Karakova, Çaylı, Kazanlı villages in Odemis province has been chosen which are the dominant in potato production. Numbers of interviewed farmers has been distributed proportionally according to the numbers of producers.
Conjoint analysis is used to determining factors which affected farmers seed choices. Conjoint analysis is used in marketing research to analyse consumer preferences for products and services.
Conjoint analysis is a popular marketing research technique. It is used in designing new products, changing or repositioning existing products, evaluating the effects of price on purchase intent, and simulating market share (Kuhfeld, 2005) [15].
Conjoint measurement is used to investigate the joint effect of a set of independent variables on an ordinal scale of a measurement dependent variable.
It is determined conjoint analysis is widely used producers seed preferences (Baidu Horna et al., 2005; Prasad et al., 2006; Nelson, 2013) [11, 17, 19].
The first step of the conjoint analysis is to determining probable seed factor and features which are affected farmers' decision.
This stage is important due to the statistical adequacy and reliability of the analysis results (Çelik, 2003) [6].
Generally, a number of variables are six or seven in the conjoint analysis (Saraçlı, 2004) [21].
According to literature many factors affect farmers' potato seed choices.
According to the literature and expert' remarks important potato seed features are seed price, yield, disease resistance, production type (industrial, cooking), harvesting time and storage duration. Seed features and levels are listed in Table 1.

Table 1. Seed features and levels on farmers seed choices

| Feature | Number of level | Explanation |
|---|---|---|
| Seed price (TL/kg) | 3 | 1.5 TL/kg<br>2.0 TL/kg<br>2.5 TL/kg |
| Disease resistance | 2 | Resistant<br>Delicate |
| Yield | 3 | Low: 2,5 ton<br>Medium: 3,5 ton<br>High: 4,5 ton |
| Production type | 2 | Industrial<br>Cooking |
| Harvesting time | 3 | Medium early<br>Early<br>Latent |
| Storage duration | 3 | Short 2 months<br>Medium 5 months<br>Long 8 months |

When the six specified features and all variables of each features are taken into consideration, the number of selection cards including all combinations is 3x2x3x2x3x3 = 324.
16 cards were created with the help of orthogonal design calculated by SPSS package program because it is not possible to get reliable and healthy answers by offering all the 324 selection cards to the potato producers.
Generally, the number of cards is 16-18 for 3 and / or 2 levels, and it becomes tradition to use 20 cards in the case of more factors (Yalnız and Bilen, 1997) [25].

## RESULTS AND DISCUSSIONS

*Characterictics of potato producers*

Descriptive statistics are given to draw a profile of the potato producers in Table 2. he interview with potato producers emphasized that an average potato producer is 47 years old in Nigde and 52 years old in Odemis. General age average is 49 years old. Interviewed producers have a primary education (7 years) in both research areas. Average household size is calculated 5 individuals in Nigde Province, and 6 individuals in Odemis district.

The number of individuals engaged in agriculture in the interviewed households was approximately four in both regions. Agricultural experience is averagely 29 years; potato-growing experience is 28 years in Nigde Central. These numbers are 31 years and 26 years in Odemis District respectively. Agricultural and potato experience durations are very near in both regions. This shows that potato is the main agricultural crop in these regions (Table 2).

Table 2. Demographics of potato producers

| | **Nigde** | | | **Odemis** | | | **Total** |
|---|---|---|---|---|---|---|---|
| | Min. | Max. | Mean | Min. | Max. | Mean | Mean |
| Age (year) | 27 | 76 | 46.59 | 26 | 80 | 51.22 | 48.96 |
| Education (year) | 5 | 12 | 6.38 | 5 | 12 | 6.87 | 6.63 |
| Household size (individuals) | 2 | 12 | 4.99 | 3 | 12 | 6.25 | 5.63 |
| Family work force (individuals) | 1 | 12 | 3.97 | 1 | 8 | 4.12 | 4.05 |
| Agricultural experience (year) | 8 | 60 | 29.26 | 5 | 60 | 31.11 | 30.21 |
| Potato growing experience (year) | 8 | 55 | 28.30 | 4 | 60 | 26.07 | 27.16 |

*General features of potato farms*

General features of interviewed farms are given in Table 3. According to the study results, average farm size is 19.32 hectares in Nigde Central. It has been calculated that 64.66 per cent of the farm is property land and the rest of it constitute from collective land. The rate of irrigated land is calculated 94.84 percent in total farmland in Nigde province. The average farm is calculated 12.05 hectare in Odemis district. 48.05 per cent of farmland is property land, 49.01 percent is rented lands and the rest of it is collective lands in Odemis. The rate of irrigated land is calculated 89 percent in total farmland in Nigde province. Average farm size is calculated 12.12 hectares considering two research regions. 3.08 percent of the farmland is fallowing lands. 57.80 percent is property land, 40.99 per cent is constituted rented land and the rest comprises of collective lands. 92.42 percent of the farmland is irrigated. The rate of collective lands is higher than Turkey's average in both study regions this is because of farmers generally growing field crops such as potato, wheat and maize. This kind of field crop is breeding in the larger land.

Table 3. General features of interviewed farms

| | **Nigde** | | | | **Odemis** | | | | **Total** | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Min | Max. | Mean | % | Min | Max. | Mean | % | Mean | % |
| Total farm land (hectares) | 24 | 650 | 19.32 | 100 | 6 | 749 | 13.05 | 100 | 16.12 | 100 |
| Total fallow land (hectares) | 0 | 100 | 0.67 | 3.47 | 0 | 100 | 0.33 | 2.54 | 0.50 | 3.08 |
| Total barren land | 0 | 100 | 0.33 | 1.70 | 0 | 440 | 1.10 | 8.46 | 0.72 | 4.49 |
| Total irrigated land (hectares) | 4 | 600 | 18.33 | 94.84 | 0 | 749 | 11.61 | 89.00 | 14.90 | 92.42 |
| Property land (hectares) | 0 | 500 | 12.45 | 64.66 | 0 | 400 | 6.27 | 48.05 | 9.32 | 57.80 |
| Rent land (hectares) | 0 | 425 | 6.82 | 35.34 | 0 | 671 | 6.39 | 49.01 | 6.61 | 40.99 |
| Collective land (hectares) | 0 | - | - | - | 0 | 100 | 0.38 | 2.93 | 0.20 | 1.21 |
| Number of plots | 1 | 52 | 12.58 | 6.51 | 1 | 52 | 10.60 | 8.13 | 11.57 | 7.18 |

*Production pattern of interviewed farms*

Crop pattern of the interviewed farms in 2016 is given in Table 4. According to that in Nigde province potato is ranked the first with

8.76-hectare production area, following with wheat by 7.04 hectares' production area. Potato area is constituted 46.97 percent of the total farmland. Potato is ranked the first in terms of production area with 5.76 hectares, following with wheat by 3.46 hectares. Potato area is constituted 45.29 percent of the total farmland. Considering 2-research regions potato is averagely grown on 7.23 hectares and this land is constituted 46.27 percent of the total farmland.

Table 4. Crop pattern on interviewed farms (2016)

| | Nigde (Hectare) | | Odemis (Hectare) | | Total (Hectare) | |
|---|---|---|---|---|---|---|
| | Mean | % | Mean | % | Mean | % |
| Potato | 8.76 | 46.97 | 5.76 | 45.29 | 7.23 | 46.27 |
| Wheat | 7.04 | 37.76 | 0.15 | 1.17 | 3.52 | 22.55 |
| Maize | 0.35 | 1.90 | 0.35 | 27.21 | 1.94 | 12.42 |
| Barley | 0.56 | 2.99 | 1.70 | 13.38 | 1.14 | 7.30 |
| Legume family | 1.48 | 7.93 | 0.01 | 0.11 | 0.73 | 4.68 |
| Feed crops and other cereals | 0.31 | 1.66 | 0.91 | 7.19 | 0.62 | 3.94 |
| Fruits | 0.004 | 0.02 | 0.03 | 0.26 | 0.02 | 0.13 |
| Vegetables | 0.15 | 0.78 | 0.68 | 5.36 | 0.42 | 2.69 |
| Swede turnip (secondary product) | - | - | 0.02 | 0.17 | 0.01 | 0.07 |
| Maize (secondary product) | - | - | 3.3 | 25.89 | 1.68 | 10.76 |
| Total farm land | 18.65 | 100.00 | 12.72 | 100.00 | 15.62 | 100.00 |

*Sum of percentage is higher than 100 because of secondary products

*Produced potatoes varieties in interviewed farms*

Produced pototoes varieties in interviewed farms is given in Table 5. According to the study results; farmers on Nigde mostly preferred Granola, Madeleine, Van Gogh, Proventa, Agria, Marfona, Banba, Jelly, Concordia, Melody and Sante potato seed varieties in 2015. These varieties are used for cooking, peel color is light yellow or yellow, rate of dry matter is high, rate of starch is very low, seed are generally long and oval shaped, high quality and yield performance, seed color is yellow, cooking quality is high, after the cooking they don't easily change their color, most of them are harvesting medium-early than other varieties, they have high protein rate.

Table 5. Distribution of potato area of interviewed farms according to the seed varieties in 2015

| | Odemis | | Nigde | | Total | |
|---|---|---|---|---|---|---|
| Varieities | Area (decares) | % | Area (decares) | % | Area (decares) | % |
| Madeleine | 0.20 | 0.40 | 30.30 | 38.36 | 14.94 | 22.77 |
| Granola | 0.42 | 0.80 | 18.67 | 23.64 | 9.35 | 14.25 |
| İnnavator | 17.74 | 33.64 | - | - | 9.06 | 13.81 |
| Melody | - | - | 14.20 | 17.98 | 6.95 | 10.59 |
| Provento | - | - | 8.78 | 11.12 | 4.30 | 6.55 |
| Agata | 5.56 | 10.54 | - | - | 2.84 | 4.33 |
| Lady Olympia | 4.85 | 9.20 | - | - | 2.48 | 3.78 |
| Alegria | 4.86 | 9.22 | - | - | 2.48 | 3.78 |
| Hermes | 4.07 | 7.72 | - | - | 2.08 | 3.17 |
| Marabel | 3.43 | 6.50 | - | - | 1.75 | 2.67 |
| Desiree | 2.88 | 5.46 | - | - | 1.47 | 2.24 |
| Lady Amberalla | 2.71 | 5.14 | - | - | 1.38 | 2.10 |
| Agria | - | - | 2.70 | 3.42 | 1.32 | 2.01 |
| Triplo | 2.07 | 3.92 | - | - | 1.06 | 1.62 |
| Challenger | 1.93 | 3.66 | - | - | 0.99 | 1.51 |
| Van Gogh | 0.76 | 1.44 | 0.58 | 0.73 | 0.67 | 1.02 |
| Concordia | - | - | 1.35 | 1.71 | 0.66 | 1.01 |
| Marfona | - | - | 1.09 | 1.38 | 0.53 | 0.81 |
| Sante | - | - | 1.04 | 1.32 | 0.51 | 0.78 |
| Alegran | 0.92 | 1.74 | - | - | 0.47 | 0.72 |
| Latona | 0.32 | 0.63 | - | - | 0.17 | 0.26 |
| Banba | - | - | 0.14 | 0.18 | 0.07 | 0.11 |
| Jelly | - | - | 0.14 | 0.18 | 0.07 | 0.11 |
| Total potato area | 52.74 | 100.00 | 78.99 | 100.00 | 65.60 | 100.00 |

Madeline is the first choice according to the production area with the rate of 38.36 per cent of Nigde potato farmers, following by Granola (23.94 per cent) and Melody (17.98 per cent). Lady Amberalla, Agata, Marabel, Lady Olympia, Alegria, Desiree, Alegran, İnnovator, Hermes, Challenger, Latona and Triplo varieties are preferred by Odemis farmers in 2015. These three varieities are constituted 79.98 per cebt of Nigde's total potato production area. General features of these varieties are describes as below; (Anonymous, 2016) [2].

These varieties mostly use in potato chips industry, peel colors are yellow and light yellow, rate of dry matter is generally low, rate of starch is high, seed are generally short and oval shaped, high quality and yield performance, seed color is white, cooking quality is low, after the cooking they easily change their color, most of them are harvesting late, they have low protein rate. The top 5 seed choice of Odemis district are Innovator (33.64 per cent), Agata (10.54 per cent), Alegria (9.22 percent), Lady Olympia (9.20 per cent) and Hermes (7.72 per cent). These 5 varieties constituted 70.32 percent of the Odemis potato production area.

*Farmers potato seed supplying places*

Interviewed farmers' potato seed supplying places in 2015 are given in Table 6.

Table 6. Seed supplying places of potato farmers

| | Nigde | | Odemis | |
|---|---|---|---|---|
| | N | % | N | % |
| Seed retailer | 65 | 94.20 | 17 | 23.61 |
| Cooperatives | 6 | 8.70 | 28 | 38.89 |
| Farmers (certified seed producer) | 5 | 7.25 | 4 | 5.56 |
| Own seed | - | - | 4 | 5.56 |
| Company of contracted farming | - | - | 23 | 31.94 |

According to the results of the surveys, 94 percent of Nigde farmers supply their seed from seed retailer, 9 percent from cooperatives and 7 per cent from other farmers (certified seed producers). Contracted farming is not used in Nigde Province so that it has not determined any company. Also, it has not found any farmers which use own potato seed. It has been determined that 23 percent of interviewed Odemis potato farmers supply their seed from seed retailer, 38 percent from cooperatives, 6 per cent from other farmers (certified seed producers) and own potato seed, 32 per cent from the company of contracted farming.

*Farmers preferences reasons for potato seed varieities*

According to the surveys, average scores of reasons for choosing potato seed varieties in Nigde Province and Odemis District are given in Table 7. It has been determined that yield is the most important factor with 4.92 points and potato seed price is the least important factor with the score of 3.75 in Nigde Province. It has been identified that similarly, the yield is the most important factor with 4.64 points and storage duration is the least important factor with 2.85 score point in Odemis District. It has determined that yield is the most important factor in both research regions.

Table 7. Farmers seed preferences reasons for potato seed varieities

| | Yield | Disease resistance | Production type | Storage duration | Harvesting time | Seed price |
|---|---|---|---|---|---|---|
| Nigde | 4.92 | 4.78 | 4.29 | 4.18 | 3.80 | 3.75 |
| Odemis | 4.64 | 4.49 | 4.30 | 2.85 | 4.33 | 4.32 |

*Technical knowledge sources of producers about potato varieties*

Technical knowledge sources of producers about potato varieties are listed in Table 8.

Table 8. Technical knowledge sources of potato farmers

| Sources | Nigde | | Odemis | |
|---|---|---|---|---|
| | N | % | N | % |
| Own experiences | 62 | 96.88 | 25 | 45.45 |
| Neighbour farmers | 6 | 9.38 | 4 | 7.27 |
| Agriculture Ministry | 7 | 10.94 | 9 | 16.36 |
| Seed retailers | 1 | 1.56 | 12 | 21.82 |
| Company of contracted farming | - | - | 10 | 18.18 |

*One farmer can use more than one technical knowledge/information sources.

According to the survey results, it has been determined that 97 per cent farmers in Nigde Province benefited from their own experiences, 9 per cent from neighbour farmers, 11 per cent from Agriculture Ministry and only 2 per cent from seed

retailers. Similarly, it has been identified that 45 per cent farmers in Odemis District used their own experiences, 7 per cent from neighbour farmers, 16 per cent from Agriculture Ministry, 22 per cent from seed retailers and 18 per cent of contracted farming companies' officers for technical knowledge during potato production.

*Reason for potato seed preferred buying places*

The reason for potato seed preferred buying places by interviewed farmers in Nigde Province and Odemis District are listed in Table 9. It has determined that "selling high-quality seed" and "desired quantity" are the most important reasons to explained for farmers preferred buying places in two research regions. Also, other reasons such as "selling wanted seed varieties", "reachable location" and "comparably cheaper price" are found important for Nigde Province potato farmers. "More convenient payment method" reason was found unimportant for Nigde potato farmers. Reachable location of the seed seller was found unimportant for Odemis District farmers.

Table 9. Seed potato reasons of preferred buying places

| Reasons of preferred buying places | Nigde | Odemis |
|---|---|---|
| Selling high quality seed | 4.97 | 4.82 |
| Desired quantity | 4.56 | 4.85 |
| Selling wanted seed varities | 4.09 | 4.07 |
| Reachable location | 4.01 | 2.79 |
| Comparably cheaper price | 3.07 | 4.05 |
| More convenient payment method | 2.00 | 4.63 |

(1: Very unimportant 2: Unimportat 3: Undecided 4: Important 5: Very important)

*Seed potato prices and payment method*

According to the survey results, it has calculated that averagely in 2016 potato seed are cheaper that the year 2015 because of the low potato demand in 2015. Prices are closer in two years in Odemis District it has determined that because of contracted farming. It has calculated that seed potato prices were 1.44 TL/kg in Nigde Province and 1.70 TL/kg in Odemis District these prices are 2.13 TL/kg and 1.71 TL/kg in 2015 respectively. Interviewed potato farmers' payment method are given in Table 10. According to the survey results, all of the Nigde farmers pay in cash on the contrary of Odemis potato farmers. It has been determined that Odemis potato farmers pay their seed expenses on deferred. Besides that, some producers can also pay in cash.

Table 10. Seed potato expenses payment method

| Region | Nigde | | Odemis | |
|---|---|---|---|---|
| Payment method | N | % | N | % |
| Farmers pay in cash | 69 | 100.00 | 2 | 2.78 |
| Farmers pay in deferred | 1 | 1.45 | 72 | 100.00 |

*Farmer can use 2 payment method together.

*Preferences for potato seed features (Conjoint analysis)*

Conjoint analysis is a technique widely used in marketing to measure relative contributions of different product attributes to the overall preference of a product (Hair et al., 2006; Rao, 2008; Hirpa et al., 2012) [10, 11, 21]. This analysis is also widely used outside of marketing, for example, to evaluate farmers' preferences for different characteristics of modern crop varieties (Baidu-Forson et al., 1997; Hirpa et al., 2012) [3, 11] and factors influencing smallholder farmers' adoption of dairy technologies (Makokha et al., 2007) [17].

In conjoint analysis, farmers were asked to ranked the seed cards, which are combinations of chosen levels of different individual attributes.

The selection of seed potato features and feature levels determined according to the literature and expert opinions. Finally, six features of potato seed are seed price, disease resistant, yield performance, production type, harvesting time and storage duration.

Six features and levels are given in Table 11. If the expected sign is linear, increase with the preferences rankings it is described as LINEER MORE, if the expected sign is negative it is described as LINEER LESS. Categorical factors are described as discrete.

For example, estimated sign is negative for seed prices so that seed prices factor is defined LINEER LESS. Disease resistance, yield performance, storage duration is defined LINEER MORE because of expectation is a linear increase. Production type and harvesting feature are defined as discrete because they are categorical.

Table 11. Features and features types using in conjoint analysis

| Features | Feature level | Factor type |
|---|---|---|
| Price | 3 | Linear (less) |
| Disease | 2 | Linear (more) |
| Yield | 3 | Linear (more) |
| Production type | 2 | Discrete |
| Harvesting time | 3 | Discrete |
| Storage duration | 3 | Linear (more) |

A full factorial design with the management attributes as factors would generate so many profiles that the full design would be too difficult to handle. Therefore, an orthogonal fractional factorial design (Addelman, 1972; Hirpa et al., 2012) [1, 11] was used to generate 16 seed profile cards. Figure 1 shows a pictograph of seed cards. In pictographs all attribute-levels were presented, so that respondents would get a good impression of the different options.

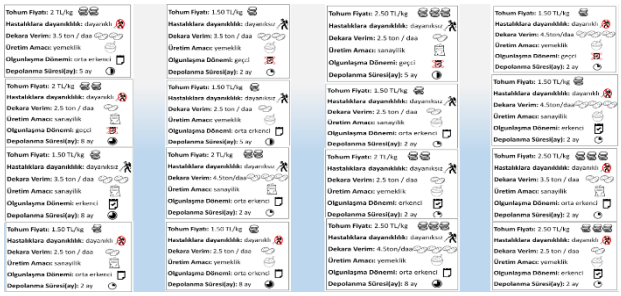

Fig. 1. Seed preference card

*Preferences for potato seed features in Nigde province*

Utility scores have been calculated for each attribute according to 69 interviewed potato farmers card rankings in Nigde Province. According to the results production type is the most important seed attributes in Nigde province with the 43.13 per cent. It has known that potato production is mostly for cooking in Nigde province because of that farmers found this attribute very important for them. Beside that, Nigde in a less developed province in terms of industry and transportation to another industry region can cause extra expenses for them. Industrial production type received a negative utility value (3.592), but this does not mean that industrial production type totally was unattractive. In fact, this type may have been acceptable to all respondents. But, all else being equal, cooking is better for Nigde potato farmers. The utilities are scaled to sum to zero within each attribute, so industrial production type has to receive a negative utility value.

Second important seed attributes have found disease resistance with the of % 17.58 in Nigde Province. Especially recent years' disease resistance is getting important by potato farmers due to soil pollution by diseases in Provinces such as Nigde and Nevsehir. It must be used the defeated seed to get high yield and quality production.

According to the model disease, delicate seeds are not affected farmers' choices and disease resistant get a positive utility value (2.946), this means that disease resistance seed is better for Nigde potato farmers. Yield performance has found the third important seed attributes with the rate of 16.56 per cent. Yield performance is important for producers because it is a result of all the material and moral sacrifices from the process with seed supply to marketing. Low yield seed performance increases 1.586, medium yield level increases 2.538 and high yield increase 4.441 of farmers' utility scores. The fourth important seed factor was found harvesting time with the rate of 9.46 per cent. It is not always possible to get producers to obtain the expected value of agricultural products, which is due to the price instability, which occurs very frequently in the market especially in agricultural products. In the marketing process harvesting time of seed such as early, medium early or latent are important, it can provide to potato producers to present their goods to the market at intervals. It has been determined that medium early harvesting time factor attributes increase 0.056, latent seed increases 0.084 utility scores of farmers' seed choices and early seed attributes decrease 0.028 points.

The fifth important factor determined by producers is storage duration with the importance rate of 7.238 per cent. Producers if they are not satisfied by market prices in harvesting period, they can have stored their products because of that reason storage duration is also important seed attributes. It has been determined that short storage duration increases 0.273, medium level

increases 0.545 and long storage increase 0.818 points of seed utility score. The last important seed factor is seed prices determined by potato producers with the rate of 6.051 per cent. Seed purchasing is mostly with cash in Nigde Province so that It has been observed that sometimes producers give up other income sources or selling their animals/livestock (live capital) for buying potato seed. According to the farmer's choices are the last important factor but when the utility score are taken into consideration, it has been found that the producers decrease seed preference to 0.280, 0.391 to be normal and 0.466 to be expensive (Table 12).

Table 12. Factor type, importance values and utility scores in Nigde Province

| Factor type | Importance values | Levels of factors | Utility score |
|---|---|---|---|
| Production type | 43.120 | İndustrial | -3.592 |
| | | Cooking | 3.592 |
| Disease | 17.577 | Delicate | 0.000 |
| | | Resistant | 2.946 |
| Yield | 16.559 | Low Yield | 1.586 |
| | | Medium Yield | 2.538 |
| | | High Yield | 4.441 |
| Harvesting time | 9.455 | Medium Early | -0.056 |
| | | Early | -0.028 |
| | | Latent | 0.084 |
| Storage duration | 7.238 | Short | 0.273 |
| | | Medium | 0.545 |
| | | Long | 0.818 |
| Price | 6.051 | Cheap | -0.280 |
| | | Normal | -0.391 |
| | | Expensive | -0.466 |
| Constant | 4.380 | | |

It is possible to determine a preferable seed card by using utility score for each attribute. Each card average important values are calculated with the equation below by using utility scores of each utility coefficient.

UTILITY=Constant + (B1) Seed Price + (B2) Disease resistance + (B3) Yield+ (B4)Production type+ (B5) Harvesting time + (B6) Storage duration

Each card scores are given in Table 15. According to the results, the highest utility score is belonging to card 4 (15.436). This card is relatively cheap (1.50 TL/kg), disease resistant, have high yield potential (4.5 tonnes /daa), production for cooking, harvested late and suitable for short storage period (2 months). The lowest utility score is belonging the card 3 (2.537). this card is cheap, delicate to disease, medium yield potential, use for industry, early harvesting and suitable for long storage period. The constant term is found 4.380. Pearson R statistics and Kendal Tau statistics coefficients are found statistically meaningful. These results show that potato farmers seed choices are related to the selected attributes ($p<0.01$).

Table 13. Card scores according to conjoint analysis in Nigde Province

| Card id | Score | Card id | Score | Card id | Score | Card id | Score |
|---|---|---|---|---|---|---|---|
| 4 | 15.436 | 16 | 12.283 | 8 | 8.412 | 10 | 5.055 |
| 1 | 13.554 | 2 | 10.587 | 12 | 6.023 | 9 | 3.836 |
| 14 | 12.986 | 6 | 9.767 | 5 | 5.831 | 7 | 2.583 |
| 15 | 12.709 | 11 | 9.412 | 13 | 5.257 | 3 | 2.537 |

*Preferences for potato seed features in İzmir province (Odemis District)*

Utility scores have been calculated for each attribute according to 69 interviewed potato farmers card rankings in Odemis District. According to the results production type is the most important seed attributes in Nigde province with the 26.84 per cent. It has known that potato production is mostly for the industry in Odemis District because of that farmers found this attribute very important for them. Industrial production type received a positive utility value (0.123), but this does not mean that cooking production type totally was unattractive. Industrial is also very common in that region due to contract production. Yield performance has found the second important seed attributes with the rate of 24.36 per cent. Low yield seed performance increases 1.883, medium yield level increases 3.012 and high yield increase 5.272 of farmers' utility scores. Third important seed attributes have found disease resistance with the 15.26 per cent in Odemis District. According to the model disease, delicate seeds are not affected farmers' choices and disease resistant get a positive utility value (2.160), this means that disease resistance seed is better for Odemis potato farmers. The fourth important seed factor was found harvesting time with the rate of 13.91 per cent. It has been determined that late harvesting time seed factor attributes increase 0.401 points, early and medium early

harvested seed factor decreases utility score of farmers seed choices. In Odemis District due to climate conditions potato can be grown in three season. Producers' preferred to harvest late to protect from prices fluctuations in harvesting season. The fifth important seed factor is seed prices determined by potato producers with the rate of 11.685 per cent. It has been found that the expensive seed prices increase producers' utility scores 3.253 points beside that cheap seed prices are less affected farmers' choices. This is a result of contracted farming in Odemis district, companies supply farmers' input such as seed, fertiliser.

Table 14. Factor type, importance values and utility scores in Odemis District

| Factor type | Importance values | Levels of factors | Utility score |
|---|---|---|---|
| Production type | 26.836 | İndustrial | .123 |
| | | Cooking | -.123 |
| Yield | 24.359 | Low Yield | 1.883 |
| | | Medium Yield | 3.012 |
| | | High Yield | 5.272 |
| Disease | 15.261 | Delicate | 0,000 |
| | | Resistant | 2.160 |
| Harvesting time | 13.911 | Medium Early | -.104 |
| | | Early | -.297 |
| | | Latent | .401 |
| Price | 11.685 | Cheap | -1.952 |
| | | Normal | -2.733 |
| | | Expensive | -3.253 |
| Storage duration | 7.949 | Short | .154 |
| | | Medium | .308 |
| | | Long | .462 |
| Constant | 6.637 | | |

The last important factor determined by producers is storage duration with the importance rate of 7.949 per cent. It has been determined that short storage duration increases 0.154, medium level increases 0.308 and long storage increase 0.462 points of seed utility score. Potato production is mainly for the industry with the contracted farming in Odemis district, and potatoes harvested by companies because of that reason farmers don't need to store their products (Table 14).

It is possible to determine a preferable seed card by using utility score for each attributes. Each card average important values are calculated with the equation below by using utility scores of each utility coefficient.

UTILITY=Constant + (B1) Seed Price + (B2) Disease resistance + (B3) Yield+ (B4) + Production type+ (B5) Harvesting time + (B6) Storage duration.

The constant term is found 6.637. Pearson R statistics and Kendal Tau statistics coefficients are found statistically meaningful. These results show that potato farmers seed choices are related to the selected attributes ($p<0.01$).

Each card scores are given in Table 15. According to the results, the highest utility score is belonging to card 4 (12.795). This card is relatively cheap (1.50 TL/kg), disease resistant, have high yield potential (4.5 tonnes /daa), production for cooking, harvested late and suitable for short storage period (2 months). The lowest utility score is belonging the card 11 (5.521). This card is relatively normal price, delicate to disease, low yield potential, and production for cooking, early harvesting and suitable for short storage.

Table 15. Card scores according to conjoint analysis in Odemis District

| Card id | Score | Card id | Score | Card id | Score | Card id | Score |
|---|---|---|---|---|---|---|---|
| 4 | 12.795 | 14 | 8.963 | 12 | 8.729 | 7 | 6.741 |
| 8 | 12.251 | 5 | 8.933 | 2 | 8.129 | 6 | 6.649 |
| 10 | 9.349 | 13 | 8.901 | 9 | 7.985 | 3 | 6.099 |
| 1 | 9.157 | 15 | 8.891 | 16 | 7.161 | 11 | 5.521 |

## CONCLUSIONS

Production type has found the first important factor in both research regions such as the cooking type in Nigde Province, industrial type in Odemis district are preferred by farmers. This shows that marketing options affect farmers' potato seed choices. Disease resistance is found the second important factor in Nigde Province and third in Odemis District after the yield performance. Many disease and pest are easy to transport due to the vegetative production of potato. Because of that in 2011 according to a new legislation rotation had become obligatory in potato fields. Therefore, that potato production is enlarged to other cities Konya, Kayseri and Adana provinces from Nigde and Nevsehir. Development of disease resistant varieties is also important to provide sustainable production in that regions.

In both research regions, producers prefer latent varieties after production type, disease

resistance and yield performance. This feature is also related to marketing options. In Turkey, potato price is one of the most fluctuated product from the market. Producers prefer latent varieties due to protect price fluctuation in harvesting period.

Agricultural lands and climate features of Turkey is fruitful for potato production in every season but there is a lack of local commercial varieties and ending up increasing external dependency. It is necessary to develop local varieties, which are adopted local conditions to increase yields performance and decrease external dependency. It is suggested that encourage cooperation activities, which can solve problems on marketing seed and other input supply chain, providing convenience credit option to farmer, get to buy desired seed in desired quantity and time with the desired payment method. In addition, other precaution, which can be helpful to get successful on seed potato production, can be summarised as below,

-Seed production system must emerge
-Give penal sanctions to people or companies, which produce unofficial potato seed
-Developed standards for seed potato production
-Determination of potato seed production area and these areas has to be closed for other consumption products
-Maintain continuity of seed production areas
-Support investment in free tissue culture for producing seed varieties production,
-Regulation has to be updated on domestic and external quarantine and overcome the deficiencies of infrastructure and technical officers related to this subject
-Seed certification process must accelerate, all the distributed seed must be certified,
-Premium quality seed in terms of disease resistant varieties have to be imported
-Provide estimation and early warning system in seed potato production areas.

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