

Full Length Research Paper

Exploring Insecticide Practices in Potato Cultivation: A Focus on Erzurum Province, Turkey

Avni Birinci* and Ahmet Semih Uzundumlu

Department of Agricultural Economics, Ataturk University Collage of Agriculture, 25 240 Erzurum, Turkey.

Accepted 8 April, 2024

This study aims to determine the cost share of insecticide application in potato cultivating in Pasinler County, Erzurum Province. The research data was derived from 95 questionnaires conducted in 9 villages Pasinler County in 2004. The study results show that all producers were using insecticides on potato cultivation areas. The average potato production per farm was 26.06 tonnes. The chemical application cost was \$4.43 per decare and the cost was 1.78% in variable costs and 1.69% in total cost. In the potato farms, on the average, 342.5 kg seed, 100.74 kg chemical fertilizer and 80.46 kg manure were used. Per kilogram potato cost was calculated as \$0.14, the mean gross margin and net profit was calculated as \$-19.87 and \$-60.89 per decare, respectively. Unfortunately, potato production is profitable if only chemicals are used at a certain level in the area. For economically sustainable production, it is necessary either to increase amount of chemicals in order to increase yield, or to increase the sale prices of potato. It has been concluded that the cost of insecticide used in this region is low relative to other areas in the country and potato production in the study area can be considered as environment friendly.

Key words: Insecticide use, potato production, profitability, environment.

INTRODUCTION

Potato is an industrial plant which can be grown everywhere in the World except Polar Regions. Generally, chemical composition depends on its breed, storing conditions, the irrigation frequency and fertilizing conditions. On the average, fresh potato contains 80% water, 18% carbohydrates and 2% proteins. Potato also contains some B1, B2, C vitamins and some minerals (Anonymous, 2004a).

Potato is planted approximately 19 million hectares in the World. Total World production is 308 million tonnes and mean yield is 16 tonnes per hectare. The leading potato producing countries are ordered as China, Russia, India, USA and Ukraine and the highest yields per hectare are listed as the countries of Netherlands, Germany, USA, France and England. Potato is planted on 200 thousand hectares in Turkey and 4.8 million ton potato is produced and yield per hectare is 24 tonnes (Anonymous, 2004b). Many different potato varieties are planted in Turkey. The main varieties are as follows:

Marfona, Concorde, Granola, Apollo, Van Gogh, Agata, Concurent, Monalisa, Marabel, Marianna, Cosmos and Agria (Anonymous, 2004 c).

For environment friendly production, it is necessary to avoid chemicals which are necessary to fight against plant diseased and insects. This will decrease the yield. Therefore, the usage of chemicals must be kept to minimum to establish a balance between economic needs and environmental concerns. A former study result indicated that the percentage of cost of the chemical application on potato in Nevsehir was about 2 - 10% of total cost and accounts for the 35 - 40% of the yield (Gunes et al., 1988).

The objective of this study is to discuss the ways to increase the welfare of potato producers and secure sustainable production in Pasinler County in Erzurum, Turkey. In this case, insecticide usage on potato cultivating and the percentage of the cost of insecticide application in Pasinler are to be determined.

The provinces where potato production is intense are, Nigde, Afyon, Bolu, Izmir, Trabzon, Konya, Erzurum and Ordu.

The potato plantation was 5386 hectare in Erzurum. The 44.55% (2400 hectare) of plantation was in Pasinler

*Corresponding author. E-mail: abirinci@atauni.edu.tr. Tel.: +90(442) 231 25 95. Fax: +90(442) 231 26 78.

Table 1. Prices used in the research

Items of payments	\$
Planting Payments (per day)	10.64
Hoeing Payments (per day)	14.18
Irrigation Payments (per day)	7.09
Harvesting Payments (per day)	14.18
Fertilizer and Insecticides Application Payments (per day)	7.09
Seed Price (per ton)	7.09
Chemical Fertilizer Price (per ton)	190.07
Manure Price (per ton)	312.06
Insecticides Price (per 150 gr)	7.09
Irrigation Price (per hour)	28.37
Sack Price (per piece)	7.09

County (Anonymous, 2004 d). Although the Potato yield in the County was (20.000 kg per hectare) higher than both mean potato yield of Erzurum (19 000 kg per hectare) and the World (16 000 kg per hectare), it is still less than the mean potato yield (24 000 kg per hectare) in Turkey. The percentage of potato production of the Province and the County in total production of Turkey's is low, but the area is relatively free of insects which will make it possible to produce potato and potato seed without using excessive chemicals. In this respect, Pasinler County has an important potential to produce potato in a way that is both environmentally friendly and economically viable.

MATERIALS AND METHODS

The research material was obtained from the agricultural cooperatives and plantations by questionnaires. There were no accounting records at chosen plantations. Questionnaire forms were filled out during the face to face meetings with the plantation owners.

Alvar, Altınbasak, Demirdoven, Ardıçlı, Epeşmece, Uğumu, Taskaynak, and Çogender villages in Pasinler were chosen as the survey area where 62% of the potato production in Pasinler is realized.

The sample size was determined by using simple random sampling method based on the criterion of the land size used for agricultural purposes for the year, 2004. To select the sample size " $n = N \cdot s^2 \cdot z^2 / (N-1) \cdot d^2 + s^2 \cdot z^2$ " formula is used (Cicek and Erkan, 1996). Here, N is the number of the potato plantations; s^2 is the variance (The variance of the potato producers); z is the Z table value (1.65) corresponding to 90% confidence limit. The sample size (n) was calculated as 95 plantations. The sample size was increased to 105 because of the possibility of missing information in the questionnaires. The complete 95 interviews were chosen for evaluation. The distribution of the chosen plantations among the villages were determined according to the planting area, number of plantations and number of plantation per village to the total plantation number ratio.

Potato production cost was estimated by taken into consideration data related to accumulated manpower and machine plowing power, and the other inputs usage. The cost analysis was done considering the equipment, manpower, machine plowing power, and number of processes which were typical in the mentioned region for preparation of soil, maintenance and harvesting activities.

In calculating the cost of inputs such as insecticides, fertilizers and seeds used in production activities, the actual payment for inputs at ranch yard prices were chosen as the basis (Gundogmus, 1998). To maintain homogeneity, all of the plantation were consider renting tractors. 70% of the sample plantations did not have a tractor anyway (Tanrivermis, 2000).

The potato farming in the region was fully irrigated. Direct payment for the irrigation terrain and all sample plantations are irrigated. Direct payment for the irrigation cooperatives was chosen as the irrigation cost. The land rent was estimated by considering actual payments for land renting, and alternative renting values (Gunes at al., 1988). The capital interest was calculated as one half of the Agriculture Bank interest rate (12.5 out of 25 %). It was assumed that the capital was held for 6 months for aforementioned production activities during a production term (Gunes at al., 1988). General management cost was calculated as 3% of the total cost excluding capital interest (Birinci, 1997) (Table 1).

In the research, every production subsection was considered independent in gross marginal analysis of agricultural plantations. Gross margin is reached by extracting variable costs from related production branch gross production cost (Karagolge, 1996). The starting point to determine the gross margin was gross production value. Gross production value consists of total auxiliary production values. In the calculation of the gross production value, production amount of every production branch was found out by multiplication of the sale price and addition of productive value increase (inventory worth increase) occurred during the production year (Akay, 1996). To calculate net income of potato plantation, total production cost was subtracted from total gross production value (Aras, 1988).

RESULTS AND DISCUSSION

On the average, 26.06 tonnes potato were produced per plantation. 83.32% of the harvested potato was sent to market while 14.26% was stored as seed, while 2.42% was consumed by the families (Table 2).

A large portion of potato producers (89.56%) sell their potatoes in Pasinler County market. 5.22% of them sell their product in Erzurum province center. The prices were determined to be between the \$ 0.085 and \$ 0.156 per kg in the local markets Pasinler and Erzurum respectively. In the region, potato producing plantations tend to use relatively low amount of insecticide early in the sea-

Table 2. Supplying Produced Potato at Plantations to the Market.

Usage and market supply	Amount (Tones)	Percentage (%)
Produced amount	26.06	100.00
Amount consumed by the family or the relatives	0.63	2.42
Amount stored as seedlings	3.71	14.26
Amount sold	21.72	83.32

Table 3. Insecticides used at plantation for potato bug (*Leptinotarsa decemlineata*).

The commercial names of used insecticides	Used amount (gram per decare)	Suggested amount (gram per decare)	Application time (Month)
Gaicho	16.80	30	April
Karete	37.92	40	June
Karen	36.00	40	June

Table 4. Requirement of manpower and plowing power of the plantations production processes.

	Plantations			
	Manpower Requirement		Plowing Power Requirement	
	Hour	%	Hour	%
Soil preparation	0.37	0.71	0.37	15.68
Planting	6.30	9.68	0.76	32.20
Maintenance	27.52	41.82	0	0
Harvesting	21.00	31.94	0.58	24.58
Bulking	10.12	15.48	0	0
Loading and transportation	0.65	1.37	0.65	27.54
Total	65.96	100.00	2.36	100.00

son. For example the insecticide Gaicho is applied to the seed at the month of April (Table 3). Karete and Karen were applied in June when potato bug appears. Plant production experts generally favor karete among other Insecticides.

Total machine plow power and manpower related to the production activities in the potato production were given in the Table 4.

As can be seen on Table 4, 65.69 h manpower per decare and 2.36 h machine plow power per decare (one-tenth of a hectare) were used in potato production. Manpower requirement per decare for production process used for maintenance was 41.82%. The harvesting was 31.94%, where soil preparation, harvesting material, transportation, and planting were 0.71, 15.48, 1.37, and 9.68% respectively.

At the plantations; work power cost per decare was \$82.82 where material cost, land rent, general management costs, capital interest cost, field cost, market cost, and average potato were \$121.65, \$30.65, \$10.38, \$31.40, \$276.89, \$288.92 respectively. Average potato yield was 2 061 kg per decare. Product market price was

\$0.11 per kg and cost per unit production was \$0.14 per kg (Table 5).

The margin between these two prices was -0.30 \$ /kg, so producers were losing money from potato production. Most important reasons for the producers at the county to loss money were that, varying costs were very high and at the year research, many of the potato producers sold their production to brokers with low prices. In the cost analysis, rent for land owned by the producers, manpower and machine power owned by the producers and their self capital interest demands were included in expenses. Producers do not consider these elements as a part of production cost. They still continue producing potato for the following years. Seed planting for potato production at the County was in April - May period. Manual planting was achieved by planting in irrigated trenches, on the other hands machine planting was achieved by planting in irrigated trenches which were opened by the machines. Average of 342.50 kg seeds, 100.74 kg chemical fertilizers and 80.46 kg manure were used per decare at plantations.

Gross margin was calculated subtracting varying cost

Table 5. Gross margin and net profit levels at the potato producing plants (\$ per decare).

Expenditure Items	Power Usage (hours per decare)		Cost (\$) per decare
	Man	Machine	
1. Work Power Cost (a+b+c)			82.82
a. Soil Preparation and Planting Costs			13.96
b. Maintenance Cost			42.70
c. Harvesting Costs			26.16
2. Material Costs			121.65
3. Land Rent			30.65
4. General Management Costs (1+2+3)*0.03			10.38
5. Capital Interest Cost (1+2+4)*0.125			31.40
6. I.Field Cost (1+2+3+4+5)			276.89
II. Marketing Costs (a+b)			12.02
a) Transporting to the Depots and Markets Cost	0.65	0.65	12.02
b) Storage Costs			0
7. Market Cost (I+II)			288.91
8. Total Constant Costs (\$ per decare) (3+4)			41.02
9. Total Variable Expenditures Cost (\$ per decare) (7-8)			247.89
10. Total of All Expenditures (\$ per decare) (8+9)			288.91
11. Potato Yield (kg per decare)			2061.00
12. Potato Sale Price (\$ /kg)			0.11
13. Gross Production Value (\$ per decare) (11 *12)			228.03
14. Gross Margin (\$ per decare) (13 -9)			-19.87
15. Net Profit (\$ per decare) (13 -10)			-60.89

Table 6. Share of insecticides cost in the variable cost for potato production.

Expenditure Items	Cost (\$ per decare)	Percentage (%)
1. Insecticide	3.46	
2. Workmanship for Insecticide Application	0.97	
3. Cost for Insecticide Application (1+ 2)	4.43	1.78
4.Total of Variable Costs	247.89	100.00

expenditures for potato production from gross production value of potato production per unit area. Gross production value per decare was \$228.03, varying cost per decare was \$247.89, and consequently, gross margin per unit area was \$-19.87 per decare.

Net profit used as a success criterion in the economical evaluation of the activities was calculated by subtracting the production cost from gross production values of potato production per unit area. Net profit of the plantations was \$ -60.89 (Table 5).

Potato producing farmers of the region mention that if they did not use chemical insecticides, they would get almost no potato production. Because of that, they had to use chemical insecticides. Mean cost of chemical application to the plantations was approximately \$4.43 per decare. Thus insecticide cost constitutes 1.78% of the variable costs and 1.69 % of the total costs (Table 6 and 7).

It can be inferred that 1.69% of the total cost prevents almost 100% production loss and provides revenue of \$228.03 per decare.

Potato producing plantations in Pasinler County would not be profitable without using chemicals, so insecticides use is necessary for production. The amount of insecticide usage does not increase the yield, but decreases the loss in the production. The average yield of potato production was calculated to be lower in the study area than the average in Turkey.

It was concluded that, in order to earn more income, the farmers should either apply more chemicals to increase potato production or produce more potato seed which sell for more at the market. The climate and soil conditions in the study area are suitable for seed production. Therefore the farmers need to be encouraged to produce more potato seed so that they can increase their income and thus their quality of life and at the same time

Table 7. Share of insecticides cost in the total cost for potato production.

Expenditure Items	Cost (\$ per decare)	Percentage (%)
1. Insecticide	3.46	
2. Workmanship for Insecticide Application	0.97	
3. Cost for Insecticide Application (1+2)	4.43	1.69
4. Total Cost	288.91	100.00

time pay attention to environmental concerns.

REFERENCES

- Akay M (1996). Structural Analysis, Evaluation of Factors Affecting the Management Results and Planning by Using Linear Programming of the Agricultural Plantations of the Tokat Province, Niksar Plains. (Unprinted Doctoral Thesis) G.O.P. University Natural and Applied Sciences Institute, Tokat
- Anonymous (2004a). Cine Tarim e-mail address <http://www.cinetarim.com.tr/dergi/arsiv47/arastirma02.htm>.
- Anonymous (2004b). FAO -mail address <http://www.fao.org/faostat>
- Anonymous (2004 c). www.cu.edu.tr/Content/Shtml/Turkish/basin/2004/0320040273.shtml
- Anonymous (2004d). Data of Agricultural Directorship of Province, Erzurum.
- Aras A (1988). Agricultural Bookkeeping E. U. Agriculture Faculty , Izmir No: 486.
- Birinci A (1997). A Research on Determination of the Factors Affecting the Capitalization Interest Used in to Determine the Values of the Lands in Erzurum and Erzincan Province (Unprinted Doctoral Thesis) Ataturk Univ. Natural and Applied Sciences Institute, Erzurum.
- Cicek A, Erkan O (1996). Sampling and Research Methods in Agricultural Economics, Gaziosmanpasa University, Agriculture Faculty, Pub. No: 12, Lecture Notes Series, No:6, Tokat

- Gundogmus E (1998). Functional Analysis of Bread Wheat in the Agricultural Plantations of Ankara Province, Akyurt County and Calculation of Production Cost Tr. J. Forestry, Ankara 22: 251-260.
- Gunes T, Kiral T, Bulbul M, Arıkan R, Tatlıdil F, Albayrak N, Celen H (1988). Project to Research the Costs of Main Agricultural Products A. U. Ankara.
- Karagolge C (1996). Agricultural Management-Analysis and Planning of Agricultural Plantations Ataturk University Publications No:827, Agriculture Faculty Publications No:326, Text Book Series No:74, Erzurum.
- Tanrivermis H (2000). Economical Analysis of Insecticide Usage for the Tomato Production in the Middle Sakarya River Basin. Ankara University Research Institute Pub. No: 42.