



EGYPTIAN ACADEMIC JOURNAL OF
BIOLOGICAL SCIENCES
TOXICOLOGY & PEST CONTROL

F



ISSN
2090-0791

WWW.EAJBS.EG.NET

Vol. 16 No. 1 (2024)

www.eajbs.eg.net



The Most Effective Methods Used to Control Mole Rats, *Spalax ehrenbergi*, on Benghazi Plain Project in Libya

Mohammad, H. Abdulkarim¹; Ali, Aqeeleh² and Chammemm, Mohsen³

¹Department of Zoology, Faculty of Arts and Science Benghazi University, Tokra Branch' Libya.

²Department of Zoology, Faculty of Arts and Science Benghazi University, Al-Abyar Branch' Libya.

³Laboratoire d'Elevage et Faune Sauvage, Instiut des regions Arides, Médenine, University Gabes, Tunisia.

*E. Mail: hussein.amgawer@uob.edu.ly

REVIEWINFO

Review History

Received:18/3/2024

Accepted:22/4/2024

Available:26/4/2024

Keywords:

Mole rats,
Spalax ehrenbergi,
Effective methods,
Control,
Damage,
Aluminum phosphide tablets.

ABSTRACT

There are different methods used to control mole rats worldwide. Toxic strychnine hydrochloride, trapping, pouring water into the tunnels, Calcium phosphate granules, shift to the cultivation of annual crops, using of Aluminum phosphide tablets, and use of Gas were used in different countries worldwide. The aim of this research is to study the level of damage and the most effective methods to control *Spalax ehrenbergi* on the Benghazi Plain project in Libya. A study was conducted to obtain information about the perceptions and practices of farmers in the Benghazi Plain project in Libya on mole rat "*Spalax ehrenbergi*" damage and their management practices in the late-2022 and early 2023. Farmers ($n = 250$) from four regions in the study area were randomly selected and interviewed using a semi-structured questionnaire. The data collected were analyzed using SPSS Statistics 24. The results indicate that farmers mainly use Aluminum phosphide tablets (80.80%) as an effective method to control mole rats "*Spalax ehrenbergi*" in their farms. The product was approved for marketing and use in Libya, and very strict instructions to the user were issued. The results also indicate that some of the farmers use gas (56.00) to control these moles if aluminum phosphide tablets are not available. The results indicate that The mole rats, *Spalax ehrenbergi*, cause small to medium damage to Agricultural crops if it is controlled by using these effective methods.

INTRODUCTION

Agricultural pests can include weeds, diseases, rodents, and plant-feeding insects and mites. These pests are estimated to destroy as much as one-third of all agricultural yield (<https://www.sciencedirect.com>). Rodents are one of the major problems in Eastern Africa, and have been the number one crop pests (Legese, & Bekele, 2023). Rodents make up the largest order of mammals, with over 40% of mammalian species. Rodents are small mammals that have sharp front teeth. Rats, mice, and squirrels are rodents. Blind mole rats "*Spalax ehrenbergi*" are widespread in the eastern Mediterranean region from northeastern Libya through Egypt, Jordan, Syria and southern Turkey. Within this region, these mole rats

are found in fragmented areas with appropriate soils for burrowing (Hutchins, 2004 & Schlitter *et al.*, 2008, Shahin *et al.*, 2018). It is a completely blind, solitary and territorial rodent, with each burrow system containing a single animal. Poison Baits, fumigants, traps, repellents, fences, and earthworm control were the methods used in European Union states to control the European mole.

No poison, other than strychnine hydrochloride, is approved for the control of moles in the UK, but before a strychnine treatment can be carried out, a specific authority from Defra is required. This administrative requirement under the Poisons Rules 1982 and Control of Pesticides Regulations 1986 does not apply to other methods of control. For each treatment, strychnine baits (1 g poison/50 worms) are normally applied for one day at the rate of up to 25/ha (10/acre) with one treated worm per mole run (Quy & Pool, 2004).

Fumigation appears to be the most widespread method of mole control among those EU states (Belgium, Denmark, France, Germany and UK) that have at some time treated moles as pests. In all cases, phosphine gas, generated when aluminum phosphide contacts soil moisture, is the main fumigant, but the formulation from which the gas evolves differs (Quy & Pool, 2004). Otherwise, Earecho (2015) in his research in Ethiopia, found that the fumigant aluminum phosphide had a significant impact on mole rats' mobility through the plots and the number of attacked Enset. In conclusion, aluminum phosphide was recommended for scaling up to minimize the damage of mole rats to Enset crops in highly mole rat-prone areas.

Trapping has long been recognized as a method of controlling moles and the technique is used widely in Britain, Denmark and France (Atkinson *et al.*, 1994 & Guedon, 1998). and to a lesser extent in Holland and Germany. Many different traps have been used in the past but today there are two main types in common use, the scissor (pincer) trap or metal half-barrel trap (Quy & Pool, 2004).

Baker *et al.* (2016) surveyed farmers, amenity managers and householders about moles and mole control on their British Farms, Amenities and Gardens after Strychnine Withdrawal in 2007, post strychnine withdrawal. Kill-trapping was by far the preferred control method used and control may be used more than can be justified by damage levels or the effect of control on damage.

Repellents used against moles fall into three main categories: physical, auditory/vibrating and olfactory. At the most basic level, physical repellents rely crudely upon the sensitivity of the moles' snout to sharp objects placed in their tunnels. Physical repellents used in the past include; pieces of bramble, holly leaves, corks studded with pins, barbed wire and broken glass (Atkinson *et al.*, 1994 & Guedon, 1998). The efficacy of these impractical measures is highly questionable, as the moles' usual reaction is to bury the offending object and tunnel around it. Physical repellents are no longer in common use and have been replaced, to some extent, by auditory/vibrating devices. Olfactory repellents have been used for many years to discourage moles and it is still a regularly held belief that the animals can be driven away by simply placing distasteful substances, such as mothballs, carbide, bad fish, tar or creosote into their runs. Naphthalene, formalin, bisulphide of carbon and sump oil have also been used at one time or another to drive moles away from areas where they are causing problems (Quy & Pool, 2004).

Fencing is used in Germany, where the mole is legally protected, to 'mole-proof' gardens that border heavily populated pastureland. The fence consists of zinc-plated wire netting with a 15 mm mesh. The netting is placed vertically in an 80 – 100 cm deep trench with 20 cm, at both the top and bottom, bent over in order to make it more difficult for moles to dig under or climb over it. A fence can prevent re-invasion into an area where moles have previously been driven away with repellents (Quy & Pool, 2004).

The mole rat is a serious pest of agriculture in Libya. It consumes underground

organs (roots and bulbs) and draws surface parts of plants into its gallery. It collects and hoards as much food as possible (Heth, 1991). The mole-rat damages flowers (carnation, gypsophila, narcissus, gladiolus, liatris, and freesia), vegetables (tomato, potato, watermelon, mangel-wurzel, papaya, pineapple, celeriac, carrot and onion), and gnaws the root collars of orchard trees. This research studied the most effective methods to control mole rats, *Spalax ehrenbergi*, on Benghazi plain project farms in Libya.

MATERIALS AND METHODS

1-Study Area:

The study area is located within Benghazi Plain in the north-east of Libya with an area of 58,200 thousand hectares, specifically in the northeast of Benghazi city, about 22 km. It extends from Sidi Khalifa area in the southwest to Talmitha area in the northeast, with a length of approximately 110 km. It is confined between the first edge of Green Mountain in the south, southeast and the coastal strip in the north and northwest with a width that widens to the south about 20 km and then narrows towards the northeast until it reaches about 0.5 km at the area of Talmitha (Al-Tabaqli, 2016).

The astronomical location of the Benghazi Plain Agricultural Project is important in determining the quality of agricultural crops in the region because it extends between (32°15'–32°42' N and 20°12'–20°55' E). This made the study area characterized by a hot, dry climate in summer and mild, rainy in winter, which is similar to the Mediterranean climate, and the rainfall rate increases towards the north. The rainy season is concentrated between the months of October and March (Al-Tabaqli, 2016). Figure 1 shows the location of the study area.

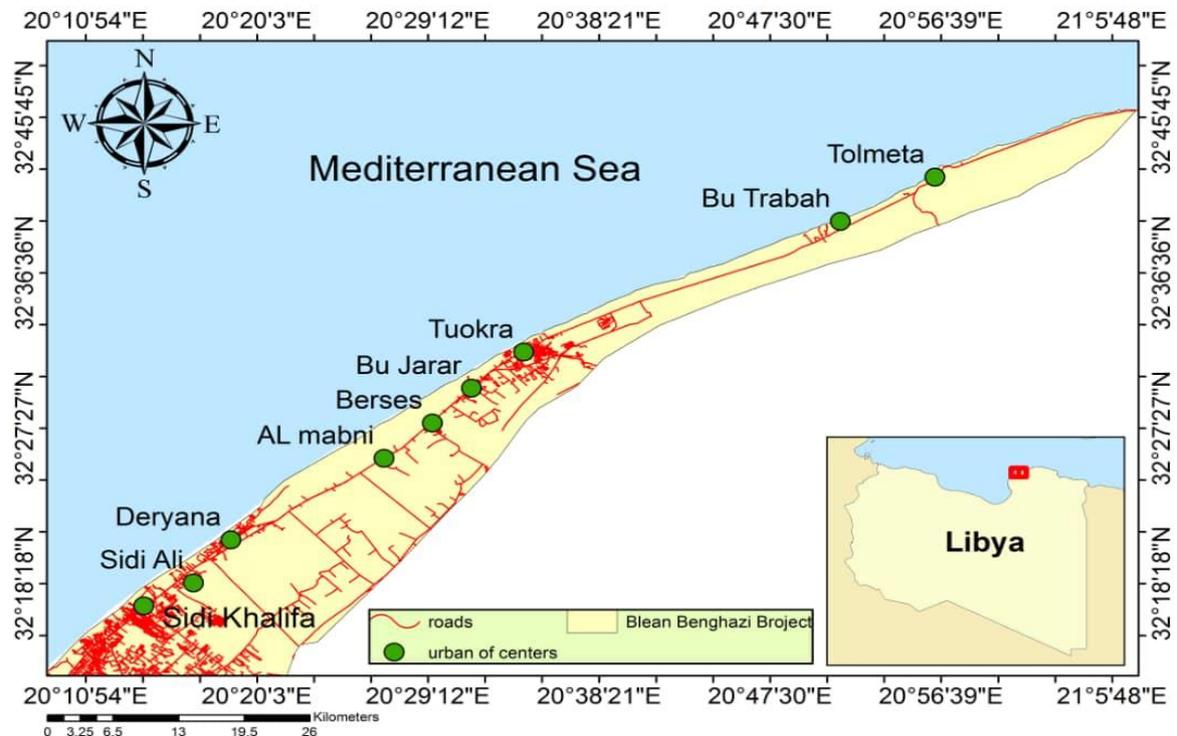


Fig. 1: The geographical location of the Benghazi agricultural project, Source: (Al-Tabaqli, 2016)

The soil of the study area was classified into seven grades of productive capacity. Soils with good development potential in the field of irrigated agricultural investment fall below the two degrees. The first and only the second, which have an active depth of more than 50 cm and a slight inclination, non-spreading surface stones and rocks with no strong evidence of erosion were identified. This soil is suitable for cultivation, and its area in the study area is about (18,624) hectares, and it is soil that does not suffer from any natural limitations that impede its investment. It is open, with good permeability, and flat topography, and has the ability to produce crops, especially fruit trees. Wheat and barley crops are grown in the study area in the months of October and November in the winter season. As for oats, the conditions in which they grow are similar to the conditions of Barley, although it needs a cooler and more humid climate. Also, vegetable crops, are grown in the study area in months of the Summer season.

2-Questionnaire Survey:

The questionnaire was designed to consist of three parts, the first part includes general information and personal data about the farmers participating in answering the questionnaire, and the second and third parts of the questionnaire were designed on a Likert scale from 1 to 5 where 1 means I strongly agree while 5 means strongly disagree, as the phrases of the second part relate to different methods used by farmers to control the mole rats, including the use of aluminum phosphide by farmers in Benghazi Plain project to combat that animal and reduce its damages. The third part of the questionnaire is related to the damages to agricultural crops and the level of these damages caused by Mole rats in the Benghazi Plain project in Libya.

3-Pilot Study:

A preliminary version of the questionnaire was designed and distributed to 20 academic experts in the faculties of agriculture, research centers and the Directorate of Agriculture in Benghazi city. Personal interviews were conducted with them in order to seek the opinion of experts and specialists regarding the questions of this questionnaire and any suggestions by them to make any amendments or additions. In order to reach the final version of the questionnaire, which will be distributed to a random sample of farmers in the farms of Benghazi Plain Project in Libya.

RESULTS

Analyzing the Demographic Profile of the Respondents:

1. Gender:

250 randomly selected individuals participated in the questionnaire, and it was found that 76% of the questionnaire respondents were males and 24% of questionnaire respondents were females, as shown in Figure 2.

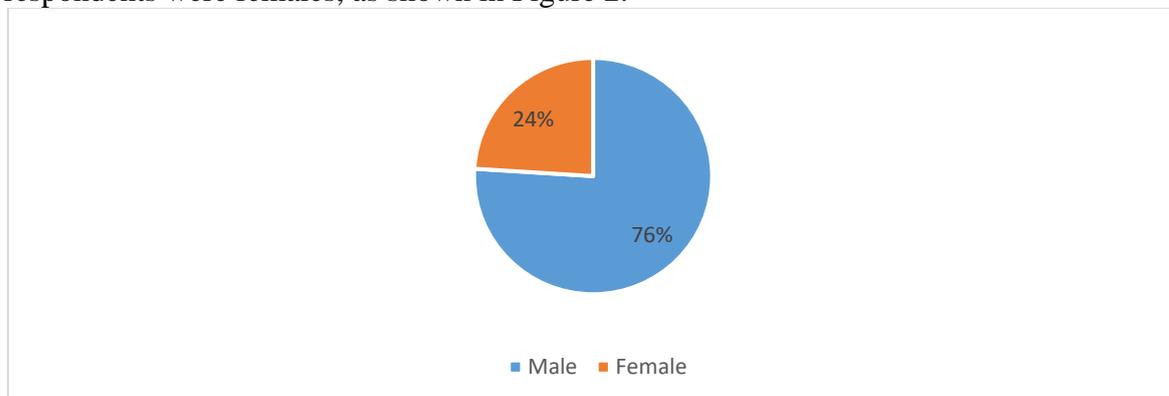


Fig. 2: Percentage of the gender of questionnaire respondents (male-female).

2. Age:

It was also found that most of the respondents (33.6%) ranged in age from 30 to 39 years, 32.4% ranged in age from 50 to 59 years, 17.6% in the age ranged from 30 to 30 years, 9.2% in the age ranged from 40 to 49 years, and the rest of the participants were over. 60 years old, as shown in Figure 3.

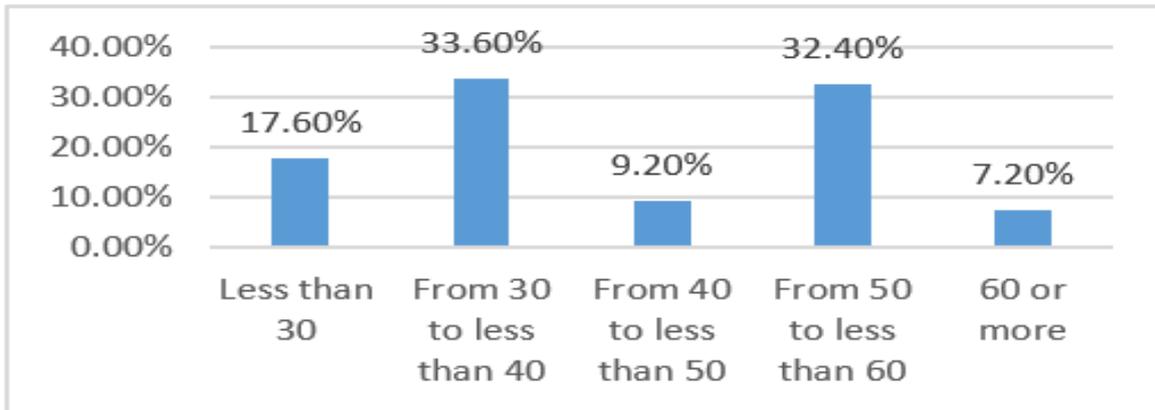


Fig. 3: Age of questionnaire respondents.

3. Marital Status:

As shown in Figure 4, Most of the questionnaire respondents (42.8%) are married, 38.80% are widows, 11.6% of the participants have not yet married, and the rest are divorced.

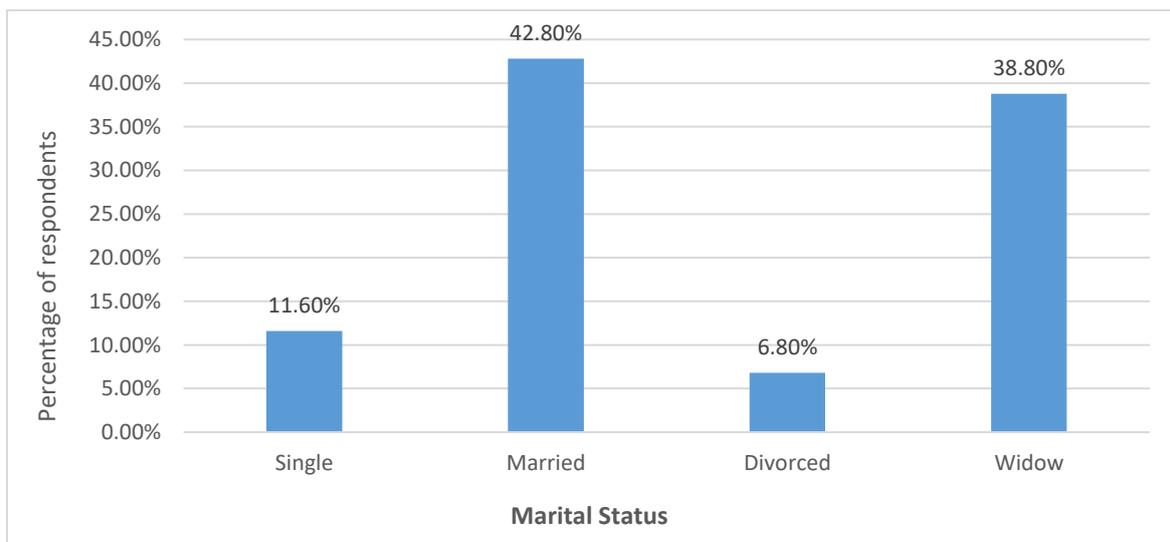


Fig. 4: Percentage of the marital status of questionnaire respondents.

4. Educational Qualification:

It was found that Most of the questionnaire respondents (42.8%) obtained a preparatory certificate, 22% obtained a secondary certificate, 14.8% obtained an intermediate institute, 13.2% obtained a higher qualification, and the rest obtained an elementary certificate only, as shown in Figure 5.

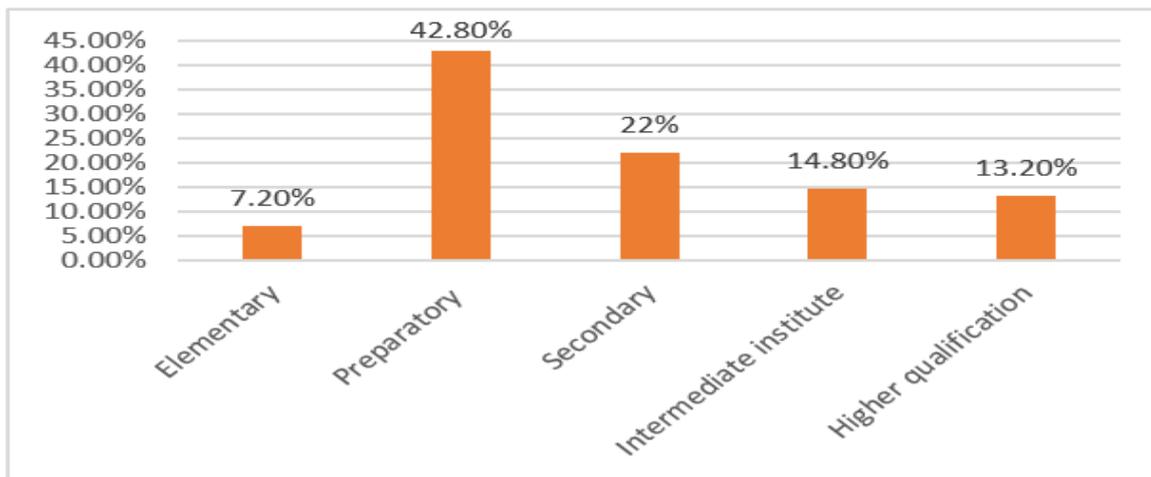


Fig. 5: Percentage of questionnaire respondents according to their educational qualification

5. The Nature of The Work:

For the nature of the work of the questionnaire respondents, it was found that most of them (46.8%) are renters and 38.8% are agricultural workers, as shown in Table (1).

Table 1: The percentage of the questionnaire respondents according to the nature of the work of each of them.

The Nature of the Work	No. of respondents	Percentage
Owner	36	14.4
Renter	117	46.8
agricultural worker	97	38.8
Total	250	100

6. Experience in the Agricultural Field:

For the experience of the questionnaire respondents in the agricultural field, it was found that most of them (33.6%) have experience of 20 years or more, 28.8% have experience ranging from five years to less than ten years, 25.6% have experience ranging from ten years to less than 20 years, and the rest of them has less than five years of experience, as shown in Figure 6.

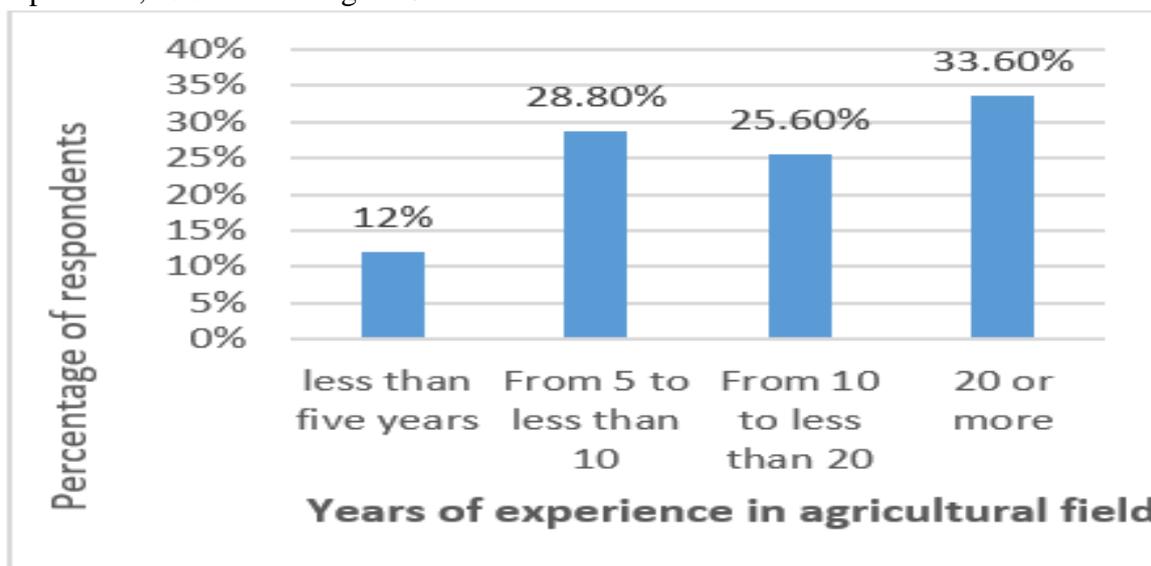


Fig. 6: Years of experience of questionnaire respondents in the agricultural field

Analyzing the Second Part of The Questionnaire Respondents:

Regarding the first statement, which states that the use of toxic strychnine is an undesirable method in controlling moles at Benghazi Plain farms in Libya, 36.4% agree with this statement, while 19.6% strongly agree, and only 7.2% disagree. Figure 7, shows the percentage of questionnaire respondents to the first statement in the second axis on a Likert’s scale.

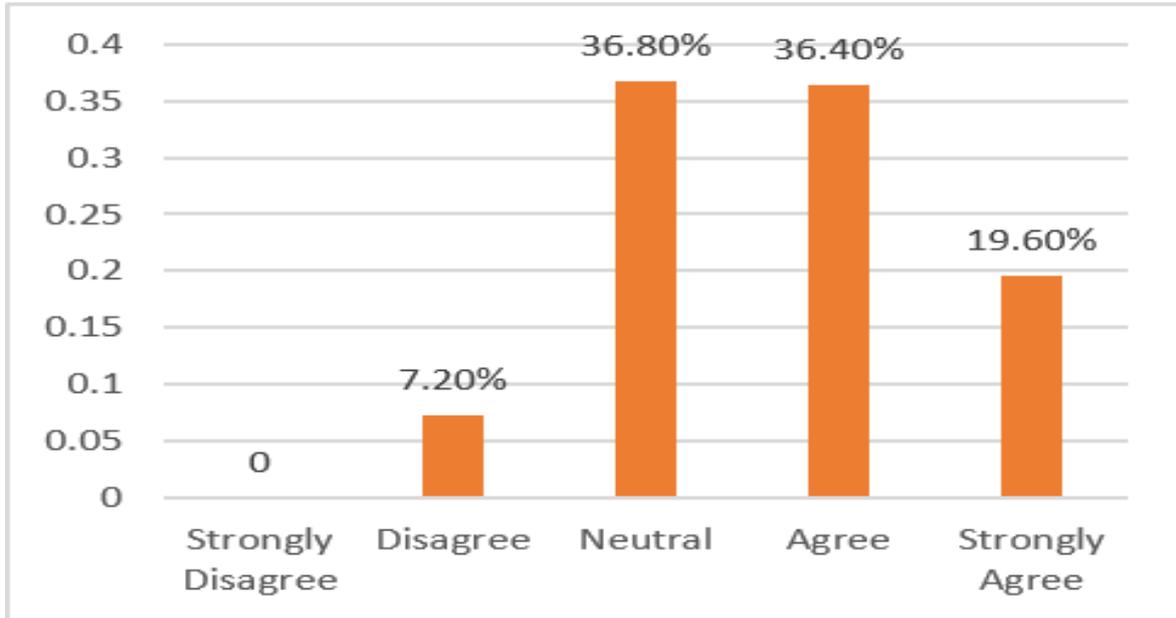


Fig. 7: Using toxic strychnine is an undesirable method in controlling moles at Benghazi Plain farms in Libya.

Regarding the second statement, which states that Farmers do not use traps to control the mole animal in the farms of Benghazi Plain in Libya, most of the respondents (44.4%) agreed with this statement, while 27.2% of the respondents strongly agreed. The percentage of questionnaire respondents about the second phrase is shown in Figure 8.

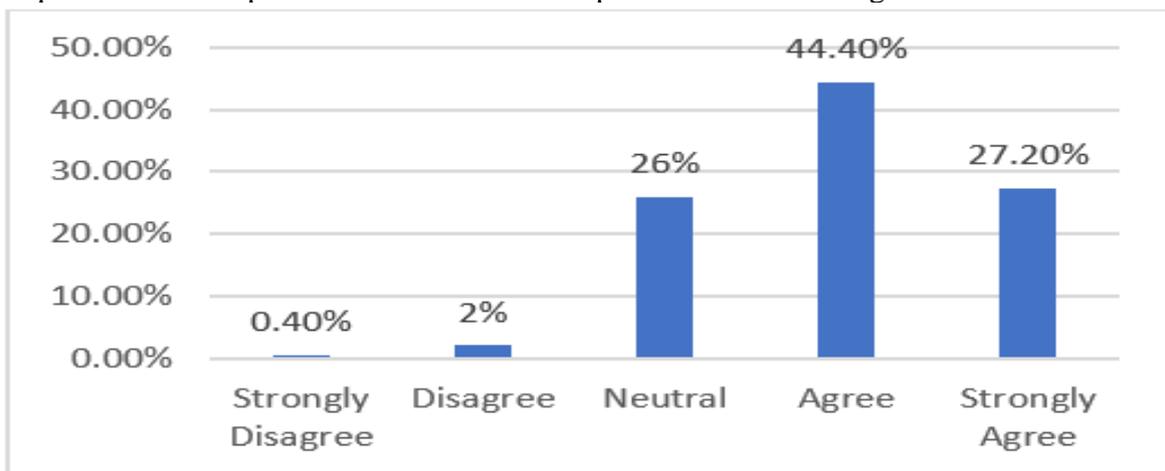


Fig. 8: Farmers do not use traps to control mole animals at Benghazi Plain farms in Libya.

Regarding the third statement, which states that controlling the distribution of dirt mounds dug by the mole and reducing the pH of these mounds is not used by farmers to combat the mole at Benghazi Plain farms in Libya, most of the respondents (38.8%) agreed with this statement, while 36.8% of the respondents agreed. Figure 9, shows the opinions of questionnaire respondents about this phrase on the Likert scale.

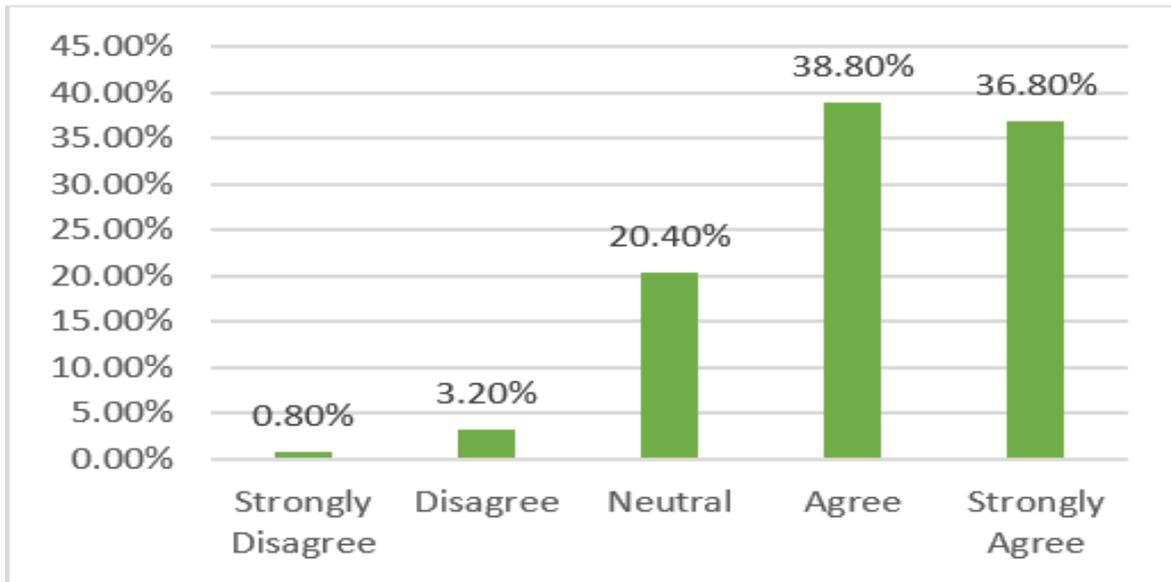


Fig. 9: Controlling the distribution of soil mounds dug by the mole and reducing the pH of these mounds is not used by farmers to control mole rats at Benghazi Plain farms in Libya.

Regarding the fourth statement, which states that Calcium phosphate granules are not used to control moles at Benghazi Plain farms in Libya, most of the respondents (48%) agreed with this statement, while 29.6% of the respondents strongly agreed. Figure 10, shows the opinions of questionnaire respondents about this phrase on the Likert scale.

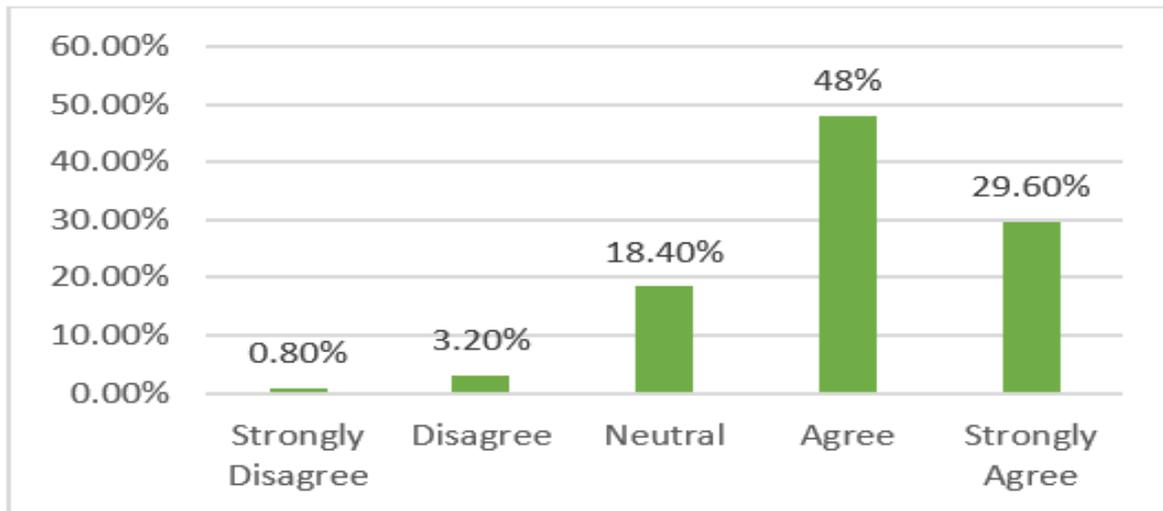


Fig. 10: Calcium phosphate granules are not used to control moles at Benghazi Plain farms in Libya.

Regarding the fifth statement, which states that the shift to the cultivation of annual crops is an impractical way to control moles at Benghazi plain farms in Libya, most of the respondents (41.6%) agreed with this statement, while 38.4% of the respondents strongly agreed. Figure 11 shows the opinions of questionnaire respondents about this phrase on the Likert scale.

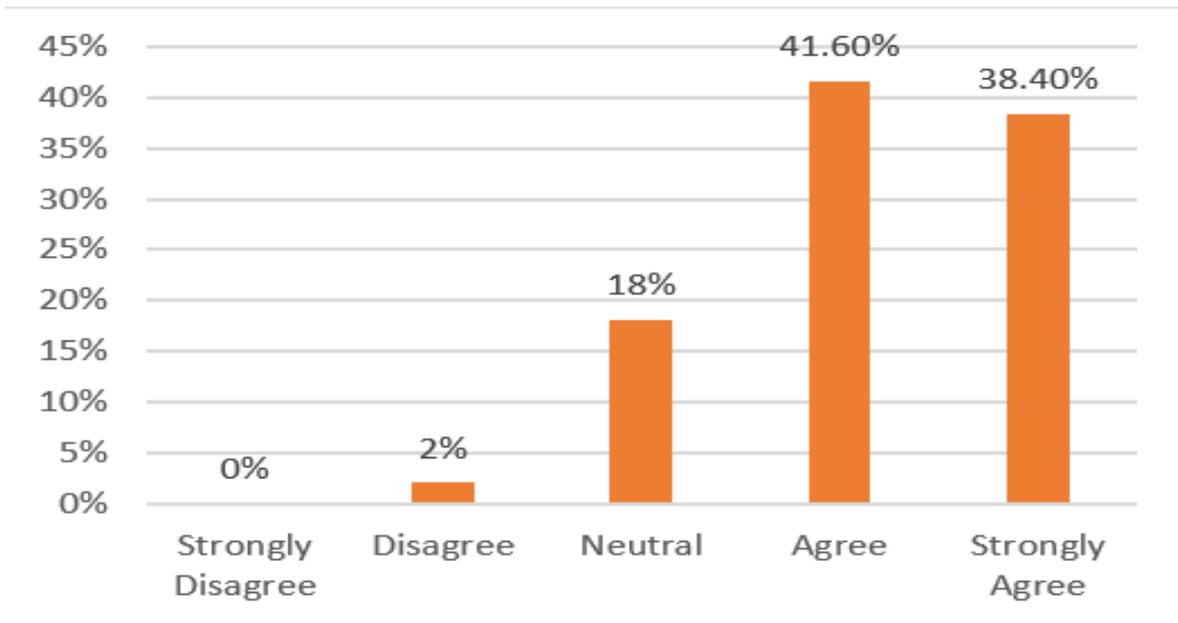


Fig. 11: The shift to the cultivation of annual crops is an impractical way to control moles at Benghazi plain farms in Libya.

Regarding the sixth statement, which states that pouring water into the tunnels of the mole animal is not used to control them at Benghazi Plain farms in Libya, most of the respondents (43.2%) strongly agreed with this statement, while 37.2% of the respondents agreed, 4.4% expressed their disapproval, 1.2% expressed their strong disapproval, and the rest were neutral.

Regarding the seventh statement, which states that the use of aluminum phosphide tablets is an effective way to control moles at Benghazi Plain farms in Libya, most of the respondents (43.2%) strongly agreed with this statement, while 37.6% of the respondents agreed. Figure 12, shows the opinions of questionnaire respondents about this phrase on the Likert scale.

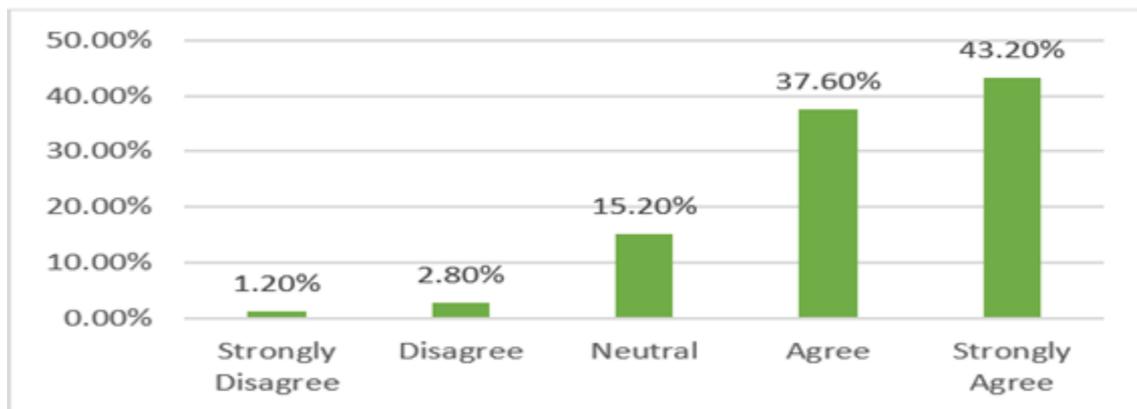


Fig. 12: Using of aluminum phosphide tablet is an effective way to control moles at Benghazi Plain farms in Libya.

Regarding the eighth statement, which states that the use of gas is an effective method to control mole rats at Benghazi Plain farms in Libya, only (19.6%) strongly agreed with this statement, while 36.4% of the respondents agreed. Figure 13, shows the opinions

of questionnaire respondents about this phrase on the Likert scale. Some of the Respondents tell us it is used as an alternative method if aluminum phosphide tablets aren't available.

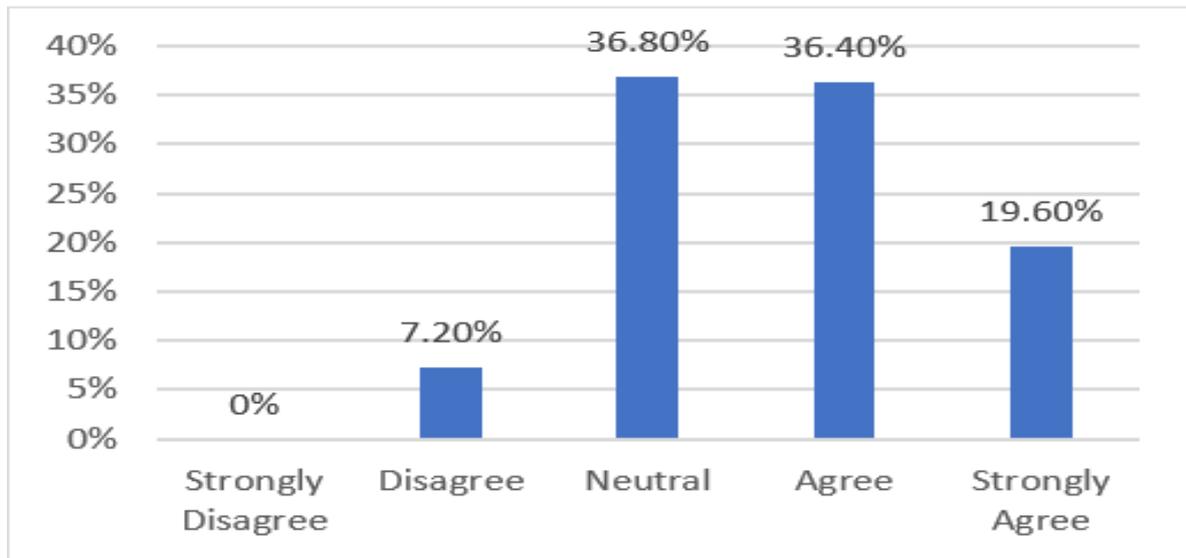


Fig.13: Using Gas is an effective method to control moles at Benghazi Plain farms in Libya.

Concerning the ninth statement, which states that "controlling moles at Benghazi Plain farms in Libya in the early stages of agricultural crop growth is more effective than controlling them in the late stages", most respondents (44.4%) strongly agreed with this statement, and 32.4% agreed. Figure 14, shows the opinions of questionnaire respondents about this phrase on the Likert scale.

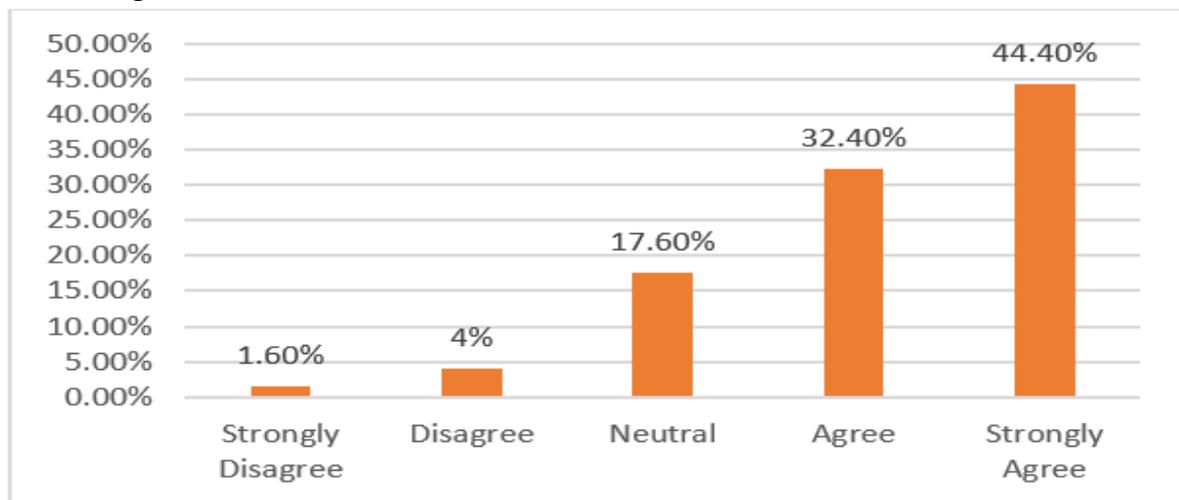


Fig. 14: Controlling mole rats at Benghazi Plain farms in Libya in the early stages of agricultural crop growth is more effective than controlling them in the late stages.

Regarding the tenth statement, which states that "the Libyan Ministry of Agriculture's provision of aluminum phosphide tablets to farmers at low prices will help in controlling moles faster, most of the questionnaire respondents (81.2%) agreed and strongly agreed with this statement. Figure 15, shows the opinions of questionnaire respondents about this phrase on the Likert scale.

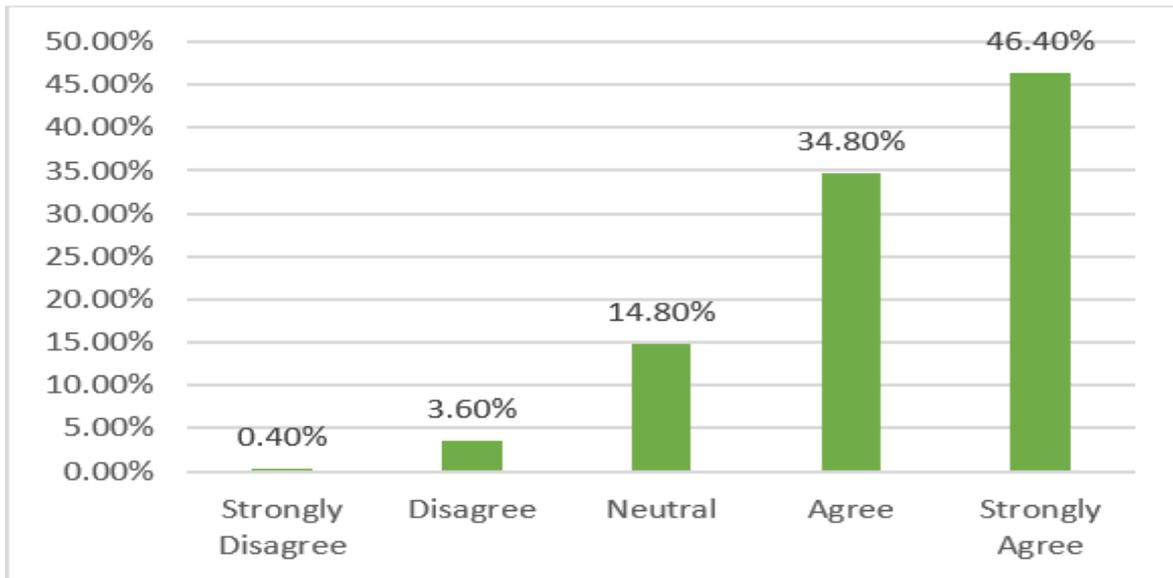


Fig. 15: The Libyan Ministry of Agriculture’s provision of aluminum phosphide tablets to farmers at low prices will help in controlling moles faster.

With regard to the eleventh statement which states that “mole rats cause great damage to agricultural crops if it is not controlled, most respondents (79.6%) agreed and strongly agreed with this statement as shown in Figure 16.

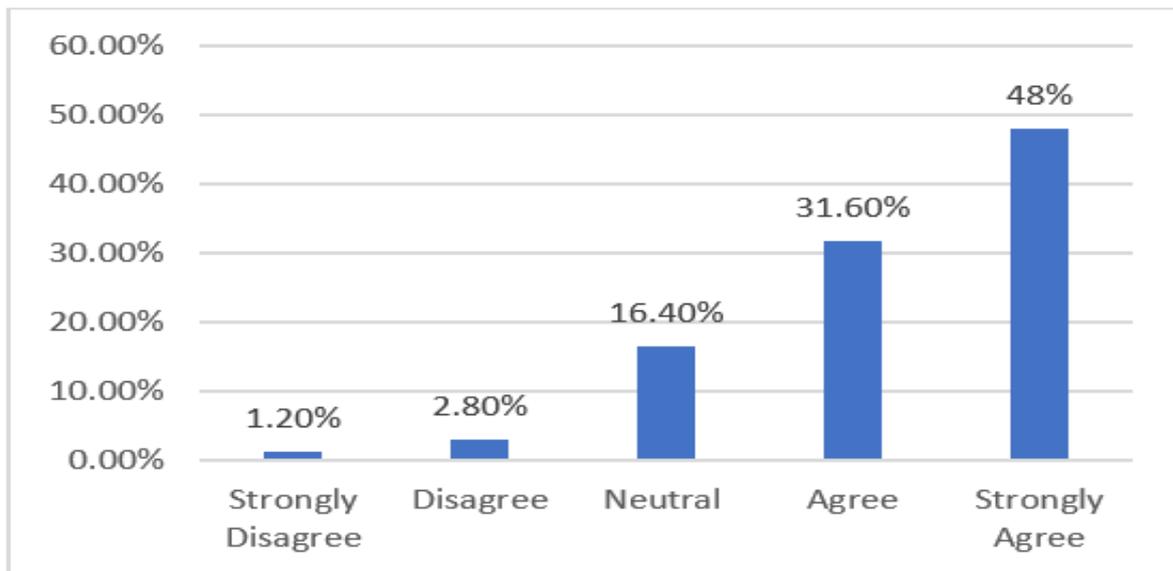


Fig. 16: Mole rats cause great damage to agricultural crops if it is not controlled.

Analyzing the Third Part of The Questionnaire Respondents:

With regard to the first statement of the third part, which states that “the mole rat has a role in maintaining the environmental balance, most of the participants (77.6%) agreed and strongly agreed with this statement. The opinions of respondents are shown in Figure 17.

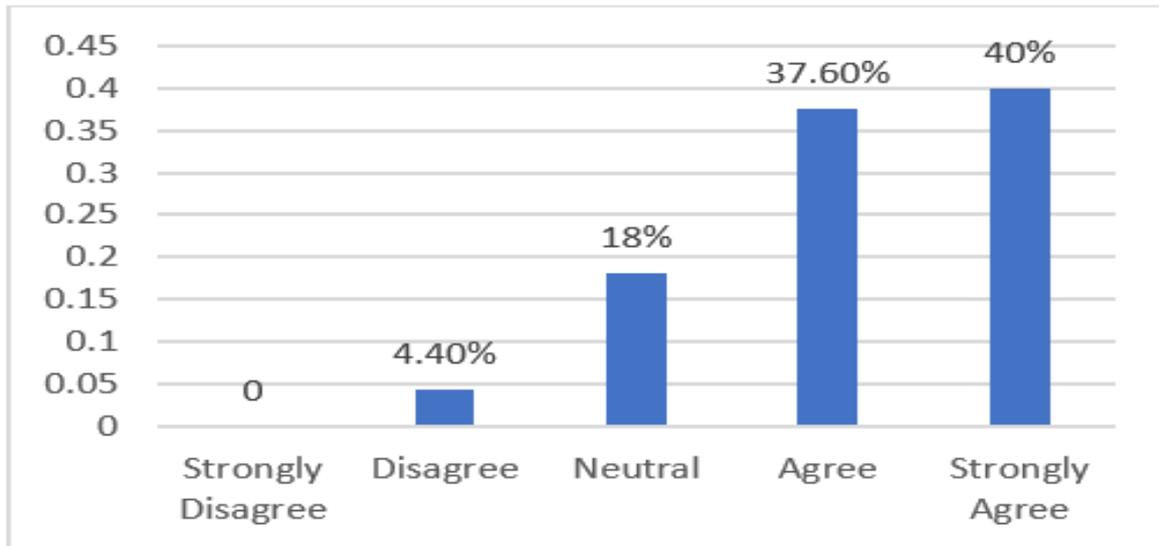


Fig. 17: The mole rat has a role in maintaining the environmental balance.

Regarding the second statement of the third part, which states that "failure to control the mole animal will cause damage to agricultural crops because it feeds on them", most respondents (74.8%) expressed their agreement and strongly agreed with that as shown in Figure 18.

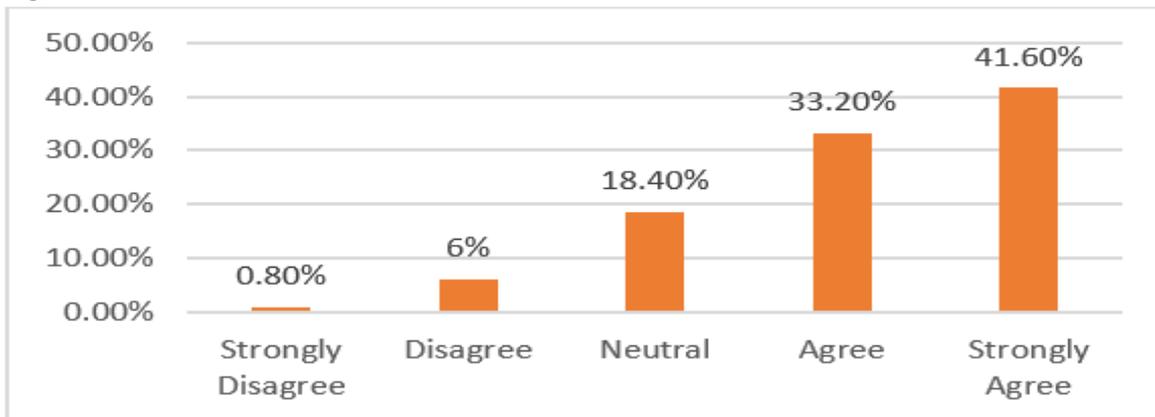


Fig. 18: Failure to control the mole rat will cause damage to agricultural crops because it feeds on them.

With regard to the third statement from the third part, which states that "failure to control the mole rats will cause waste of irrigation water", most of the respondents (84%) expressed their agreement and strongly agreed with that as shown in Figure 19.

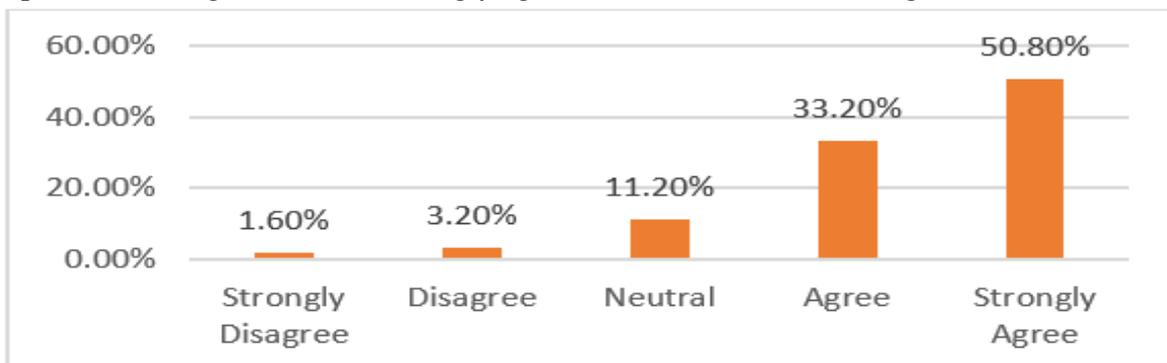


Fig 19: Failure to control the mole rats will cause waste of irrigation water.

Regarding the fourth statement of the third part, which states that “I believe that soil mounds indicate the presence of blind mole rats”, most of the respondents (86.4%) agreed and strongly agreed with that as shown in Figure 20.

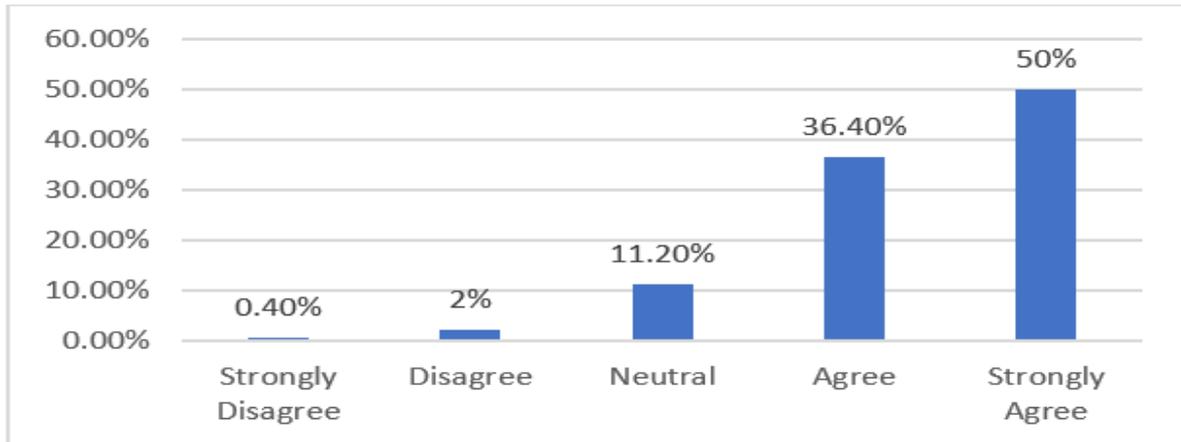


Fig. 20: Opinions of questionnaire respondents if “soil mounds indicate the presence of blind mole rats”.

Regarding the fifth statement of the third part, which states that “Destroying the roots of plants and agricultural crops indicates the presence of blind mole rats”, most of the respondents (84.4%) expressed their agreement and strongly agreed with that as shown in Figure 21.

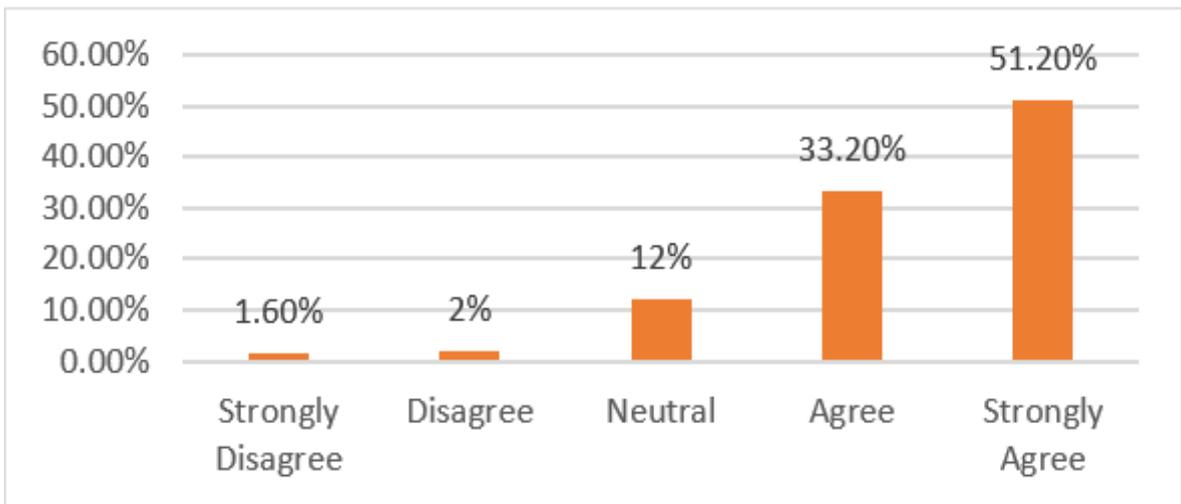


Fig. 21: Destroying the roots of plants and agricultural crops indicates the presence of blind mole rats.

Regarding the sixth statement of the third part, which states that it is promptly important to train Libyan farmers about the effective method to control Blind mole rats (*Spalax ehrenbergi*) in their farms, most of the respondents (84%) expressed their agreement and strongly agree with that as shown in Figure 22.

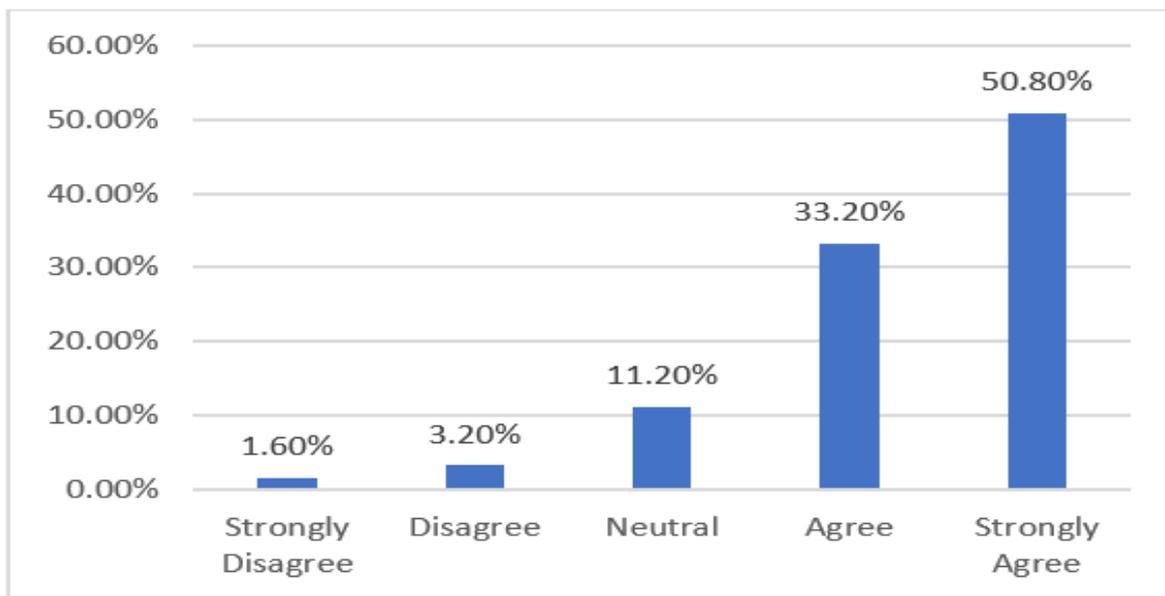


Fig. 22: The importance of training Libyan farmers about the effective method to control Blind mole rats (*Spalax ehrenbergi*) in their farms.

Regarding the seventh statement of the third part, which states that it is necessarily important to issue a binding law for using aluminum phosphide tablets to control mole rats as an agricultural pest in agricultural projects in Libya, most of the respondents (77.6%) agreed and strongly agreed with this statement. The opinions of respondents are shown in Figure 23.

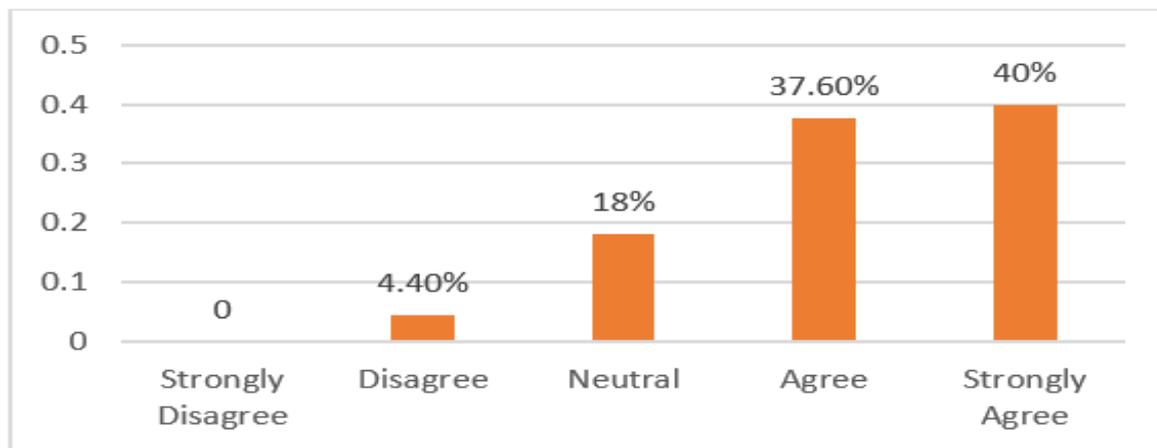


Fig. 23: The importance of issuing a binding law for using aluminum phosphide tablets to control mole rats as an agricultural pest in agricultural projects in Libya.

DISCUSSION

The aim of this research is to study the level of damage and the most effective methods to control *Spalax ehrenbergi* on Benghazi Plain project in Libya. A study was conducted to obtain information about the perceptions and practices of farmers in Benghazi Plain project in Libya on mole rat “*Spalax ehrenbergi*” damage and their management practices in the late-2022 and early 2023.

For the level of damage and the most effective stage of crop growth to control these mole rats in Benghazi Plain project in Libya, the results obtained from the questionnaire analysis indicate that:

1. The mole rats, *Spalax ehrenbergi*, cause huge damage about (30%) to Agricultural crops if it is not controlled.
2. The mole rat, *Spalax ehrenbergi*, causes small to medium damage to Agricultural crops if it is controlled.
3. Most Libyan farmers believe that controlling the mole rats in their farms should be done in the early stages of crop growth.

For the most effective methods used by the farmers to control these mole rats in Benghazi Plain project in Libya, the results obtained from the questionnaire analysis indicate that:

1. Strychnine hydrochloride is not used in controlling mole rats in Libyan farms.
2. Most of the respondents 44.4% agreed and 27.2% strongly agreed that farmers do not use traps to control the mole rats in their farms at Benghazi Plain project in Libya.
3. Pouring water into the tunnels of the mole rats is not used to control them in Benghazi plain farms in Libya.
4. Most farmers in the Benghazi Plain project in Libya use aluminum phosphide tablets to control moles in their farms as the most effective method in controlling them.
5. Libyan farmers use gas to control these moles as an alternative method if aluminum phosphide tablets are not available.

CONCLUSION

Blind mole rats (*Spalax ehrenbergi*) are widespread in the eastern Mediterranean region from northeastern Libya through Egypt, Jordan, Syria and southern Turkey. These mice, or the so-called blind mole rat, are found in the farms of Benghazi Plain Project in Libya. The aim of this research is to present a study on the effect of blind mole rats on agricultural crops in Benghazi Plain project in Libya and about the damage it causes to these crops. Also, it aims to study the effective methods used to control these moles. Finally, it aims to determine the most effective method used to control these moles in Benghazi Plain project in Libya.

A random sample of farmers, amounting to (250) owners and tenants, was surveyed in farms of Benghazi Plain project, and personal interviews with these farmers were relied upon to obtain answers from them to the questions of this questionnaire.

The study concluded that these rats cause small to medium damage, with different methods being used to control them, and that these damages consisted of cutting and damaging plant roots while digging tunnels, and that they feed on agricultural crops, especially vegetables and grains, and that they cause waste of irrigation water while digging tunnels. The study also found that most farmers in the Benghazi Plain project in Libya use aluminum phosphide tablets to control moles in their farms and that some of them also use gas to control these moles if aluminum phosphide tablets are not available. This rat causes small to medium damage to agricultural crops if it is controlled by using these effective methods.

From the above conclusions, it was recommended the following:

- 1- It is instantly and necessarily important to Issue a binding law for using aluminum phosphide tablets to control mole rats as an agricultural pest in agricultural projects in Libya.
2. It is promptly important to train Libyan farmers about the effective method to control Blind mole rats (*Spalax ehrenbergi*) in their farms.
3. Conducting more studies on blind mole rats (*Spalax ehrenbergi*) living in the agricultural environment in the Benghazi Plain project in Libya to include periods of activity of moles at the level of different seasons of the year and times of the day, as well as conducting more studies to identify the behavior of those moles in terms of storage times for their food and their preferred food, and the soil in which it is preferred to live through an analysis of the soil elements.

Declarations:**Ethical Approval:** Not applicable**Competing interests:** The authors declare that they have no duality of interest associated with this manuscript.**Authors Contributions:** Contribution is equal between authors.**Funding:** No specific funding was received for this work**Availability of Data and Materials:** All datasets analysed and described during the present study are available from the corresponding author upon reasonable request.**Acknowledgements:** Not applicable.**REFERENCES**

- Al-Tabaqli, S. A. H. A. (2016). Evaluating the agricultural situation in the Benghazi Agricultural Settlement Plain Project, Master's thesis, Faculty of Arts, University of Benghazi, Libya, 243 pages.
- Atkinson, R. P. D., Macdonald, D. W. and Johnson, P. J. (1994). The status of the European mole *Talpa europaea* L. as an agricultural pest and its management. *Mammal Review*, 24, 73-90.
- Baker, S. E., Ellwood, S. A., Johnson, P. J. and Macdonald, D. W. (2016). Moles and Mole Control on British Farms, Amenities and Gardens after Strychnine Withdrawal. *Animals*, 6, 39.
- Earecho, M. K. (2015). Demonstration of Effective Management Option for Mole Rat of Enset in Kafa Zone. *Journal of Poverty, Investment and Development*, Volume (17), ISSN 2422-846X.
- Guedon, G. (1998). Mole control in farming: how to avoid the use of strychnine. *Phytoma*, 510, 10-16.
- Heth, G. (1991). The environmental impact of subterranean mole rats (*Spalax ehrenbergi*) and their burrows. *Symposium of the Zoological Society of London*, 63, 265 - 280.
- Hill, D. S. (2008). Pests of crops in warmer climates and their control. Springer Science & Business Media, UK, 704 pages. ISBN: 9781402067389.
- Hutchins, M. (2004). Rats, mice, and relatives. V. *Grizimek's Animal Life Encyclopedia*, 16, 281295.
- Legese, K., & Bekele, A. (2023). Farmers' Perceptions of Rodents' Damage and Management Practices in Wenchi Highlands, Central Ethiopia. *International Journal of Zoology*, Volume 2023, Article ID 6683791, 10 pages.
- Quy, R., & Pool, D. (2004). A Review of Methods Used within the European Union to control the European Mole, *Talpa Europaea*. Department for Environment, Food and Rural Affairs (Defra publications), 31 pages. Available at www.defra.gov.uk, Retrieved 14 January 2023.
- Schlitter, D.; Shenbrot, G.; Kryštufek, B.; Sozen, M. (2008) [Amended version of 2008 assessment]. *Nannospalax ehrenbergi*. IUCN Red List of Threatened Species. 2008 Retrieved 14 January 2023.
- Shahin, A. A., Faleh, A. B., Mohamed, A. M., & El Shater, A. E. R. A. (2018). Chromosomal, morphological and penial variation in the blind mole rats *Nannospalax ehrenbergi* (Rodentia: Spalacidae) in Egypt. *Hystrix, the Italian Journal of Mammalogy*, 29(1), 137-144.

ARABIC SUMMARY

الطرق الأكثر فعالية لمكافحة فئران الخلد *Spalax ehrenbergi* في مشروع سهل بنغازي في ليبيا

محمد ، حسين عبد الكريم¹ و علي ، عقيلة² و شمام ، محسن³

- (1) قسم علم الحيوان كلية الآداب والعلوم فرع توكره جامعة بنغازي ليبيا.
- (2) قسم علم الحيوان كلية الآداب والعلوم فرع الأبيار جامعة بنغازي ليبيا.
- (3) مختبر الثروة الحيوانية والحياة البرية ، معهد المناطق القاحلة، مدن، جامعة قابس، تونس.

البريد الإلكتروني (1) : husein.amgawer@uob.edu.ly

هناك طرق مختلفة تستخدم لمكافحة فئران الخلد في جميع أنحاء العالم. وهذه الطرق هي: استخدام هيدروكلوريد الأستركنين السام، والمصائد، وصب المياه في الأنفاق، واستخدام حبيبات فوسفات الكالسيوم، والتحول إلى زراعة المحاصيل الحولية، واستخدام أقراص فوسفيد الألومنيوم، واستخدام الجاز. الهدف من هذا البحث هو دراسة مستوى الأضرار التي يتسبب فيها والطرق الأكثر فعالية لمكافحة فئران الخلد من نوع *Spalax ehrenbergi* في مشروع سهل بنغازي في ليبيا. تم إجراء هذه الدراسة في نهاية عام 2022 وبداية عام 2023 لجمع بيانات عن الأضرار التي تتسبب فيها فئران الخلد للمحاصيل الزراعية وعن الطرق الأكثر فعالية التي يستخدمها المزارعين لمكافحتها. تكونت عينة البحث من 250 من المزارعين وأصحاب المزارع تم اختيارهم بطريقة عشوائية موزعين على أربعة مناطق في منطقة الدراسة عن باستخدام استبيان تم توزيعه على أصحاب المصلحة. تم تحليل البيانات التي تم جمعها باستخدام إحصائيات SPSS 24. وتشير النتائج إلى أن المزارعين يستخدمون بشكل رئيسي أقراص فوسفيد الألومنيوم كوسيلة فعالة في السيطرة على انتشار *Spalax ehrenbergi* في مزارعهم. كما تشير النتائج إلى أن بعض المزارعين يستخدمون الجاز للسيطرة على هذه الفئران في حالة عدم توفر أقراص فوسفيد الألومنيوم. وأخيرا تشير النتائج إلى أن فئران الخلد *Spalax ehrenbergi* تسبب أضراراً صغيرة إلى متوسطة للمحاصيل الزراعية إذا تمت السيطرة عليها باستخدام هذه الطرق الفعالة.